K.S.Rangasamy College of Technology

(Autonomous)

Curriculum & Syllabus

of

Electronics and Communication Engineering Department

(For the batch admitted in 2022 – 23)

R 2022

Courses Accredited by NBA, Accredited by NAAC with 'A++' Grade, Approved by AICTE, Affiliated to Anna University, Chennai.

KSR Kalvi Nagar, Tiruchengode – 637 215.
Namakkal District, Tamil Nadu, India.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision

To become recognized as a leader in Electronics and Communication Engineering education and research

Mission

- To craft professionals and technology leaders adherent to the professional ethical code in the areas of Electronics and communication Engineering
- To address the needs of the society while advancing boundaries of disciplinary and multidisciplinary research and cultivate universal moral values

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: **Career Growth:** Graduates will be able to have successful technical and professional career growth

PEO2: **Knowledge and Skills:** Graduates will be able to apply the scientific, mathematical and engineering fundamentals to provide solutions to the problems in Electronics and Communication Engineering and related fields.

PEO3: **Ethics and Life-long Learning:** Graduates will be able to engage in independent learning, exhibit creativity and innovation with ethical and professional behaviour while addressing societal needs**.**

PROGRAMME OUTCOMES (POs)
Engineering Graduates will be able to:

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design /development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

Engineering Graduates will be able to:

PSO1: **Solutions for Complex Problems**: Solve complex engineering problems by applying engineering knowledge in the field of Signal/Image processing and Communication.

PSO2: **Development of products**: Design system components and develop products that meet the specific needs of industry and society in Electronics and Communication Engineering

PSO3: **Interpersonal Skills**: Develop essential interpersonal skills and attitude needed for ethical leadership and teamwork such as effective listening and communication, presentation, team building and assertiveness.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMMEOUTCOMES (POs)

The B.E. Electronics and Communication Engineering Programme outcomes leading to the achievement of the objectives are summarized in the following Table.

Programme Educational Objectives	Programme Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO 1	3	3	3	3	3	2	2	3	3	3	2	3
PEO 2	3	3	3	3	3	3	3	3	3	3	3	3
PEO 3	2	2	2	2	2	3	2	3	3	3	2	3

Contributions: 3 - Strong; 2 - Medium; 1 - Some

MAPPING: Electronics and Communication Engineering (UG)

YEAR	SEM	COURSE CODE	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	I	60 EN 001	Professional English I								2	3	3	2	3
		60 MA 001	Matrices and Calculus	3	2			2							
		60 PH 003	Physics for Electrical Engineering	3							2	2			
		60 ME 002	Engineering Graphics	3	2.8	3		3			3				
		60 CS 001	C Programming	3	3	3		3				2	2		2
		60 MY 001	Environmental Studies and Climate Change	3	2			3	2.7	2.8	2				2
		60 CS 0P1	C Programming Laboratory	3	3	3		3				2	2		2
		60 ME 0P1	Fabrication and Reverse Engineering Laboratory	3	2	3			2	2		3			3
	II	60 EN 002	Professional English II								2	3	3	2	3
		60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	3	2			2							
		60 CH 003	Chemistry for Electronic Engineering	3	2.6										
		60 ME 005	Foundation of Mechanical Engineering	3	3						2	3	3		
		60 EC 201	Electronic Devices	3	2.6	3	3	3			3	3	3		3
		60 GE 001	Heritage of Tamils / தமிழர் மரபு	2					1.5	1	2.4	2	2		1.8
		60 CP 0P2	Engineering Physics and Chemistry Laboratory	3								2			
		60 EC 2P1	Electronic Devices Laboratory	3	3	3	3	3	3		3	3	3		3
		60 CG 0P1	Career Skill Development – I								2	3	3	2	3
II	III	60 MA 009	Linear Algebra and Numerical Methods	3	2			2							

		60 CS 002	Data Structures and Algorithms	3	3	2	2.6	2	2	2	2.4	2.6	2		2
		60 EC 301	Electronic Circuits	3	3	3	3	3			3	3	3		3
		60 EC 302	Circuit Analysis	3	3	3	3	2.6				3	3		2
		60 EC 303	Digital System Design	2.8	2.8	3	3	3			3	3	3		
		60 MY 002	Universal Human Values						3	3	3	2.8	3	2	3
		60 GE 002	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	3				3	2	2.8	3	2.5	2.2		3
		60 EC 3P1	Analog and Digital Electronics Laboratory	2.8	2.8	3	3	2.6				3	3		3
		60 CS 0P2	Data Structures and Algorithms Laboratory	3	3	2	2.7	2	2	2	3	2.6	2		2
		60 CG 0P2	Career Skill Development – II								2	3	3	2	3
		60 CG 0P6	Internship												
		60 MA 016	Probability and Inferential Statistics	3	2			2							
		60 EC 401	Signals and Systems	3	3	3	3	2	2			3	3		
		60 EC 402	Linear Integrated Circuits	2.6	2.8	3	3	3			3	3	3		3
		60 EC 403	Electromagnetic Waves	3	3	3	3	3			3	3	3		3
		60 EC 404	Analog Communication	3	3	3	3	3				3	3		3
	IV	60 OE L1*	Open Elective I												
		60 EC 4P1	Linear Integrated Circuits and Electromagnetics Laboratory	3	3	3	3	3	2.8			3	3		3
		60 EC 4P2	Electronic Design Project Laboratory	3	3	3	3	3	3	3	3	3	3	3	3
		60 CG 0P3	Career Skill Development – III	2.6	2.6	2.6	2.8		2.4				2	3	3
		60 CG 0P6	Internship												
		60 EC 501	Control Systems Engineering	3	3	3	3	2				3	3		
		60 EC 502	VLSI and Chip Design	3	3	3	3	3		3	3	3	3		3
		60 EC 503	Digital Signal Processing	3	3	3	3	3	2			3	3		2
		60 EC 504	Microprocessors and Microcontrollers	3	3	2.8	3	3			3	3	3		3
		60 EC E1*	Professional Elective I												
		60 OE L2*	Open Elective II												
	V	60 MY 003	Startups and Entrepreneurship	2.8	2.6	3	2.4	2.2	2.5	1.7	1.8	1.3	2	2.2	2.4
		60 EC 5P1	Microcontrollers Laboratory	3	3	3	3	3				3	3		
		60 EC 5P2	VLSI Laboratory	3	3	3	3	3			3	3	3		3
		60 EC 5P3	Signal Processing Laboratory	3	3	3	3	3			3	3	3		3
		60 CG 0P4	Career Skill Development – IV	2.6	2.6	2.6	2.8		2.4				2	3	3
III		60 CG 0P6	Internship												
		60 EC 601	Embedded systems	3	3	2.8	3	3			3	3	3		3
		60 EC 602	Digital Communication	2.8	2.4	3	2.6	3			3	3	3		3
		60 EC 603	Mobile Communication and Networks	3	3	3	3	3	3	3	3	3	3		3
		60 EC 604	Machine Learning Techniques	3	3	3	3	3			3	3	3		3
		60 EC E2*	Professional Elective II												
	VI	60 OE L3*	Open Elective III												
		60 EC 6P1	Innovation Engineering Laboratory	3	3	3	3	3	3	3	3	3	3	3	3
		60 EC 6P2	Embedded systems Laboratory	3	3	3	3	3			3	3	3	3	3
		60 EC 6P3	Digital Communication Laboratory	3	3	3	2	3	2	2	3	3	3	2	3
		60 CG 0P5	Comprehension Test	3	3	2	2					1	2	2	3
		60 CG 0P6	Internship												
		60 HS 002	Engineering Economics and Financial Accounting	2.7	3	2.5	2.8	3	2	2.3	2			2.8	2.5
		60 EC 701	Antennas and Microwave Engineering	3	3	3	3	3		2		3	3		
IV	VII	60 EC 702	Computer Networks	3	3	3	3	3			3	3	3		3
		60 EC E3*	Professional Elective III												
		60 EC E4*	Professional Elective IV												

Passed in BoS Meeting held on 20/07/2022
Approved in Academic Council Meeting held on 23/07/2022

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

		60 AB 00*	NCC\NSS\NSO\YRC\ RRC\Yoga\Fine Arts												
		60 AC 001	Research Skill Development	2	2	2	2	3	2	2	3	3	3		3
		60 EC 7P1	RF Laboratory	3	3	3	3	3		2		3	3		3
		60 EC 7P2	Networks Laboratory	3	3	3	3	3			3	3	3		3
		60 EC 7P3	Project Work - Phase I	3	3	3	3	3	3	3	3	3	3	3	3
		60 CG 0P6	Internship												
	VIII	60 EC E5*	Professional Elective V												
		60 EC 8P1	Project Work - Phase II	3	3	3	3	3	3	3	3	3	3	3	3
		60 CG 0P6	Internship												

K.S. RANGASAMY COLLEGE OF TECHNOLOGY

Credit Distribution for B.E (ECE) Programme – 2022 –2023 Batch

S.No.	Category	Credits Per Semester								Total Credits	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	2	2	-	-	-	-	3	-	7	4.32
2.	BS	7	9	4	4	-	-	-	-	24	14.81
3.	ES	11	3	5	-	-	-	-	-	19	11.73
4.	PC	-	5	12	15	18	16.5	8	-	74.5	45.99
5.	PE	-	-	-		3	3	6	3	15	9.26
6.	OE	-	-	-	3	3	3	-	-	9	5.56
7.	CG	-	-	-	2	-	1.5	2	8	13.5	8.33
8.	MC	MC I	-	MC II	-	MC III	-	-	-	-	-
9.	AC	-	-	-	-	-	-	AC		-	-
10.	GE	-	GE I	GE II	-	-	-	-	-	-	-
Total		20	19	21	24	24	24	19	11	162	100

HS - HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES
BS - BASIC SCIENCE COURSES
ES - ENGINEERING SCIENCE COURSES
PC - PROFESSIONAL CORE COURSES
PE - PROFESSIONAL ELECTIVE COURSES
OE - OPEN ELECTIVE COURSES
CG - CAREER GUIDANCE COURSES
MC - MANDATORY COURSES
AC - AUDIT COURSES
GE - GENERAL ELECTIVE COURSES

- Open Electives are courses offered by different departments that do not have any prerequisites and could be of interest to students of any branch.

K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE – 637215

(Autonomous)
DEPARTMENT OF ECE
MINOR DEGREE PROGRAMME - INTERNET OF THINGS
LIST OF COURSES

S.No.	Course Code	Course Name	Category	Contact Periods	L	T	P	C
1.	60 EC M01	Internet of Things and its Application	PE	3	3	0	0	3
2.	60 EC M02	Security of Cyber Physical Systems	PE	3	3	0	0	3
3.	60 EC M03	Embedded Systems for IoT	PE	3	3	0	0	3
4.	60 EC M04	IoT Processors	PE	3	3	0	0	3
5.	60 EC M05	IoT Device Development and Integration	PE	3	3	0	0	3
6.	60 EC M06	Industrial IoT and Industry 4.0	PE	3	3	0	0	3
				Total	18	0	0	18

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Tiruchengode - 637 215.

K.S.RANGASAMY COLLEGE OF TECHNOLOGY,TIRUCHENGODE -637215

(An Autonomous Institution affiliated to Anna University)

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HS)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EN 001	Professional English I	HS	3	1	0	2	2	Basic knowledge of reading and writing in English
2.	60 EN 002	Professional English II	HS	3	1	0	2	2	Basic knowledge of reading and writing in English and should have completed Professional English I.
3.	60 HS 002	Engineering Economics and Financial Accounting	HS	3	3	0	0	3	NIL
4.	60 AB 001	National Cadet Corps (Air wing)	HS	4	2	0	2	3	NIL
5.	60 AB 002	National Cadet Corps (Army Wing)	HS	4	2	0	2	3	NIL

BASIC SCIENCE (BS)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 MA 001	Matrices and Calculus	BS	5	3	1	0	4	NIL
2.	60 PH 003	Physics for Electrical Engineering	BS	3	3	0	0	3	NIL
3.	60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	BS	5	3	1	0	4	NIL
4.	60 CH 003	Chemistry for Electronic Engineering	BS	3	3	0	0	3	NIL
5.	60 CP 0P2	Engineering Physics and Chemistry Laboratory	BS	4	0	0	4	2	NIL
6.	60 MA 009	Linear Algebra and Numerical Methods	BS	5	3	1	0	4	NIL
7.	60 MA 016	Probability and Inferential Statistics	BS	5	3	1	0	4	NIL

ENGINEERING SCIENCES (ES)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 ME 002	Engineering Graphics	ES	6	2	0	4	4	NIL
2.	60 CS 001	C Programming	ES	3	3	0	0	3	NIL
3.	60 CS 0P1	C Programming Laboratory	ES	4	0	0	4	2	NIL
4.	60 ME 0P1	Fabrication and Reverse Engineering Laboratory	ES	4	0	0	4	2	NIL
5.	60 ME 005	Foundation of Mechanical Engineering	ES	3	3	0	0	3	NIL
6.	60 CS 002	Data Structures and Algorithms	ES	3	3	0	0	3	NIL
7.	60 CS 0P2	Data Structures and Algorithms Laboratory	ES	4	0	0	4	2	Programming knowledge in C language

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PROFESSIONAL CORE (PC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC 201	Electronic Devices	PC	3	3	0	0	3	Physics for Electrical Engineering
2.	60 EC 2P1	Electronic Devices Laboratory	PC	4	0	0	4	2	NIL
3.	60 EC 301	Electronic Circuits	PC	3	3	0	0	3	Electronic Devices
4.	60 EC 302	Circuit Analysis	PC	6	2	1	2	4	NIL
5.	60 EC 303	Digital System Design	PC	4	2	1	0	3	NIL
6.	60 EC 3P1	Analog and Digital Electronics Laboratory	PC	4	0	0	4	2	Electronic Devices Laboratory
7.	60 EC 401	Signals and Systems	PC	4	2	1	0	3	Integrals, Partial Differential Equations and Laplace transform
8.	60 EC 402	Linear Integrated Circuits	PC	3	3	0	0	3	Electronic Circuits
9.	60 EC 403	Electromagnetic Waves	PC	5	3	1	0	4	Circuit Analysis
10.	60 EC 404	Analog Communication	PC	4	2	0	2	3	NIL
11.	60 EC 4P1	Linear Integrated Circuits and Electromagnetics Laboratory	PC	4	0	0	4	2	Electronic Circuits
12.	60 EC 501	Control Systems Engineering	PC	5	3	1	0	4	Integrals, Partial Differential Equations and Laplace Transform and Signals and Systems
13.	60 EC 502	VLSI and Chip Design	PC	3	3	0	0	3	Digital System Design
14.	60 EC 503	Digital Signal Processing	PC	5	3	1	0	4	Signals and Systems
15.	60 EC 504	Microprocessors and Microcontrollers	PC	3	3	0	0	3	Digital System Design
16.	60 EC 5P1	Microcontrollers Laboratory	PC	3	0	0	3	1.5	Microprocessors and Microcontrollers
17.	60 EC 5P2	VLSI Laboratory	PC	2	0	0	2	1	Digital System Design
18.	60 EC 5P3	Signal Processing Laboratory	PC	3	0	0	3	1.5	Signals and Systems
19.	60 EC 601	Embedded systems	PC	3	3	0	0	3	Microprocessors and Microcontrollers, Basics of C Programming
20.	60 EC 602	Digital Communication	PC	5	3	1	0	4	Analog Communication
21.	60 EC 603	Mobile Communication and Networks	PC	3	3	0	0	3	NIL
22.	60 EC 604	Machine Learning Techniques	PC	5	3	0	2	4	NIL
23.	60 EC 6P2	Embedded systems Laboratory	PC	3	0	0	3	1.5	Microprocessors and Microcontrollers, Basics of C Programming

24.	60 EC 6P3	Digital Communication Laboratory	PC	2	0	0	2	1	Analog Communication
25.	60 EC 701	Antennas and Microwave Engineering	PC	3	3	0	0	3	Electromagnetic Waves
26.	60 EC 702	Computer Networks	PC	3	3	0	0	3	NIL
27.	60 EC 7P1	RF Laboratory	PC	2	0	0	2	1	Electromagnetic Waves
28.	60 EC 7P2	Networks Laboratory	PC	2	0	0	2	1	NIL

PROFESSIONAL ELECTIVES (PE) / HONOURS*

SEMESTER V, PROFESSIONAL ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC E11	Wearable Devices	PE	4	2	0	2	3	Electronic Devices
2.	60 EC E12	IoT Hardware	PE	5	1	0	4	3	Electronic devices and circuits, Basics of C Programming
3.	60 EC E13	Radar Technologies	PE	4	2	0	2	3	Electromagnetic Waves
4.	60 EC E14	Optical Communication and Networks	PE	4	2	0	2	3	Electromagnetic Waves
5.	60 EC E15	Data Science	PE	4	2	0	2	3	NIL
6.	60 EC E16	Consumer Electronics	PE	4	2	0	2	3	Basic knowledge of Electrical and Electronics Engineering
7.	60 EC E17	Speech and Audio Processing	PE	4	2	0	2	3	Digital Signal Processing

SEMESTER VI, PROFESSIONAL ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC E21	Human Assist Devices	PE	3	3	0	0	3	Electronic Devices
2.	60 EC E22	IoT Product Development	PE	5	1	0	4	3	Electronic devices and circuits, Basics of C Programming, IoT Hardware
3.	60 EC E23	Avionics Systems	PE	3	3	0	0	3	Radar Technologies
4.	60 EC E24	Wireless Sensor Networks	PE	3	3	0	0	3	NIL
5.	60 EC E25	Digital Image Processing	PE	4	2	0	2	3	Signals and Systems
6.	60 EC E26	Optoelectronic Devices	PE	3	3	0	0	3	Electronic Devices
7.	60 EC E27	Therapeutic Equipment	PE	3	3	0	0	3	NIL

SEMESTER VII, PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC E31	Medical Imaging Systems	PE	3	3	0	0	3	Digital Image Processing
2.	60 EC E32	Wireless Broadband Networks	PE	3	3	0	0	3	NIL
3.	60 EC E33	Satellite Communication	PE	3	3	0	0	3	Digital Communication
4.	60 EC E34	5G Communication Networks	PE	3	3	0	0	3	Mobile Communication and Networks
5.	60 EC E35	Artificial Intelligence	PE	4	2	0	2	3	Machine Learning Techniques
6.	60 EC E36	Ad hoc and Sensor Networks	PE	3	3	0	0	3	NIL
7.	60 EC E37	Fundamentals of Nanoelectronics	PE	3	3	0	0	3	NIL

SEMESTER VII, PROFESSIONAL ELECTIVE IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC E41	Brain Computer Interface and Applications	PE	3	3	0	0	3	NIL
2.	60 EC E42	Industrial IoT and Industry 4.0	PE	3	3	0	0	3	Internet of Things
3.	60 EC E43	Remote Sensing	PE	3	3	0	0	3	NIL
4.	60 EC E44	Advanced Wireless Communication Techniques	PE	3	3	0	0	3	Wireless Communication
5.	60 EC E45	Computer Vision: Algorithms and Applications	PE	4	2	0	2	3	Digital Image Processing
6.	60 EC E46	VLSI Testing	PE	3	3	0	0	3	VLSI and Chip Design
7.	60 EC E47	Positioning and Navigation Systems	PE	3	3	0	0	3	Digital Communication

SEMESTER VIII, PROFESSIONAL ELECTIVE V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC E51	Wireless Body Area Networks	PE	3	3	0	0	3	NIL
2.	60 EC E52	Micro Electro Mechanical Systems	PE	3	3	0	0	3	NIL
3.	60 EC E53	Rocketry and Space Mechanics	PE	3	3	0	0	3	Satellite Communication
4.	60 EC E54	Software Defined Networks	PE	3	3	0	0	3	Mobile Communication and Networks
5.	60 EC E55	Deep Learning	PE	4	2	0	2	3	Machine Learning Techniques
6.	60 EC E56	Biomedical Instrumentation	PE	3	3	0	0	3	NIL
7.	60 EC E57	Massive MIMO Networks	PE	3	3	0	0	3	Mobile Communication and Networks

*Students can opt for honour degree without specialization by completing 18 credits choosing the necessary courses from the list of electives given above. Courses can be chosen from any of the elective list as per the interest of the students.

SEMESTER VII - AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 AC 001	Research Skill Development	AC	1	1	0	0	0	NIL

MANDATORY COURSES (MC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 MY 001	Environmental Studies and Climate Change	MC	2	2	0	0	0	NIL
2.	60 MY 002	Universal Human Values	MC	3	3	0	0	3	NIL
3.	60 MY 003	Startups and Entrepreneurship	MC	2	2	0	0	2	Basic knowledge of reading and writing in English

GENERAL ELECTIVE COURSES (GE)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 GE 001	Heritage of Tamils / தமிழர் மரபு	GE	1	1	0	0	1	NIL
2.	60 GE 002	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	GE	1	1	0	0	1	NIL

OPEN ELECTIVES I / II / III (OE)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC L01	Internet of Things	OE	5	1	0	4	3	Microprocessors and Microcontrollers, Basics of C Programming
2.	60 EC L02	Wearable Devices	OE	3	3	0	0	3	NIL
3.	60 EC L03	Next Generation Wireless Networks	OE	3	3	0	0	3	NIL
4.	60 EC L04	Microprocessor and Microcontroller	OE	3	3	0	0	3	NIL
5.	60 EC L05	5G Communications and MIMO	OE	3	3	0	0	3	NIL
6.	60 EC L06	Mobile Robotics	OE	3	3	0	0	3	NIL

INTEGRATED COURSES

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC 302	Circuit Analysis	PC	6	2	1	2	4	NIL
2.	60 EC 404	Analog Communication	PC	4	2	0	2	3	NIL
3.	60 EC 604	Machine Learning Techniques	PC	5	3	0	2	4	NIL
4.	60 EC E11	Wearable Devices	PE	4	2	0	2	3	Electronic Devices
5.	60 EC E13	Radar Technologies	PE	4	2	0	2	3	Electromagnetic Waves
6.	60 EC E14	Optical Communication and Networks	PE	4	2	0	2	3	Electromagnetic Waves
7.	60 EC E15	Data Science	PE	4	2	0	2	3	NIL

8.	60 EC E16	Consumer Electronics	PE	4	2	0	2	3	Basic knowledge of Electrical and Electronics Engineering
9.	60 EC E17	Speech and Audio Processing	PE	4	2	0	2	3	Digital Signal Processing
10.	60 EC E25	Digital Image Processing	PE	4	2	0	2	3	Signals and Systems
11.	60 EC E35	Artificial Intelligence	PE	4	2	0	2	3	Machine Learning Techniques
12.	60 EC E45	Computer Vision: Algorithms and Applications	PE	4	2	0	2	3	Digital Image Processing
13.	60 EC E55	Deep Learning	PE	4	2	0	2	3	Machine Learning Techniques

PROJECT BASED COURSES

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	60 EC E12	IoT Hardware	PE	5	1	0	4	3	Electronic devices and circuits, Basics of C Programming
2.	60 EC E22	IoT Product Development	PE	5	1	0	4	3	Electronic devices and circuits, Basics of C Programming, IoT Hardware
3.	60 EC L01	Internet of Things	OE	5	1	0	4	3	Microprocessors and Microcontrollers, Basics of C Programming

CAREER GUIDANCE COURSES (CG)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
4.	60 CG 0P1	Career Skill Development – I	CG	2	0	0	2	1	Basic knowledge of reading and writing in English
5.	60 CG 0P2	Career Skill Development – II	CG	2	0	0	2	1	Basic knowledge of reading and writing in English
6.	60 CG 0P3	Career Skill Development – III	CG	2	0	0	2	1	Basic knowledge of Arithmetic and Logical Reasoning
7.	60 CG 0P4	Career Skill Development – IV	CG	2	0	0	2	1	Basic knowledge of Arithmetic and Logical Reasoning
8.	60 CG 0P5	Comprehension Test	CG	2	0	0	2	1	Fundamental knowledge in all core subjects.
9.	60 EC 4P2	Electronic Design Project Laboratory	CG	4	0	0	4	2	Analog and Digital

									Electronics Laboratory
10.	60 EC 6P1	Innovation Engineering Laboratory	CG	3	0	0	3	1.5	NIL
11.	60 EC 7P3	Project work – Phase I	CG	4	0	0	4	2	NIL
12.	60 EC 8P1	Project work – Phase II	CG	16	0	0	16	8	NIL
13.	60 CG 0P6	Internship	CG	0	0	0	0	1\2 \3	NIL

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COURSES OF STUDY

(For the candidates admitted in 2022-2023)

SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		Induction Programme	-	-	-	-	-	0
		THEORY						
1.	60 EN 001	Professional English I	HS	3	1	0	2	2
2.	60 MA 001	Matrices and Calculus	BS	5	3	1	0	4
3.	60 PH 003	Physics for Electrical Engineering	BS	3	3	0	0	3
4.	60 ME 002	Engineering Graphics	ES	6	2	0	4	4
5.	60 CS 001	C Programming	ES	3	3	0	0	3
6.	60 MY 001	Environmental Studies and Climate Change	MC	2	2	0	0	0
		PRACTICALS						
7.	60 CS 0P1	C Programming Laboratory	ES	4	0	0	4	2
8.	60 ME 0P1	Fabrication and Reverse Engineering Laboratory	ES	4	0	0	4	2
			Total	30	14	1	14	20

I to VII semester

NCC[%] - Course can be waived with 3 credits in VII semester or offered as extra credits

NSS/NSO/YRC/RRC/Fine Arts[%] 3 credits is not accounted for CGPA

Career Skill Development (CSD)* - additional credit is offered not accounted for CGPA.

I to VIII semester

Internship[$] 3 additional credits not accounted for CGPA is offered based on the Internship duration

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1.	60 EN 002	Professional English II	HS	3	1	0	2	2
2.	60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	BS	5	3	1	0	4
3.	60 CH 003	Chemistry for Electronic Engineering	BS	3	3	0	0	3
4.	60 ME 005	Foundation of Mechanical Engineering	ES	3	3	0	0	3
5.	60 EC 201	Electronic Devices	PC	3	3	0	0	3
6.	60 GE 001	Heritage of Tamils / தமிழர் மரபு	GE	1	1	0	0	1[&]
		PRACTICALS						
7.	60 CP 0P2	Engineering Physics and Chemistry Laboratory	BS	4	0	0	4	2
8.	60 EC 2P1	Electronic Devices Laboratory	PC	4	0	0	4	2
9.	60 CG 0P1	Career Skill Development – I	CG	2	0	0	2	1*
			Total	**28**	**14**	**1**	**12**	**19**

Heritage of Tamils[&] additional 1 credit is offered and not account for CGPA.

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SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 MA 009	Linear Algebra and Numerical Methods	BS	5	3	1	0	4
2.	60 CS 002	Data Structures and Algorithms	ES	3	3	0	0	3
3.	60 EC 301	Electronic Circuits	PC	3	3	0	0	3
4.	60 EC 302	Circuit Analysis	PC	6	2	1	2	4
5.	60 EC 303	Digital System Design	PC	4	2	1	0	3
6.	60 MY 002	Universal Human Values	MC	3	3	0	0	$3^{\#}$
7.	60 GE 002	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	GE	1	1	0	0	$1^{\&}$
PRACTICALS								
8.	60 EC 3P1	Analog and Digital Electronics Laboratory	PC	4	0	0	4	2
9.	60 CS 0P2	Data Structures and Algorithms Laboratory	ES	4	0	0	4	2
10.	60 CG 0P2	Career Skill Development – II	CG	2	0	0	2	1*
11.	60 CG 0P6	Internship	CG	0	0	0	0	1\2\3$^{\$}$
			Total	**35**	**17**	**3**	**12**	**21**

- Tamils and Technology$^{\&}$ additional 1 credit is offered and not account for CGPA.
- UHV$^{\#}$ additional 3 credit is offered and not accounted for CGPA.

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 MA 016	Probability and Inferential Statistics	BS	5	3	1	0	4
2.	60 EC 401	Signals and Systems	PC	4	2	1	0	3
3.	60 EC 402	Linear Integrated Circuits	PC	3	3	0	0	3
4.	60 EC 403	Electromagnetic Waves	PC	5	3	1	0	4
5.	60 EC 404	Analog Communication	PC	4	2	0	2	3
6.	60 OE L1*	Open Elective I	OE	3	3	0	0	3
PRACTICALS								
7.	60 EC 4P1	Linear Integrated Circuits and Electromagnetics Laboratory	PC	4	0	0	4	2
8.	60 EC 4P2	Electronic Design Project Laboratory	CG	4	0	0	4	2
9.	60 CG 0P3	Career Skill Development – III	CG	2	0	0	2	1*
10.	60 CG 0P6	Internship	CG	0	0	0	0	1\2\3$^{\$}$
			Total	**34**	**16**	**3**	**12**	**24**

SEMESTER V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 EC 501	Control Systems Engineering	PC	5	3	1	0	4
2.	60 EC 502	VLSI and Chip Design	PC	3	3	0	0	3
3.	60 EC 503	Digital Signal Processing	PC	5	3	1	0	4
4.	60 EC 504	Microprocessors and Microcontrollers	PC	3	3	0	0	3
5.	60 EC E1*	Professional Elective I	PE	4	2	0	2	3
6.	60 OE L2*	Open Elective II	OE	3	3	0	0	3
7.	60 MY 003	Startups and Entrepreneurship	MC	2	2	0	0	2##
PRACTICALS								
8.	60 EC 5P1	Microcontrollers Laboratory	PC	3	0	0	3	1.5
9.	60 EC 5P2	VLSI Laboratory	PC	2	0	0	2	1
10.	60 EC 5P3	Signal Processing Laboratory	PC	3	0	0	3	1.5
11.	60 CG 0P4	Career Skill Development – IV	CG	2	0	0	2	1*
12.	60 CG 0P6	Internship	CG	0	0	0	0	1\2 \3$
			Total	**35**	**19**	**2**	**12**	**24**

##Startups and Entrepreneurship - additional 2 credit is offered and not accounted for CGPA

SEMESTER VI

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 EC 601	Embedded systems	PC	3	3	0	0	3
2.	60 EC 602	Digital Communication	PC	5	3	1	0	4
3.	60 EC 603	Mobile Communication and Networks	PC	3	3	0	0	3
4.	60 EC 604	Machine Learning Techniques	PC	5	3	0	2	4
5.	60 EC E2*	Professional Elective II	PE	3	3	0	0	3
6.	60 OE L3*	Open Elective III	OE	3	3	0	0	3
PRACTICALS								
7.	60 EC 6P1	Innovation Engineering Laboratory	CG	3	0	0	3	1.5
8.	60 EC 6P2	Embedded systems Laboratory	PC	3	0	0	3	1.5
9.	60 EC 6P3	Digital Communication Laboratory	PC	2	0	0	2	1
10.	60 CG 0P5	Comprehension Test	CG	2	0	0	2	1*
11.	60 CG 0P6	Internship	CG	0	0	0	0	1\2 \3$
			Total	**32**	**18**	**1**	**12**	**24**

Comprehension Test* - one additional credit is offered and not accounted for CGPA calculation.

SEMESTER VII

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1.	60 HS 002	Engineering Economics and Financial Accounting	HS	3	3	0	0	3
2.	60 EC 701	Antennas and Microwave Engineering	PC	3	3	0	0	3
3.	60 EC 702	Computer Networks	PC	3	3	0	0	3
4.	60 EC E3*	Professional Elective III	PE	3	3	0	0	3
5.	60 EC E4*	Professional Elective IV	PE	3	3	0	0	3
6.	60 AB 00*	NCC\NSS\NSO\YRC\RRC\Yoga\Fine Arts	HS	4	2	0	2	3%
7.	60 AC 001	Research Skill Development	AC	1	1	0	0	0
		PRACTICALS						
8.	60 EC 7P1	RF Laboratory	PC	2	0	0	2	1
9.	60 EC 7P2	Networks Laboratory	PC	2	0	0	2	1
10.	60 EC 7P3	Project Work - Phase I	CG	4	0	0	4	2
11.	60 CG 0P6	Internship	CG	0	0	0	0	1\2\3$
			Total	**24**	**16**	**0**	**8**	**19**

NCC% - Course can be waived with 3 credits in VII semester or offered as extra 3 credits.
NSS/NSO/YRC/RRC/Fine Arts% 3 extra credits not accounted for CGPA

SEMESTER VIII

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1.	60 EC E5*	Professional Elective V	PE	3	3	0	0	3
		PRACTICALS						
2.	60 EC 8P1	Project Work - Phase II	CG	16	0	0	16	8
3.	60 CG 0P6	Internship	CG	0	0	0	0	1\2\3$
			Total	**19**	**3**	**0**	**16**	**11**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 162

Note: HS-Humanities and Social Sciences including Management Courses, BS-Basic Science Courses, ES-Engineering Science Courses, PE-Professional Core Courses, PE-Professional Elective Courses, GE-General Elective Courses, OE-Open Elective Courses, CG-Career Guidance Courses, MC-Mandatory Courses

L: Lecture
T: Tutorial
P: Practical

Note:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

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B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

FIRSTSEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 EN 001	Professional English I	2	40	60	100	45	100
2.	60 MA 001	Matrices and Calculus	2	40	60	100	45	100
3.	60 PH 003	Physics for Electrical Engineering	2	40	60	100	45	100
4.	60 ME 002	Engineering Graphics	2	40	60	100	45	100
5.	60 CS 001	C Programming	2	40	60	100	45	100
6.	60 MY 001	Environmental Studies and Climate Change	2	100	00	100	00	100
PRACTICAL								
7.	60 CS 0P1	C Programming Laboratory	3	60	40	100	45	100
8.	60 ME 0P1	Fabrication and Reverse Engineering Laboratory	3	60	40	100	45	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination and 40 marks for practical End semester Examination.

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60 EN 001	Professional English I	Category	L	T	P	Credit
		HS	1	0	2	2

Objectives

- To help learners improve their vocabulary and to enable them to use words appropriately in different academic and professional contexts
- To help learners develop strategies that could be adopted while reading texts
- To help learners acquire the ability to speak effectively in English in real life and career related situations
- To equip students with effective speaking and listening skills in English
- To facilitate learners to enhance their writing skills with coherence and appropriate format effectively

Pre-requisites

- Basic knowledge of reading and writing in English.

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Compare and interpret complex academic texts	Understand
CO2	Recall the denotative and connotative meanings of technical texts	Remember
CO3	Interpret definitions, descriptions, narrations, and essays on various topics	Understand
CO4	Express fluently and accurately in formal and informal communicative contexts	Understand
CO5	Summarize their opinions effectively in both oral and written medium of communication	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO2	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO3	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO4	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO5	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	50	50	80	80
Apply	-	-	-	-
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 EN 001 - Professional English I								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	1	0	2	45	2	40	60	100

Introduction to Fundamentals of Communication* **Listening:** General Information - Specific Details-Conversation - Introduction to Classmates – Audio - Video (Formal - Informal). **Speaking:** Self Introduction - Introducing a Friend - Conversation - Politeness Strategies. **Reading:** Reading Brochures (Technical Context), Telephone Messages - Social Media Messages Relevant to Technical Contexts and Emails. **Writing:** Writing Letters – Informal and Formal – Basics and Format Orientation **Language Focus:** Present Tenses - Word Formation (Affixes) - Synonyms, Antonyms and Contranyms - and Phrasal Verbs - Abbreviations - Acronyms (as Used in Technical Contexts).	[9]
Narration and Summation* **Listening:** Podcast, Anecdotes - Stories - Event Narration; Documentaries and Interviews with Celebrities. **Speaking:** Narrating Personal Experiences / Events; Interviewing a Celebrity; Reporting / and Summarizing of Documentaries / Podcasts/ Interviews. **Reading:** Biographies, Travelogues - Newspaper Reports - Excerpts from Literature - and Travel - Technical Blogs. **Writing:** Paragraph Writing - Short Report on an Event (Field Trip Etc.). **Language Focus:** Past Tenses and Prepositions - One-Word Substitution.	[9]
Description of A Process - Product* **Listening:** Listen to a Product and Process Descriptions; Advertisements about Products or Services **Speaking:** Picture Description; Giving Instruction to use the Product; Presenting a Product. **Reading:** Advertisements, Gadget Reviews and User Manuals. **Writing:** Definitions; Instructions; and Product - Process Description. **Language Focus:** Imperatives - Comparative Adjectives - Future Tenses. Homonyms - And Homophones - Discourse Markers (Connectives - Sequence Words)	[9]
Classification and Recommendations * **Listening:** TED Talks; Scientific Lectures; and Educational Videos. **Speaking:** Small Talk; Mini Presentations **Reading:** Newspaper Articles and Journal Reports **Writing:** Note-Making / Note-Taking; Recommendations; Transferring Information from Non-Verbal (Chart, Graph etc, to Verbal Mode) **Language Focus:** Articles; Pronouns - Possessive - Relative Pronouns; Subject-Verb Agreement; Collocations	[9]
Expression* **Listening:** Debates/ Discussions; Different Viewpoints on an Issue; and Panel Discussions. **Speaking:** Group Discussions, Debates - Role Plays. **Reading:** Editorials; and Opinion Blogs. **Writing:** Essay Writing (Descriptive or Narrative). **Language Focus:** Punctuation; Compound Nouns; Simple, Compound - Complex Sentences. Cause - Effect Expressions.	[9]
Total Hours:	45

Text Book(s):

1.	"English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2.	Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020.

Reference(s):

1.	Paul Emmerson and Nick Hamilton, "Five Minute Activities for Business English", Cambridge University Press, New York, 2005.

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2.	Arthur Brookes and Peter Grundy,” Beginning to Write: Writing Activities for Elementary and Intermediate Learners”, Cambridge University Press, New York, 2003
3.	Michael McCarthy and Felicity O Dell, “English Vocabulary in Use: Upper Intermediate”, Cambridge University Press, N.York, 2012
4.	Lakshmi Narayanan, “A Course Book on Technical English”, Scitech Publications (India) Pvt. Ltd., 2020.

* SDG 4 - Quality Education

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Introduction to Fundamentals of Communication**	
1.1	Listening for General Information and Specific Details	1
1.2	Self-Introduction	1
1.3	Narrating Personal Experiences	1
1.4	Reading Relevant to Technical Contexts and Emails	1
1.5	Writing Letters – Informal	1
1.6	Writing Letters – Formal	1
1.7	Present Tenses	1
1.8	Synonyms, Antonyms and Contranyms, and Affixes	1
1.9	Phrasal Verbs; Abbreviations & Acronyms	1
2	**Narration and Summation**	
2.1	Listening to Podcasts, Documentaries and Interviews with Celebrities	1
2.2	Narrating Personal Experiences	1
2.3	Summarizing of Documentaries	1
2.4	Reading Travelogues, and Excerpts from Literature	1
2.5	Paragraph Writing	1
2.6	Short Report on an Event (Field Trip etc.).	1
2.7	Past Tenses	1
2.8	Prepositions	1
2.9	One-Word Substitution	1
3	**Description of a Process / Product**	
3.1	Listen to a Product and Process Descriptions	1
3.2	Picture Description	1
3.3	Giving Instruction to use the Product	1
3.4	Reading Advertisements, Gadget Reviews and User Manuals	1
3.5	Writing Definitions and Instructions	1
3.6	Future Tenses	1
3.7	Homonyms and Homophones	1
3.8	Imperatives	1
3.9	Comparative Adjectives, and Discourse Markers	1
4	**Classification and Recommendations**	
4.1	Listening to TED Talks and Educational Videos	1
4.2	Listening to Scientific Lectures	1
4.3	Small Talk and Mini Presentations	1
4.4	Reading Newspaper Articles and Journal Reports	1
4.5	Note-Making / Note-Taking	1
4.6	Recommendations	1
4.7	Transferring Information from Non-Verbal	1
4.8	Articles and Pronouns	1
4.9	Subject-Verb Agreement and Collocations	1

5	**Expression**	
5.1	Listening to Debates and Panel Discussions	1
5.2	Group Discussions	2
5.3	Role Plays	1
5.4	Reading Editorials and Opinion Blogs	1
5.5	Essay Writing (Descriptive or Narrative)	1
5.6	Punctuation and Cause - Effect Expressions.	1
5.7	Compound Nouns	1
5.8	Simple, Compound & Complex Sentences	1

Course Designer(s)

1. Dr.A.Palaniappan - palaniappan@Ksrct.ac.In

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60 MA 001	Matrices and Calculus	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To familiarize the students with basic concepts in cayley-hamilton theorem and orthogonal transformation.
- To get exposed to the fundamentals of differential calculus in various methods.
- To acquire skills to understand the concepts involved in jacobians and maxima and minima.
- To solve various linear differential equations and method of variation of parameters.
- To learn various techniques and methods in solving definite and indefinite integrals.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Apply the concepts of Cayley-hamilton theorem and orthogonal transformation to the matrix	Apply
CO2	Apply the concepts of differentiation in solving various Engineering problems	Apply
CO3	Obtain Jacobians and maxima and minima of functions of two variables	Apply
CO4	Employ various methods in solving differential equations	Apply
CO5	Apply different techniques to evaluate definite and indefinite integrals	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
3 - Strong;2 - Medium;1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	10	10
Understand	10	10	20	20
Apply	40	40	70	70
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

Passed in BoS Meeting held on 20/07/2022
Approved in Academic Council Meeting held on 23/07/2022

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common To MECH, ECE, EEE, CSE, MCT, CIVIL, IT, TXT, BT, FT, AI&DS, AI&ML								
60 MA 001 - Matrices and Calculus								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	40	60	100

Matrices Characteristic Equation – Eigen Values and Eigen Vectors of a Real Matrix – Properties of Eigen Values and Eigen Vectors –Cayley-Hamilton Theorem-Orthogonal Transformation of a Symmetric Matrix to Diagonal Form – Reduction of Quadratic Form to Canonical Form by an Orthogonal Transformation - Nature of Quadratic Form – Applications: Stretching of an Elastic Membrane. **Hands - on:** Matrix operations - Addition, Multiplication, Transpose, Inverse and Rank.	[9]
Differentiation Representation of Functions - Limit of A Function - Continuity - Derivatives - Differentiation Rules (Sum, Product, Quotient, Chain Rules) – Successive Differentiation-Leibnitz's Theorem- **Applications: Maxima and Minima of Functions of One Variable*.** **Hands - on:** Determine the solution of system of linear equations	[9]
Functions of Several Variables Partial Differentiation – Homogeneous Functions and Euler's Theorem – Jacobians – Taylor's Series for Functions of Two Variables – **Applications: Maxima and Minima of Functions of Two Variables – Constrained Maxima and Minima: Lagrange's Method of Undetermined Multipliers***. **Hands - on:** Compute the Eigen values and Eigen vectors of a Matrix	[9]
Differential Equations Linear Differential Equations of Second And Higher Order with Constant Co-Efficient - R.H.S is of the Form $e^{\alpha x}, sin\, \alpha\, x, cos\, \alpha\, x,\ x^n, n > 0,$ - Differential Equations with Variable Coefficients: Cauchy's and Legendre's Form of Linear Equations – Method of Variation of Parameters. **Hands - on:** Solve the first and second order ordinary differential equations	[9]
Integration Definite and Indefinite Integrals - Substitution Rule - Techniques of Integration: Integration by Parts, Integration of Rational Functions by Partial Fraction, Integration of Irrational Functions - Improper Integrals - Applications: Hydrostatic Force and Pressure, Moments and Centres of Mass. **Hands-on:** Compute the Maxima and Minima of a function of one variable	[9]
Total Hours: (Lecture - 45; Hands - on - 05; Tutorial - 10)	**60**

Text Book(s):

1.	Grewal B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017.
2.	Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Limited, New Delhi, 2016.

Reference(s):

1.	Dass H.K, "Higher Engineering Mathematics", 3rd (Revised) Edition, S.Chand & Company Ltd,New Delhi, 2014.
2.	Veerarajan T, "Engineering Mathematics", for Semesters I & II, 1st Edition, Tata McGraw Hill Publishing Co., New Delhi, 2019.
3.	Kandasamy P, Thilagavathy K and Gunavathy K, "Engineering Mathematics - I", S.Chand & Company Ltd, New Delhi, 2017.
4.	Bali N P and Manish Goyal, "A text book of Engineering Mathematics",10th Edition, Laxmi Publications (P) Ltd, 2016.

*SDG 4 – Quality Education

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. Of Hours**
1	**Matrices**	
1.1	Characteristic equation	1
1.2	Eigen values and Eigen vectors of a real matrix	1
1.3	Properties of Eigen values and Eigen vectors	1
1.4	Cayley-Hamilton theorem	1
1.5	Orthogonal transformation of a symmetric matrix to diagonal form	1
1.6	Nature of quadratic form	1
1.7	Reduction of quadratic form to canonical form by Orthogonal transformation	2
1.8	Stretching of an elastic membrane	1
1.9	Tutorial	2
1.10	Hands-on	1
2	**Differentiation**	
2.1	Representation of functions	1
2.2	Limit of a function and Continuity	1
2.3	Differentiation rules (sum, product, quotient, chain rules)	2
2.4	Successive differentiation	1
2.5	Leibnitz's theorem	2
2.6	Maxima and minima of functions of one variable	2
2.7	Tutorial	2
2.8	Hands-on	1
3	**Functions of Several Variables**	
3.1	Partial differentiation	1
3.2	Homogeneous functions and Euler's theorem	1
3.3	Jacobians	2
3.4	Taylor's series for functions of two variables	1
3.5	Maxima and minima of functions of two variables	2
3.6	Lagrange's Method of Undetermined Multipliers	2
3.7	Tutorial	2
3.8	Hands-on	1
4	**Differential Equations**	
4.1	Linear differential equations of second and higher order with constant co-efficient	1
4.2	R.H.S is of the form $e^{\alpha x}$, $\sin \alpha x$, $\cos \alpha x$, $x^n, n > 0$	2
4.3	Differential equations with variable coefficients: Cauchy's form of linear equations	2
4.4	Differential equations with variable coefficients: Legendre's form of linear equations	2
4.5	Method of variation of parameters	2
4.6	Tutorial	2
4.7	Hands-on	1
5	**Integration**	
5.1	Definite and Indefinite integrals	2
5.2	Substitution rule	1
5.3	Techniques of Integration: Integration by parts	1

5.4	Integration of rational functions by partial fraction	1
5.5	Integration of irrational functions	1
5.6	Improper integrals	1
5.7	Hydrostatic force.	1
5.8	Pressure, moments and centres of mass.	1
5.9	Tutorial	2
5.10	Hands-on	1

Course Designer(s)

1. Dr.C.Chandran - cchandran@ksrct.ac.in
2. Mr.G.Mohan - mohan@ksrct.ac.in

60 PH 003	Physics for Electrical Engineering (Common to ECE, EE & EEE)	Category	L	T	P	Credit
		BS	3	0	0	3

Objectives

- To make the students to understand the basics of crystallography, crystal growth and its importance in semiconductor devices
- To enable the students in understanding the importance of quantum physics and its applications.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To understand the dielectric properties of materials including magnetic materials, applications of dielectrics and magnetic materials
- To introduce advanced materials and nano technology for various modern engineering applications

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Recognize the basics of crystallography, different crystal growth techniques and its applications	Understand
CO2	Utilize the fundamentals of quantum mechanics and apply to one dimensional motion of particles	Apply
CO3	Acquire knowledge on basics of semiconductor physics and its applications in various devices	Understand
CO4	Realize the knowledge on magnetic and dielectric properties of materials and their applications	Understand
CO5	Infer the properties of new engineering materials and nano materials for potential applications	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	2	2	-	-	-	-	-	-

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	14	16	16
Understand	46	46	80	80
Apply	04	-	04	04
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to EEE, EE, ECE								
60 PH 003 - Physics for Electrical Engineering								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Crystal Structure of Solids* Lattice - Unit Cell – Crystal Systems and Bravais Lattice - Miller Indices - D Spacing in Cubic Lattice - Calculation of Number of Atoms Per Unit Cell - Atomic Radius - Coordination Number - Packing Factor for Hcp Structure - Production of Single Crystal Silicon by Melt Growth Techniques (Bridgman and Czochralski) - Basic Properties of Silicon Wafers - Wafer Orientation – Wafer Cleaning – Pattern Alignment - Imperfections in Crystals.	[9]
Quantum Mechanics* Black Body Radiation – Dual Nature of Light - De-Broglie Hypothesis - Properties of Matter Waves - Time -Dependent and Time Independent Schrodinger Equation for Wave Function - Applications: Particle in a Box (One Dimensional and Three Dimensional) - Physical Significance of Wave Function-Uncertainty Principle - Applications - Electron Microscope - Scanning Electron Microscope.	[9]
Semiconducting Materials Properties - Elemental and Compound Semiconductors - Carrier Concentration in Intrinsic and Extrinsic Semiconductors - Experimental Determinations of Resistivity of Semiconductor by Four Probe Method - Hall Coefficient-Experimental Determination of Hall Coefficient - Semiconductor Devices - P-N Junction Diode, **Solar Cell, LED****.	[9]
Magnetic and Dielectric Materials* Magnetic Materials: Origin of Magnetic Moment - Bohr Magnetron - Classification of Magnetic Materials - Domain Theory - Hysteresis - Soft and Hard Magnetic Materials - Applications - Giant Magneto Resistance (GMR). Dielectric Materials: Polarization - Electronic, Ionic, Orientational and Space Charge - Frequency and Temperature Dependence of Polarization - Breakdown Mechanisms - Applications of Dielectrics in Capacitor and Transformer.	[9]
Advanced Materials and Nanotechnology* Advanced Materials: Metallic Glasses – Preparation, Properties and Applications - Shape Memory Alloys (SMA) - Characteristics, Properties of NiTi Alloy Applications. Nano Technology: Properties - Top-Down Process: Ball Milling Method - Bottom-Up Process: Vapour Phase Deposition - Carbon Nano Tube (CNT): Properties, Preparation by Electric Arc Method - Application - Single Electron Phenomena and Single Electron Transistor (SET)	[9]
Total Hours:	**45**

Text Book(s):	
1.	Avadhanulu.M.N, Kshirsagar.P.G, Arun Murthy. TVS, “A Text Book of Engineering Physics”, S Chand Publications, New Delhi, 2022.
2.	Malik.H.K, Singh.A.K, “Engineering Physics”, Mcgraw Hill Education Private Limited, New Delhi. 2021.
3.	Joshi.D.R, “Engineering Physics”, Mcgraw Hill Education Private Limited, New Delhi. 2010.
Reference(s):	
1.	Pillai.S.O, “A Textbook of Engineering Physics”, New Age International (P) Limited, New Delhi, 2014.
2.	Laud.B.B, “Lasers and Non-Linear Optics”, New Age International Publications, New Delhi, 2015.
3.	Palanisamy.P.K, “Physics of Materials”, Scitech Publications, Chennai. 2012.

* SDG 4 - Quality Education

** SDG 7 - Sustainable and modern energy for all

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Course Contents and Lecture Schedule

S. No.	Topics	No. Of Hours
1.0	**Crystal Structure of Solids**	
1.1	Lattice - Unit Cell – Crystal Systems and Bravais Lattice	1
1.2	Miller Indices - D Spacing in Cubic Lattice	1
1.3	Calculation of Number of Atoms Per Unit Cell	1
1.4	Atomic Radius - Coordination Number - Packing Factor for HCP Structure	1
1.5	Production of Single Crystal Silicon by Melt Growth Techniques	1
1.6	(Bridgman And Czochralski)	1
1.7	Basic Properties of Silicon Wafers	1
1.8	Wafer Orientation – Wafer Cleaning	1
1.9	Pattern Alignment - Imperfections in Crystals	1
2.0	**Quantum Mechanics**	
2.1	Black Body Radiation	1
2.2	Dual Nature of Light - De-Broglie Hypothesis	1
2.3	Properties of Matter Waves	1
2.4	Time-Dependent and Time Independent Schrodinger Equation for Wave Function	1
2.5	Applications: Particle in a Box (One Dimensional and Three Dimensional)	1
2.6	Physical Significance of Wave Function-Uncertainty Principle	1
2.7	Applications of Schrodinger Equation	1
2.8	Electron Microscope	1
2.9	Scanning Electron Microscope	1
3.0	**Semiconducting Materials**	
3.1	Properties of Semiconductor	1
3.2	Elemental and Compound Semiconductors	1
3.3	Carrier Concentration in Intrinsic and Extrinsic Semiconductors	1
3.4	Experimental Determinations of Resistivity of Semiconductor	1
3.5	Four Probe Method	1
3.6	Hall Coefficient	1
3.7	Experimental Determination of Hall Coefficient	1
3.8	Semiconductor Devices – P-N Junction Diode	1
3.9	Solar Cell, LED	1
4.0	**Magnetic and Dielectric Materials**	
4.1	Origin of Magnetic Moment - Bohr Magnetron	1
4.2	Classification of Magnetic Materials	1
4.3	Domain Theory - Hysteresis - Soft and Hard Magnetic Materials	1
4.4	Applications - Giant Magneto Resistance (*GMR*)	1
4.5	Electronic Polarization, Ionic Polarization	1
4.6	Orientational And Space Charge Polarization	1
4.7	Frequency and Temperature Dependence of Polarization	1
4.8	Breakdown Mechanisms	1
4.9	Applications of Dielectrics in Capacitor and Transformer	1
5.0	**Advanced Materials and Nanotechnology**	
5.1	Metallic Glasses – Preparation, Properties and Applications	1
5.2	Shape Memory Alloys (SMA)	1
5.3	Characteristics, Properties of NiTi Alloy Applications	1
5.4	Properties - Top-Down Process: Ball Milling Method	1
5.5	Bottom-Up Process: Vapour Phase Deposition	1

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5.6	Carbon Nano Tube (CNT): Properties	1
5.7	Preparation by Electric Arc Method	1
5.8	CNT-Application	1
5.9	Single Electron Phenomena and Single Electron Transistor (SET)	1

Course Designer(s)

1. Dr. V. Vasudevan - vasudevanv@ksrct.ac.in
2. Mr.S. Vanchinathan - vanchinathan@ksrct.ac.in
3. Dr.P. Suthanthira Kumar - suthanthirakumar@ksrct.ac.in

60 ME 002	Engineering Graphics	Category	L	T	P	Credit
		ES	2	0	4	4

Objectives

- To acquire various concepts of dimensioning, conventions and standards.
- To impart the graphic skills for converting pictorial views of solids in to orthographic views.
- To learn the concept in projection of solids, section of solids and development of different types of surfaces.
- To learn the concept of isometric projection.
- To learn the geometry and topology of engineered components

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Demonstrate the Impact of computer technologies on graphical communication	Apply
CO2	Convert the pictorial views in to orthographic views using drafting software	Apply
CO3	Draw the projection of simple solids, true shape of sections and development of surfaces	Apply
CO4	Construct the isometric projections of objects using drafting software.	Apply
CO5	Interpret a design project illustrating engineering graphical skills.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	3	-	3	-	-	3	-	-	-	-	2	3	-
CO4	3	3	3	-	3	-	-	3	-	-	-	-	2	3	-
CO5	3	3	3	-		-	-		-	-	-	-	2	3	-

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	20	20	30	30
Apply	30	30	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Approved in Academic Council Meeting held on 23/07/2022

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 ME 002 - Engineering Graphics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I	2	0	4	90	4	40	60	100

Introduction to Computer Aided Drafting (CAD) Software* Theory of CAD Software - Menu System, Tool Bars (Standard, Object Properties, Draw, Modify and Dimension) - Drawing Area (Background, Crosshairs, Coordinate System) - Dialog Boxes and Windows - Shortcut Menus (Button Bars) - The Command Line and Status Bar - Different Methods of Zoom - Select and Erase Objects.	[6+12]
Orthographic Projection* Theory of Projection - Terminology and Methods of Projection - First Angle and Third Angle Projection - Conversion of Pictorial Views into Orthographic Views	[6+12]
Projection of Solids and Sections of Solids* Projections of Simple Solids: Prism, Pyramid, Cylinder and Cone (Axis Parallel to One Plane and Perpendicular to Other, Axis Inclined to One Plane and Parallel to Other). Sections of Simple Solids: Prism, Pyramid, Cylinder and Cone in Simple Positions (Cutting Plane Is Inclined to One of The Principal Planes and Perpendicular to The Other) – True Shape of Sections **Development of Surfaces*** Principle of Development-Methods of Development: Parallel Line Development-Cube, Prism and Cylinder. Radial Line Development - Pyramid and Cone	[6+12]
Isometric Projection* Principles of Isometric Projection - Isometric Scale, Isometric Views, Conventions - Isometric Views of Lines, Planes, Simple and Compound Solids - Conversion of Orthographic Views in to Isometric View	[6+12]
Application of Engineering Graphics* Geometry and Topology of Engineered Components: Creation of Engineering Models and Their Presentation in Standard 2D Blueprint Form, 3D Wire - Frame and Shaded Solids - Geometric Dimensioning and Tolerance - Use of Solid Modelling Software for Creating Associative Models - Floor Plans: Windows, Doors, and Fixtures such as Water Closet (WC), Bath Sink, Shower, etc. - Applying Colour Coding According to Building Drawing Practice - Drawing Sectional Elevation Showing Foundation to Ceiling – Introduction to Building Information Modelling (BIM).	[6+12]
Total Hours: (Lecture - 30; Practical - 60)	**90**

Text Book(s):

1.	Bhatt N.D, “Engineering Drawing”, 53rd Edition, Charotar Publishing House Pvt. Ltd., Gujarat, 2019.
2.	Venugopal K., “Engineering Graphics”, New Age International (P) Limited, 2014.

Reference(s):

1.	Shah M.B, Rana B.C., and V.K.Jadon., “Engineering Drawing”, Pearson Education, 2011.
2.	Natarajan K.V, “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2014.
3.	Agrawal B. &Agrawal C. M, “Engineering Graphics”, TMH Publication, 2012.
4.	Narayana, K.L & Kannaiah p, “Text Book on Engineering Drawing”, Scitech Publishers, 2008.

*SDG 9 – Industry Innovation and Infrastructure

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. Of Hours**
1	**Introduction to Computer Aided Drafting (CAD) Software**	
1.1	Theory of CAD Software	1
1.2	Menu System, Tool bars (Standard, Object Properties, Draw, Modify and Dimension)	4
1.3	Drawing Area (Background, Crosshairs, Coordinate System)	4
1.4	Dialog Boxes and Windows – Shortcut Menus	4
1.5	The Command Line and Status Bar	1
1.6	Different Methods of Zoom – Select and Erase Objects.	4
2	**Orthographic Projection**	
2.1	Introduction to Orthographic Projections	2
2.2	Planes of Projection	2
2.3	Projection of Points	2
2.4	Projection of Lines Inclined to Both Planes	2
2.5	Projection of Planes	2
2.6	Projection of Planes Inclined to Both Planes	2
2.7	Conversions of Pictorial Views to Orthographic Views	2
2.8	Practice Class for Pictorial Views to Orthographic Views	2
2.9	Practice Class for Pictorial Views to Orthographic Views	2
3	**Projection of Solids**	
3.1	Projections of Simple Solids: Prism	1
3.2	Projections of Simple Solids: Cylinder	1
3.3	Projections of Simple Solids: Pyramid	1
3.4	Projections of Simple Solids: Cone	1
3.5	Practice Class for Projection of Solids	1
3.6	Axis of Solid Inclined to Both HP And VP	2
3,7	Section of Solids for Prism	1
3,8	Section of Solids for Cylinder	1
3,9	Section of Solids for Pyramid	1
3,10	Section of Solids for Cone	1
3,11	Auxiliary Views - Draw the Sectional Orthographic Views of Geometrical Solids	2
3.12	Draw The Sectional Orthographic Views of Objects from Industry	1
3,13	Development of Surfaces of Right Solids Prism	1
3.14	Development of Surfaces of Right Solids Pyramid	1
3.15	Development of Surfaces of Right Solids Cylinder and Cone	2
4	**Isometric Projection and Introduction to Autocad**	
4.1	Principles of Isometric Projection	2
4.2	Isometric Scale	2
4.3	Isometric Projections of Simple Solids: Prism,	2
4.4	Isometric Projections of Simple Solids: Pyramid,	2
4.5	Isometric Projections of Simple Solids: Cylinder	2
4.6	Isometric Projections of Simple Solids: Cone	2
4.7	Isometric Projections of Frustum	2
4.8	Isometric Projections of Truncated Solids	2
4.9	Combination of Two Solid Objects in Simple Vertical Positions	2

5	**Application of Engineering Graphics**	
5.1	Geometry and Topology of Engineered Components:	2
5.2	Creation Of Engineering Models and Their Presentation in Standard 2D Blueprint Form,	2
5.3	3D Wire-Frame and Shaded Solids – Geometric Dimensioning and Tolerance – Use of Solid Modeling Software for Creating Associative Models	4
5.4	Floor Plans: Windows, Doors, And Fixtures Such as Water Closet (WC), Bath Sink, Shower, etc.	2
5.5	Applying Colour Coding According to Building Drawing Practice	2
5.6	Drawing Sectional Elevation Showing Foundation to Ceiling	4
5.7	Introduction to Building Information Modelling (BIM).	2

Course Designer(s)

1. Dr.K.Mohan - mohank@ksrct.ac.in

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60 CS 001	C Programming	Category	L	T	P	Credit
		ES	3	0	0	3

Objectives

- To learn most fundamental element of the C language and to examine the execution of branching, looping statements
- To examine the concepts of arrays, its characteristics and types and strings
- To understand the concept of functions, pointers and the techniques of putting them to use
- To apply the knowledge of structures and unions to solve basic problems in C language
- To enhance the knowledge in file handling functions for storage and retrieval of data

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Construct the fundamental building blocks of structured Programming in C	Apply
CO2	Implement the different operations on arrays and strings	Apply
CO3	Develop simple real world applications utilizing functions, recursion and pointers	Apply
CO4	Demonstrate the concepts of structures, unions, user defined data types and preprocessor	Apply
CO5	Interpret the file concepts using proper standard library functions for a given application	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	2	2	-	2	3	3	2
CO2	3	3	3	-	3	-	-	-	2	2	-	2	3	3	2
CO3	3	3	3	-	3	-	-	-	2	2	-	2	3	3	2
CO4	3	3	3	-	3	-	-	-	2	2	-	2	3	3	2
CO5	3	3	3	-	3	-	-	-	2	2	-	2	3	3	2
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	10	10	20	20
Apply	40	40	60	60
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

Passed in BoS Meeting held on 20/07/2022
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 CS 001 – C Programming								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I	3	0	0	45	3	40	60	100

Basics of C, I/O, Branching and Loops* Structure of a C Program - Data Types - Keywords - Variables - Type Qualifiers - Constants – Operators - Expressions and Precedence - Console I/O - Unformatted and Formatted Console I/O - Conditional Branching and Loops - Writing and Evaluation of Conditionals and Consequent Branching	[9]
Arrays and Strings* Arrays: One Dimensional Arrays - Two Dimensional Arrays - Matrix Manipulation - Character Arrays - Strings: String Manipulation with and Without String Handling Functions.	[7]
Functions and Pointers* Functions: Scope of a Function - Library Functions and User Defined Functions - Function Prototypes – Call by Value and Call by Reference - Function Categorization - Arguments to Main Function - Recursion and Application - Passing Arrays to Functions - Storage Class Specifiers. Introduction to Pointer Variables - the Pointer Operators - Pointer Expressions - Pointers and Arrays - Generating a Pointer to an Array - Indexing Pointers - Function and Pointers - Dynamic Memory Allocation.	[11]
Structures, Unions, Enumerations, Typedef and Preprocessors* Structures - Introduction to Structures and Initialization - Arrays of Structures - Arrays and Structures, Nested Structures - Passing Structures to Functions - Structure Pointers - Unions - Bit Fields - Enumerations - Typedef - The Preprocessor and Commands.	[9]
File Handling* File: Streams - Reading and Writing Characters - Reading and Writing Strings - File System Functions - File Manipulation - Sequential Access - Random Access Files - Command Line Arguments.	[9]
Total Hours:	**45**

Text Book(s):

1.	Herbert Schildt, “The Complete Reference C”, 4th Edition, Tata Mcgraw Hill Edition, 2010.
2.	Byron Gottfried, “Programming with C”, 3rd Edition, Mcgraw Hill Education, 2014.

Reference(s):

1.	E.Balagurusamy, “Programming in ANSI C”, 7th Edition, Tata Mcgraw Hill Edition, New Delhi, 2016.
2.	Brian W. Kernighan and Dennis M. Ritchie, “C Programming Language”, Prentice-Hall.
3.	Reemathareja, “Computer Fundamentals and Programming in C”, 2nd Edition, Oxford Higher Education, 2016.
4.	K N King, “C Programming: A Modern Approach”, 2nd Edition, W.W.Norton, New York, 2008.

*SDG 4 - Quality Education

Course Contents and Lecture Schedule

1	**Basics of C, I/O, Branching and Loops**	
1.1	Structure of a C Program, Keywords	1
1.2	Data Types, Type Qualifiers	1
1.3	Variables and Constants	1
1.4	Operators–Expressions and Precedence	1
1.5	Console I/O– Unformatted and Formatted Console I/O	1
1.6	Conditional Branching	1
1.7	Iteration and Loops	2
1.8	Writing and Evaluation of Conditionals and Consequent Branching	1
2	**Arrays and Strings**	
2.1	One Dimensional Array	1
2.2	Two-Dimensional Array and Matrix Manipulation	1
2.3	Character Arrays and Strings Basics	1
2.4	String Manipulation Without String Handling Functions	2
2.5	String Manipulation with String Handling Functions	2
3	**Functions and Pointers**	
3.1	Scope of A Function – Library Functions, User Defined Functions and Function Prototypes	1
3.2	Function Call by Value and Function Call by Reference, Function Categorization	2
3.3	Arguments to Main Function	1
3.4	Recursion and Application	1
3.5	Passing Arrays to Functions	1
3.6	Storage Class Specifiers	1
3.7	Introduction to Pointer Variables - The Pointer Operators - Pointer Expressions	1
3.8	Pointers and Arrays - Generating a Pointer to an Array - Indexing Pointers	1
3.9	Function and Pointers	1
3.10	Dynamic Memory Allocation	1
4	**Structures, Unions, Enumerations, Typedef and Preprocessors**	
4.1	Introduction to Structures and Initialization	1
4.2	Arrays and Structures, Arrays of Structures	1
4.3	Structures within Structures, Passing Structures to Functions	2
4.4	Structure Pointers	1
4.5	Unions and Bit Fields.	1
4.6	Enumerations - Typedef	1
4.7	Preprocessor Commands	2
5	**File Handling**	
5.1	File Streams –Reading and Writing Characters - Reading and Writing Strings	2
5.2	File System Functions and File Manipulation	2
5.3	Sequential Access	2
5.4	Random Access Files	2
5.5	Command Line Arguments and Files	1

Course Designer(s)

1. Dr.P.Kaladevi - kaladevi@ksrct.ac.in

Passed in BoS Meeting held on 20/07/2022
Approved in Academic Council Meeting held on 23/07/2022

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

60 MY 001	Environmental Studies and Climate Change	Category	L	T	P	Credit
		MC	2	0	0	0

Objectives

- To understand the impact climate changes in ecosystem and biodiversity.
- To analyze the impacts of pollution, control and legislation.
- To explain the importance of sustainable development practices.
- To explore the significance of organic farming.
- To identify the Geo-spatial tools for resource management.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Interpret the impacts of pollution on climate change	Understand
CO2	Categorize the wastes and its management.	Analyze
CO3	Identify the different types of sustainable practices	Apply
CO4	Classify the organic farming techniques	Apply
CO5	Categorize the Geo-spatial tools for resource management	Analyze

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	3	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	3	3	2	-	-	-	2	-	-	-
CO3	3	2	-	-	-	3	3	2	-	-	-	2	-	-	-
CO4	3	2	-	-	-	2	3	-	-	-	-	2	-	-	-
CO5	3	2	-	-	3	-	2	-	-	-	-	2	-	-	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (30 Marks)		Quiz (20 marks)		Seminar presentation (50 marks)
	Case Study	Activity Report	Quiz 1	Quiz 2	
Remember	10	10	5	5	10
Understand	30	20	10	10	15
Apply	-	30	-	5	15
Analyse	20	-	5	-	10
Evaluate	-	-	-		-
Create	-	-	-		-
Total	60	60	20	20	50

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K.S.Rangasamy College of Technology,
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

Common to all branches

60 MY 001 - Environmental Studies and Climate Change

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	2	0	0	30	0	100	-	100

Pollution and its Impact on Climate Change* Pollution: Sources and Impacts of Air Pollution – Green House Effect- Global Warming - Climate Change - Ozone Layer Depletion - Acid Rain. Carbon Footprint - Climate Change on Various Sectors - Agriculture, Forestry and Ecosystem – Climate Change Mitigation and Adaptation. Action Plan on Climate Change. IPCC, UNFCCC, Kyoto Protocol, Montreal Protocol on Climatic Changes. *Activity*: Study of carbon emission nearby place or industry.	[6]
Integrated Waste Management** Waste - Types and Classification. Principles of Waste Management (5R Approach) - Swachh Bharat Abhiyan - Commercial Waste, Plastic Waste, Domestic Waste, E-Waste and Biomedical Waste - Risk Management: Collection, Segregation, Treatment and Disposal Methods. Waste Water Treatment - ASP *Activity*: Analysis and design of waste management systems, prepare a model / project - wealth from waste	[6]
Sustainable Development Practices*** Sustainable Development Goals (SDGs) **-** Green Computing- Carbon Trading - Green Building – Eco- Friendly Plastic – Alternate Energy: Hydrogen – Bio-Fuels – Solar Energy – Wind – Hydroelectric Power. Water Scarcity- Watershed Management, Ground Water Recharge and Rainwater Harvesting. *Activity*: Select a topic and analyze the value of sustainable development.	[6]
Environment and Agriculture**** Organic Farming - Bio-Pesticides - Composting, Bio Composting, Vermi - Composting, Roof Gardening and Irrigation. Waste Land Reclamation. Climate Resilient Agriculture. Green Auditing *Activity*: Prepare a Green Auditing Report on Energy, Water Etc.	[6]
Geo-Science in Natural Resource Management Data Base Software in Environment Information, Digital Image Processing Applications in Forecasting. GPS, Remote Sensing and Geographical Information System (GIS), World Wide Web (WWW), Environmental Information System (ENVIS). *Activity*: Prepare the report using IT Tool.	[6]
Total Hours:	**30**

Text Book(s):

1.	Anubha Kaushik , C P Kaushik. "Perspectives in Environmental Studies", 6th Edition New Age International Publishers, January 2018.

Reference(s):

1.	G.Tyler Miller, "Environmental Science", 14th Edition Cengage Publications, Delhi, 2013.
2.	Gilbert M.Masters and Wendell P. Ela, "Environmental Engineering and Science", 3rd Edition, PHI Learning Private Limited, 2015.
3.	Erachbharucha. Textbook of Environmental Studies for Undergraduate Courses, Universities Press, 2000.

*SDG 13 – Climate Action

**SDG 4 – Clean Water and Sanitation

***SDG 6 – Affordable and Clean Energy

****SDG 3 – Good Health and Well-being

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Course Contents and Lecture Schedule

S.No	Topic	No. Of Hours
1	**Pollution and Its Impact on Climate Change**	
1.1	Pollution: Sources and Impacts of Air Pollution – Green House Effect- Global Warming- Climate Change - Ozone Layer Depletion - Acid Rain	2
1.2	Climate Change on Various Sectors: Agriculture, Forestry and Ecosystem. – Climate Change Mitigation and Adaptation	2
1.3	Action Plan on Climate Change - IPCC, UNFCCC, KYOTO Protocol, Montreal Protocol on Climatic Changes	2
2	**Integrated Waste Management**	
2.1	Waste - Types and Classification. Principles of Waste Management (5R Approach) - Swachh Bharat Abhiyan	2
2.2	Commercial Waste, Plastic Waste, Domestic Waste, E-Waste and Biomedical Waste	2
2.3	Risk Management: Collection, Segregation, Treatment and Disposal Methods.	1
2.4	Waste Water Treatment- ASP	1
3	**Sustainable Development Practices**	
3.1	Sustainable Development Goals (SDGs) - Green Computing - Carbon Trading - Green Building - Eco- Friendly Plastic	2
3.2	Alternate Energy: Hydrogen - Bio-Fuels - Solar Energy - Wind - Hydroelectric Power	2
3.3	Water Scarcity- Watershed Management, Ground Water Recharge and Rainwater Harvesting	2
4	**Environment and Agriculture**	
4.1	Organic Farming - Bio-Pesticides	2
4.2	Composting, Bio Composting, Vermi-Composting	2
4.3	Roof Gardening and Irrigation	1
4.4	Waste Land Reclamation. Climate Resilient Agriculture, Green Auditing	1
5	**Geo-Science in Natural Resource Management**	
5.1	Data Base Software in Environment Information, Digital Image Processing Applications in Forecasting	2
5.2	GPS, Remote Sensing and Geographical Information System (GIS)	2
5.3	World Wide Web (WWW), Environmental Information System (ENVIS)	2

Course Designers

1. Dr.T.A.Sukantha - sukantha@ksrct.ac.in
2. Dr.B.Srividhya - srividhya@ksrct.ac.in
3. Dr.S.Meenachi - meenachi@ksrct.ac.in
4. Ms.D.Kirthiga - kiruthiga@ksrct.ac.in

Passed in BoS Meeting held on 20/07/2022
Approved in Academic Council Meeting held on 23/07/2022

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60 CS 0P1	C Programming Laboratory	Category	L	T	P	Credit
		ES	0	0	4	2

Objectives

- To enable the students to apply the concepts of C to solve simple problems
- To use selection and iterative statements in C programs
- To apply the knowledge of library functions in C programming
- To implement the concepts of arrays, functions, structures and pointers in C
- To implement the file handling operations through C

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Implement computational problems using selection and iterative statements	Apply
CO2	Demonstrate C program to manage collection of related data.	Apply
CO3	Design and implement different ways of passing arguments to functions, Recursion and implement pointers concepts.	Apply
CO4	Develop a C program to manage collection of different data using structures, Union, user-defined data types and preprocessor directives.	Apply
CO5	Demonstrate C program to store and retrieve data using file concepts.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	2	2	-	2	3	3	-
CO2	3	3	3	-	3	-	-	-	2	2	-	2	3	3	-
CO3	3	3	3	-	3	-	-	-	2	2	-	2	3	3	-
CO4	3	3	3	-	3	-	-	-	2	2	-	2	3	3	-
CO5	3	3	3	-	3	-	-	-	2	2	-	2	3	3	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)	
	Lab	Activity			
Remember	-	-	-	-	-
Understand	-	12	-	-	-
Apply	50	13	100		100
Analyse	-	-	-		-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-
Total	50	25	100	-	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 CS 0P1 – C Programming Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

List of Experiments:

1. Implementation of Simple computational problems using various formulas*.
2. Implementation of Problems involving Selection statements*.
3. Implementation of Iterative problems e.g., sum of series*.
4. Implementation of 1D Array manipulation*.
5. Implementation of 2D Array manipulation*.
6. Implementation of String operations*.
7. Implementation of Simple functions and different ways of passing arguments to functions and Recursive Functions*.
8. Implementation of Pointers*.
9. Implementation of structures and Union*.
10. Implementation of Bit Fields, Typedef and Enumeration*.
11. Implementation of Preprocessor directives*.
12. Implementation of File operations*.

* SDG 4 - Quality Education

Course Designer(s)

1. Dr.P.Kaladevi - Kaladevi@Ksrct.Ac.In

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60 ME 0P1	Fabrication and Reverse Engineering Laboratory	Category	L	T	P	Credit
		ES	0	0	4	2

Objectives

- To acquire skills in operating hand tools and instruments.
- To provide hands-on training on Carpentry, Sheet metal, Fitting and Welding.
- To provide hands-on training on household wiring and electronic circuits.
- To offer real time activity on plumbing connections in domestic applications.
- To provide hands-on activities on dismantling, and assembling the Home Appliance, Center lathe operations, computer's internal components and peripherals.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Perform power tools operations	Apply
CO2	Make a wooden model using carpentry Process	Apply
CO3	Make a model using sheet metal, filing and joining a MS Plate	Apply
CO4	Repair and Maintenances of water lines for home applications	Apply
CO5	Trouble shoots the electrical and electronic circuits, Electrical Machines and realizes the reputation of house wiring, home Appliance, computer internal components and peripherals.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	-	-	2	2	-	3	-	-	3	-	3	3
CO2	3	2	3	-	-	2	2	-	3	-	-	3	-	3	3
CO3	3	2	3	-	-	2	2	-	3	-	-	3	-	3	3
CO4	3	2	3	-	-	2	2	-	3	-	-	3	-	3	3
CO5	3	2	3	-	-	2	2	-	3	-	-	3	-	3	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	25	12	50	50
Apply	25	13	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All branches								
60 ME 0P1 - Fabrication and Reverse Engineering Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

Syllabus

Performs of Power Tools*
Drilling in Different Walls and Materials Fitting of Hand Shower Mount, Shirt Hanger, Towel Hanger and Pipe with Clamps.

Carpentry Process*
Design and Development of Wooden Model Using the Carpentry Process T / Cross Joint / Different Joints

Sheet Metal and Filling Process*
Design and Development of Metal Model - Make a Tray Components Using Sheet Metal Process and Mating of Square Joint in MS Plate Using the Filling Process

Welding Process*
Fabrication of Models with MS Plate Using Arc Welding- Lap Joint, Butt Joint, T Joint

Plumbing Process*
Repair and Maintenances of Pipe Fitting for Home Applications Study of Plumbing Tools, Assembly of G.I. Pipes/ PVC and Pipe Fittings, Cutting of Threads in G.I. Pipes by Thread Cutting Dies.

Residential House Wiring*
Design and Excusion of Residential House Wiring with and without UPS- 1 BHK - 2 BHK. Design and Fabrication of Domestic LED Lamps - Circuit Designing (Calculation of Components)

Electronic Circuit Wiring*
PCB Fabrication – Soldering - Assembling of Audio Amplifiers- Connecting USB/Bluetooth MP3 Player Board -
Connecting Volume Controllers - Connecting Bass & Treble Filter Boards - Connecting Surround and Sub-Woofer Filter Board

Assembling and Dismantling of Electronics Machines*
Iron Box, Induction Stove, Water Heater, Mixer, Table Fan, Ceiling Fan

Study Exercises
Demonstration of Centre Lathe Operations Facing, Turning, and Drilling and its Components.
Assemble and Dismantle of Vacuum Cleaner / Refrigerator and its Components

Computer Hardware Study Exercises
Identify Internal Components of Computer - Assemble and Dismantle Desktop Computer System

List of Experiments:

1. **Fitting of Wall Mounting Parts using Power Tools**
   A) Drilling in Different Walls and Materials
   B) Fitting of Hand Shower Mount, Shirt Hanger, Towel Hanger and Pipe with Clamps.
2. **Making of Wooden Model using the Carpentry Process**
   A) T / Cross Joint
   B) Mortise and Tenon Joint / Different Joints
3. **Making of Metal Model**
   A) Making of Components using Sheet Metal Process
   B) Mating of Components using the Filling Process

4. Fabrication of Welded Model

5. Repair and Maintenance of Pipe Fitting for Home Applications

A) Assembly of GI Pipes/PVC and Pipe Fitting

B) Cutting of Threads in GI Pipes by Thread Cutting Dies

6. Assembling and Dismantling of

A) Iron Box

B) Induction Stove

C) Water Heater

D) Mixer

E) Table Fan

F) Ceiling Fan

7. Design and Execution of Residential House Wiring

A) 1 BHK

B) 2 BHK

8. Design and Execution of Residential House Wiring With UPS.

A) 1 BHK

B) 2 BHK

9. Design and Fabrication of Domestic LED Lamps

A) Circuit Designing (calculation of components)

B) PCB Fabrication

C) Soldering

10. Assembling of Audio Amplifiers

A) Connecting USB/Bluetooth MP3 Player Board

B) Connecting Volume Controllers

C) Connecting Bass & Treble Filter Boards

D) Connecting Surround and Sub-Woofer Filter Board

Study Exercises

1. Demonstration of centre lathe and its operations like facing, turning, and drilling.
2. Dismantle and assemble of vacuum cleaner / refrigerator.
3. Study of components of computer. dismantle and assemble of desktop computer systems

*****SDG 9 – Industry Innovation and Infrastructure

Course Designer(s)

1. Mr.S Sakthivel - sakthivels@ksrct.ac.in
2. Dr. D Sri Vidya - srividhya@ksrct.ac.in
3. Mr. K. Raguvaran - raguvaran@ksrct.ac.in

Passed in BoS Meeting held on 20/07/2022
Approved in Academic Council Meeting held on 23/07/2022

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Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

SECOND SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 EN 002	Professional English II	2	40	60	100	45	100
2.	60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	2	40	60	100	45	100
3.	60 CH 003	Chemistry For Electronic Engineering	2	40	60	100	45	100
4.	60 ME 005	Foundation of Mechanical Engineering	2	40	60	100	45	100
5.	60 EC 201	Electronic Devices	2	40	60	100	45	100
6.	60 GE 001	Heritage of Tamils / தமிழர் மரபு	2	100	00	100	00	100
PRACTICAL								
7.	60 CP 0P2	Engineering Physics and Chemistry Laboratory	3	60	40	100	45	100
8.	60 EC 2P1	Electronic Devices Laboratory	3	60	40	100	45	100
9.	60 CG 0P1	Career Skill Development – I	2	100	00	100	00	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

60 EN 002	Professional English II	Category	L	T	P	Credit
		HS	1	0	2	2

Objectives

- To help learners improve their vocabulary and enable them to use words appropriately in different academic and professional contexts.
- To help learners develop strategies that could be adopted while reading texts.
- To help learners acquire the ability to speak and write effectively in English in real life and career related situations.
- Improve listening, observational skills, and problem-solving capabilities
- Develop message generating and delivery skills

Pre-requisites

- Basic knowledge of reading and writing in English and should have completed Professional English I

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Compare and contrast products and ideas in technical texts.	Understand
CO2	Illustrate cause and effects in events, industrial processes through technical texts	Understand
CO3	Infer problems in order to arrive at feasible solutions and communicate them orally and in the written format.	Understand
CO4	Relate events and the processes of technical and industrial nature.	Remember
CO5	Demonstrate their opinions in a planned and logical manner, and draft effective résumés in context of job search.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO2	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO3	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
CO4	-	-	-	-	-	-	-	2	3	3	2	3	3	3	3
CO5	-	-	-	-	-	-	-	2	3	3	2	3	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	50	50	80	80
Apply	-	-	-	-
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022

Common to All Branches

60 EN 002 – Professional English II

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	1	0	2	45	2	40	60	100

Making Comparisons* **Listening:** Evaluative Listening: Advertisements, Product Descriptions – Audio / Video; Filling a Graphic Organiser (Choosing a Product or Service by Comparison) **Speaking:** Marketing a Product, Persuasive Speech Techniques. **Reading:** Reading Advertisements, User Manuals and Brochures. **Writing:** Professional Emails, Email Etiquette - Compare and Contrast Essay. **Language Focus:** Mixed Tenses, Prepositional Phrases, Same Words Used in Different Contexts and Discourse Markers	[9]
Expressing Causal Relations in Speaking and Writing* **Listening:** Listening to Longer Technical Talks and Completing – Gap Filling Exercises. Listening Technical Information from Podcasts – Listening to Process/Event Descriptions to Identify Cause & Effects. **Speaking:** Describing and Discussing the Reasons of Accidents or Disasters based on News Reports. **Reading:** Longer Technical Texts – Cause and Effect Essays, and Letters / Emails of Complaint. **Writing:** Writing responses to complaints **Language Focus:** Active Passive Voice Transformations, Infinitive and Gerunds – Word Formation (Noun-Verb-Adj-Adv), Adverbs.	[9]
Problem Solving* **Listening:** Listening to / Watching Movie Scenes/ Documentaries Depicting a Technical Problem and Suggesting Solutions. **Speaking:** Group Discussion (based on Case Studies) – Techniques and Strategies. **Reading:** Case Studies, Excerpts from Literary Texts, News Reports etc. **Writing:** Letter to the Editor, Checklists, Problem Solution Essay / Argumentative Essay **Language Focus:** Error Correction; If Conditional Sentences - Compound Words, Sentence Completion.	[9]
Reporting of Events and Research* **Listening:** Listening Comprehension Based on New Report and Documentaries – **Speaking:** Interviewing, Presenting Oral Reports, Mini Presentations on Select Topics. **Reading:** Newspaper Articles. **Writing:** Recommendations, Transcoding, Accident Report, Precis writing and Summarising, and Plagiarism **Language Focus:** Reported Speech – Modals - Conjunctions- use of Prepositions	[9]
The Ability to put Ideas or Information Coherently* **Listening:** Listening to TED Talks, Presentations, Formal job interviews, (Analysis of the Interview Performance). **Speaking:** Participating in Role Plays, Virtual Interviews, Making Presentations with Visual Aids **Reading:** Excerpts of Interview with Professionals **Writing:** Job / Internship Application – Cover letter & Résumé **Language Focus:** Numerical Adjectives, Question Types: Wh/ Yes or No/ and Tags; Relative Clauses - Idioms.	[9]
Total Hours:	**45**

Text Book(s):

1.	"English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2.	Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020.

Reference(s):

1.	Raman. Meenakshi, Sharma. Sangeeta, "Professional English", Oxford university press, New Delhi, 2019.

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2.	Arthur Brookes and Peter Grundy, "Beginning to Write: Writing Activities for Elementary and Intermediate Learners", Cambridge University Press, New York, 2003.
3.	Prof. R.C. Sharma & Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill & Co. Ltd., New Delhi, 2001.
4.	Arora.V.N and Laxmi Chandra, "Improve Your Writing", Oxford University Press, New Delhi, 2001.

* SDG 4 - Quality Education

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Making Comparisons**	
1.1	Evaluative Listening	1
1.2	Product Descriptions and Filling a Graphic Organiser	1
1.3	Marketing a Product by using Persuasive Techniques	2
1.4	Reading Advertisements, User Manuals and Brochures	1
1.5	Writing Professional Emails	1
1.6	Compare and Contrast Essay	1
1.7	Mixed Tenses and Prepositional Phrases	1
1.8	Same Words used in Different Contexts	1
2	**Expressing Causal Relations in Speaking and Writing**	
2.1	Listening to Longer Technical Talks	1
2.2	Listening to Process/Event Descriptions	1
2.3	Describing and Discussing the Reasons of Accidents or Disasters	1
2.4	Reading Longer Technical Texts – Cause and Effect Essays	1
2.5	Writing Responses to Complaints	1
2.6	Active Passive Voice Transformations	2
2.7	Infinitive and Gerunds	1
2.8	Word Formation (Noun-Verb-Adj-Adv), Adverbs.	1
3	**Problem Solving**	
3.1	Listening to Documentaries and Suggesting Solutions	1
3.2	Group Discussion (based on case studies)	2
3.3	Reading Case Studies, Excerpts from Literary Texts and News Reports	1
3.4	Letter to the Editor	1
3.5	Checklists	1
3.6	Problem Solution and Argumentative Essays	1
3.7	Error Correction and Sentence Completion	1
3.8	If Conditional Sentences	1
4	**Reporting of Events and Research**	
4.1	Listening Comprehension	1
4.2	Interviewing and Presenting Oral Reports	1
4.3	Mini Presentations on Select Topics	1
4.4	Reading Newspaper Articles	
4.5	Recommendations	1
4.6	Transcoding	1
4.7	Precis Writing, Summarising and Plagiarism	1
4.8	Reported Speech, Modals	1
4.9	Conjunctions	1
5	**The Ability to put Ideas or Information Coherently**	

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5.1	Listening to Formal Job Interviews	1
5.2	Role Plays	2
5.3	Virtual Interviews	1
5.4	Reading Company Profiles	1
5.5	Writing Statement of Purpose (SoPs)	1
5.6	Writing Résumé	1
5.7	Numerical Adjectives and Relative Clauses - Idioms	1
5.8	Question types: Wh/ Yes or No/ and Tags	1

Course Designer(s)

1. Dr.A.Palaniappan - palaniappan@ksrct.ac.in

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60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To acquire the knowledge about multiple integrals.
- To familiarize the basic concepts of vector calculus.
- To get exposed to the fundamentals of analytic functions.
- To solve various types of partial differential equations.
- To familiarize the concepts of Laplace transform.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Interpret the basic concepts of double and triple integrals.	Apply
CO2	Interpret the basic concepts of vector calculus.	Apply
CO3	Construct the Analytic functions and evaluate the complex integrals.	Apply
CO4	Compute the solutions of partial differential equations using different methods.	Apply
CO5	Apply Laplace transform techniques for solving differential equations.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	10	10
Understand	10	10	20	20
Apply	40	40	70	70
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022								
Common to Mech, ECE, EE, EEE, CSE, MCT, CIVIL, IT, TXT, BT, FT								
60 MA 003 – Integrals, Partial Differential Equations and Laplace Transform								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	3	1	0	60	4	40	60	100

Content	Hours
Multiple Integrals Double integration – Cartesian and Polar Co-ordinates – Change of Order of Integration – Area as Double Integral – Triple Integration in Cartesian Co-ordinates – Change of Variables - Cartesian to Polar Co-ordinates and Cartesian to Cylindrical Co-ordinates. **Hands - on:** Evaluating double integrals, triple integrals, area as double integrals and volume as triple integrals	[9]
Vector Calculus* Introduction - Gradient of a Scalar Point Function –Directional Derivative – Angle of Intersection of Two Surfaces – Divergence and Curl (excluding vector identities) – Solenoidal and irrotational Vectors – Application: Green's Theorem in the Plane – Gauss Divergence Theorem -Stokes' Theorem (statement only). **Hands – on:** Evaluating gradient, divergence and curls.	[9]
Analytic Functions and Integrals Analytic Function – Necessary and Sufficient Conditions (statement only)-Properties – Harmonic Function – Construction of an Analytic Function – Cauchy's Integral Theorem (statement only) – Cauchy's Integral Formula – Classification of Singularities – Application: Cauchy's Residue Theorem. **Hands - on:** Plotting and visualizing functions of single variable, two and three variables.	[9]
Partial Differential Equations* Formation of Partial Differential Equations by Eliminating Arbitrary Constants and Arbitrary Functions – Non- Linear Partial Differential Equations of First Order – Lagrange's Linear Equations – Application: Homogeneous Linear Partial Differential Equations with Constant Coefficients. **Hands - on:** Calculate homogeneous linear partial differential equations.	[9]
Laplace Transform Conditions for Existence – Transforms of Elementary Functions – Basic Properties – Derivatives and Integrals of Transforms – Initial and Final Value Theorem – Transform of Periodic Functions. Inverse Laplace Transform – Convolution Theorem (excluding proof) – Application: Solution of Second Order Ordinary Differential Equations with Constant Co-efficients. **Hands – on:** Evaluating Laplace, inverse Laplace Transforms and solve differential equations	[9]
Total Hours (Lecture - 45; Hands-on - 05; Tutorial - 10):	**60**

Text Book(s):

1.	Grewal B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017.
2.	Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Limited,New Delhi, 2016.

Reference(s):

1.	Dass H.K, "Higher Engineering Mathematics", 3rd (Revised) Edition, S.Chand& Company Ltd, New Delhi, 2014.
2.	Veerarajan T, "Engineering Mathematics", for Semesters I & II, 1st Edition, Tata McGraw Hill Publishing Co., New Delhi, 2019.
3.	Kandasamy P, Thilagavathy K and Gunavathy K, "Engineering Mathematics - I", S.Chand& Company Ltd, New Delhi, 2017
4.	Bali N P and Manish Goyal, A text book of Engineering Mathematics",10th Edition, Laxmi Publications(P) Ltd, 2016.

* SDG 4 – Quality Education

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Course Contents and Lecture Schedule		
S.No	**Topic**	**No. of Hours**
1	**Multiple Integrals**	
1.1	Double Integration	1
1.2	Cartesian and Polar Coordinates	1
1.3	Change of Order of Integration	1
1.4	Area as Double Integral	1
1.5	Triple Integration in Cartesian Coordinates	1
1.6	Change of Variables	2
1.7	Cartesian to Polar Coordinates	1
1.8	Cartesian to Cylindrical Coordinates	1
1.9	Tutorial	2
1.10	Hands-on	1
2	**Vector Calculus**	
2.1	Introduction: Gradient of a Scalar Point Function	1
2.2	Directional Derivative	1
2.3	Angle of Intersection of Two Surfaces	1
2.4	Divergence and Curl (Excluding Vector Identities)	1
2.5	Solenoidal and Irrotational Vectors	1
2.6	Application: Green's Theorem in The Plane	1
2.7	Gauss Divergence Theorem	2
2.8	Stokes' Theorem (Statement Only)	1
2.9	Tutorial	2
2.10	Hands-on	1
3	**Analytic Functions and Integrals**	
3.1	Analytic Function	1
3.2	Necessary and Sufficient Conditions (Statement Only)	1
3.3	Properties	1
3.4	Harmonic Function	1
3.5	Construction of an Analytic Function	1
3.6	Cauchy's Integral Theorem (Statement Only), Cauchy's Integral Formula	2
3.7	Classification of Singularities	1
3.8	Applications: Cauchy's Residue Theorem.	1
3.9	Tutorial	2
3.10	Hands-on	1
4	**Partial Differential Equations**	
4.1	Formation of Partial Differential Equations by Eliminating Arbitrary Constants	1
4.2	Formation of Partial Differential Equations by Eliminating Arbitrary Functions	2
4.3	Non- Linear Partial Differential Equations of First Order	3
4.4	Lagrange's Linear Equations	1
4.5	Application: Homogeneous Linear Partial Differential Equations with Constant Coefficients.	2
4.6	Tutorial	2
4.7	Hands-on	1
5	**Laplace Transform**	
5.1	Conditions for existence	1
5.2	Transforms of Elementary Functions	1
5.3	Basic Properties	1

5.5	Derivatives and Integrals of Transforms, Initial and Final Value Theorem	1
5.6	Transform of Periodic Functions	1
5.7	Inverse Laplace Transform	1
5.8	Convolution Theorem (Excluding Proof)	1
5.9	Application: Solution of Second Order Ordinary Differential Equation with Constant Co-Efficient.	2
5.10	Tutorial	2
5.11	Hands-on	1

Course Designer(s)

1. Dr. C. Chandran – cchandran@ksrct.ac.in
2. Dr. K. Prabakaran – prabakaran@ksrct.ac.in

60 CH 003	Chemistry for Electronic Engineering (Common to EEE, ECE & EE)	Category	L	T	P	Credit
		BS	3	0	0	3

Objectives

- To help the learners to analyse the hardness of water and its removal
- To study the concepts of electrochemistry and its applications
- To study the types of batteries and fuel cells.
- To explain the characteristics and application of chemical sensors
- To study the working principles of smart materials and its applications

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Identify the types of hardness of water and its removal.	Apply
CO2	Interpret the applications of electro chemistry.	Understand
CO3	Illustrate the significance of the types of batteries and fuel cells.	Understand
CO4	Categorize the types of sensors for various applications.	Apply
CO5	Identify the properties, principles, and applications of various smart materials in modern technologies.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	20	20	20	20
Understand	30	40	60	60
Apply	10	-	20	20
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022								
Common to EEE, ECE & EE								
60 CH 003 – Chemistry for Electronic Engineering								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	3	0	0	45	3	40	60	100

Water Technology* Introduction – Commercial and Industrial uses of Water – Hardness – Types – Estimation of Hardness by EDTA Method – Internal Conditioning (Colloidal, Phosphate, Calgon and Carbonate Conditioning Methods) – External Conditioning (Zeolite Process, Demineralization Process) – Desalination Methods (Reverse Osmosis and Electro dialysis). Flash Evaporation	[9]
Electrochemistry** Electrode Potential – Nernst Equation – Derivation and Problems – Reversible and Irreversible cells – Types of Electrodes and its Applications – Reference Electrodes – pH, Conductometric and Potentiometric Titrations – Principles of Electro Plating and Electro Less Plating – Fabrication process of Printed Circuit Board.	[9]
Energy Storage Devices ** ,* &** **** Batteries –Types of Batteries. Fabrication and Working of Alkaline Battery – Lead-Acid Battery-Ni-Cd-Lithium-Ion Batteries – Fuel Cells: Hydrogen-Oxygen Fuel Cell – Microbial Fuel Cell (MFC). Organic Solar Cells – Working Principle and Applications Organic Transistors – Construction - Working Principle and Applications in Electronic Industries.	[9]
Chemical Sensors*** Sensors – Chemical Sensors – Characteristics – Elements and Characterization - Potentiometric Sensors – Amperometric Sensors – Sensors Based on Electrochemical Methods – Electrochemical Biosensors – Optical Biosensors: Enzyme Sensors – Bio Affinity Sensors – DNA Sensors. Chemical Sensors as Detectors and Indicators: Indicators for Titration Processes – Separation Methods. Nano technology in Chemical Sensors.	[9]
Electronic Materials *** Liquid Crystal Polymers – Organic Light Emitting Diode (OLED) - [Polythiopene] - Working and Applications – Conductive Polymers and Semi Conducting Polymers: Principle and Applications- Organic: Organic Dielectric Material [Polystyrene, PMMA]. Smart Screen Materials: Inorganic Rare Earth Metals [Yttrium, Lanthanum, Cerium] - Conductive Components: Indium Tin Oxide [Properties and Applications] - Touch Screen [Resistive and Capacitive] - Magnetic Storage [Iron Oxide, Cobalt Alloy] – Optical Storage [Photo Chromic Materials] - Solid Storage.	[9]
Total Hours:	**45**

Text Book(s):	
1.	O.G. Palanna, “Engineering Chemistry”, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2017.
2.	Jain. P.C. and Monica Jain, “Engineering Chemistry”, 14^{th} Edition, Dhanpatrai publishing co. New Delhi, 2015.
Reference(s):	
1.	Pletcher D and Walsh F C, “Industrial Electrochemistry”, 2^{nd} Edition, Chapman and Hall, New York, 1990.
2.	O.V. Roussak and H.D. Gesser, “Applied Chemistry-A Text Book for Engineers and Technologists”, 2^{nd} Edition, Springer Science Business Media, New York, 2013.
3.	Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, 2^{nd} Edition, Cambridge University Press, Delhi, 2019.
4.	Hagen Klauk, “Organic Electronics: Materials, Manufacturing and Applications”, Wiley-VCH, 2006.

* SDG 6 - Improve Clean Water and Sanitation
**SDG 7 - Affordable and clean energy
***SDG 9 - Industry, innovation and infrastructure
****SDG 12 - Responsible consumption and production

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Water Technology**	
1.1	Introduction – Commercial and Industrial uses of water	1
1.2	Hardness - types	1
1.3	Estimation of Hardness of water by EDTA method	1
1.4	Internal conditioning (Colloidal, Phosphate, Calgon and Carbonate)	1
1.5	External conditioning (Zeolite process)	1
1.6	Demineralization process	1
1.7	Desalination methods - Reverse Osmosis	1
1.8	and Electro dialysis	1
1.9	Flash Evaporation	1
2.0	**Electrochemistry**	
2.1	Electrode Potential - Nernst Equation - Derivation and Problems	2
2.2	Reversible and Irreversible Cells	1
2.3	Types of Electrodes and its Applications	1
2.4	Reference Electrodes - pH	1
2.5	Conductometric and Potentiometric Titrations	1
2.6	Principles of Electro Plating and Electro Less Plating-	2
2.7	Fabrication Process of Printed Circuit Board.	1
3.0	**Energy Storage Devices**	
3.1	Batteries - Types of Batteries.	2
3.2	Fabrication and Working of Alkaline Battery	1
3.3	Lead-Acid Battery	1
3.4	Ni-Cd-Lithium Ion Batteries	1
3.5	Fuel Cells: Hydrogen-Oxygen fuel cell	1
3.6	Microbial fuel cell (MFC).	1
3.7	Organic Solar Cells-Working Principle and Applications Organic Transistors	1
3.8	Construction-Working Principle and Applications in Electronic Industries.	1
4.0	**Chemical Sensors**	
4.1	Sensors – Chemical Sensors - Characteristics	1
4.2	Elements and Characterization	1
4.3	Potentiometric Sensors, Amperometric Sensors	1
4.4	Sensors Based on Electrochemical Methods	1
4.5	Electrochemical Biosensors	1
4.6	Optical Biosensors: Enzyme Sensors – Bio affinity Sensors	1
4.7	DNA Sensors. Chemical Sensors as Detectors and Indicators	1
4.8	Indicators for Titration Processes	1
4.9	Separation Methods. Nano technology in Chemical Sensors.	1
5.0	**Electronic Materials**	
5.1	Liquid Crystal Polymers - Organic Light Emitting Diode (OLED) - [polythiopene] - Working and Applications	2
5.2	Conductive Polymers and Semi Conducting Polymers: Principle and Applications	2
5.3	Organic: Organic Dielectric Material [Polystyrene, PMMA].	1
5.4	Smart Screen Materials: Inorganic Rare Earth Metals [Yttrium, Lanthanum, Cerium]	1
5.5	Conductive Components: Indium tin Oxide [properties and applications] - Touch Screen [resistive and capacitive]	1

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5.6	Magnetic Storage [Iron oxide, Cobalt alloy]	1
5.7	Optical Storage [photo chromic materials] - Solid Storage.	1

Course Designer(s)

1. Dr.T.A.Sukantha - sukantha@ksrct.ac.in
2. Dr.B.Srividhya - srividhya@ksrct.ac.in
3. Dr.S.Meenachi - meenachi@ksrct.ac.in
4. Ms.D.Kirthiga - kiruthiga@ksrct.ac.in

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60 ME 005	Foundation of Mechanical Engineering	Category	L	T	P	Credit
		ES	3	0	0	3

Objectives

- To learn a process for analysis of static objects, concepts of force and motion of particles.
- To acquire knowledge on thermodynamics process, laws and entropy.
- To impart the concept of heat transfer mechanism through simple and composite geometries
- To learn the concept of refrigeration & Air-conditioning with its application.
- To identify the different sources of energy and to know the working principle of power plants

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Apply basic knowledge on static and dynamic systems.	Apply
CO2	Explain thermodynamic systems, properties and laws of thermodynamics.	Apply
CO3	Apply the principles of basic modes of heat transfer in solving heat transfer problems.	Apply
CO4	Identify the types of refrigeration and air-conditioning systems and explain its working principles.	Understand
CO5	Classify sources of energy and demonstrate method of power generation.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	-	-	-	2	-	-	-	-	3	3	-
CO2	3	3	-	-	-	-	-	2	-	-	-	-	3	3	-
CO3	3	3	-	-	-	-	-	2	-	-	-	-	3	3	-
CO4	3	3	-	-	-	-	-	2	3	3	-	-	3	3	-
CO5	3	3	-	-	-	-	-	2	3	3	-	-	3	3	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	40	40	60	60
Apply	10	10	20	20
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022								
Common to ECE and EE								
60 ME 005 – Foundation of Mechanical Engineering								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	3	0	0	45	3	40	60	100

Basics of Statics and Dynamics of Particles Introduction – Units and Dimensions-Laws of Mechanics – Principle of Transmissibility-Lame's Theorem, Parallelogram and Triangular Law of Forces. Displacement, Velocity, Acceleration and their Relationship – Relative Motion.	[9]
Thermodynamics – Laws and Entropy Basic concepts – Thermodynamic Systems – Laws of Thermodynamics: Zeroth law of Thermodynamics, First law of thermodynamics – Second law of Thermodynamics – Cyclic heat engine, heat pump, Carnot cycle - Entropy.	[9]
Heat Transfer Introduction – Modes of Heat Transfer: Conduction, Convection and Radiation – Laws of Conduction – Types of Convection – Laws of Radiation – Radiation Shields – Fourier Law of Heat Conduction in Simple and Composite Wall Geometrics, Types of Boundary and Initial Conditions – Fins: Types – Fin Efficiency.	[9]
Refrigeration and Air-Conditioning** Introduction – Terminology of Refrigeration and Air Conditioning Systems – Working Principle of Vapour Compression and Absorption System – Layout of Typical Domestic Refrigerator. Window, Split and Central Air Conditioners.	[9]
Sources of Energy* and Power Plants*** Introduction – Energy- Classification of Energy Sources – Conventional Energy Sources: Working Principle of Thermal, Gas, Diesel, Hydro-Electric and Nuclear Power Plants. Non – Conventional Energy Sources: Working Principle of Solar, Wind, Tidal and Geothermal Power Plants.	[9]
Total Hours:	**45**

Text Book(s):

1.	Pravin Kumar, "Basic Mechanical Engineering", 2nd Edition, Pearson India Education Services Pvt. Ltd, Chennai, 2018.
2.	Rajasekaran, S., Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", 3rd Edition Vikas Publishing House Pvt. Ltd., 2017.

Reference(s):

1.	YunusA.Cengel, ''Heat Transfer: A Practical Approach'', 2nd Edition, Mc graw-Hill, 2002.
2.	Arora.C.P., ''Refrigeration and Airconditioning'', 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2008.
3.	Arora, S. C., Domkundwar.S., ''A Course in Power Plant Engineering'', Dhanpatrai& Co., New Delhi, 2014.
4.	Jayakumar, V. and Kumar, M, ''Engineering Mechanics'', PHI Learning Private Ltd, New Delhi, 2012.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 3 – Good Health and Well Being
***SDG 12 – Responsible Consumption and Production

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Basics of Statics and Dynamics of Particles**	
1.1	Introduction -Units and Dimensions	1
1.2	Laws of Mechanics–Principle of Transmissibility	1
1.3	Lame ‘s Theorem	1
1.4	Parallelogram Law of forces	1
1.5	Triangular Law of forces	1
1.6	Displacement, Velocity, Acceleration and their Relationship	2
1.7	Relative Motion	2
2.0	**Thermodynamics – Laws and Entropy**	
2.1	Basic Concepts – Thermodynamic Systems	2
2.2	Laws of Thermodynamics: Zeroth Law of Thermodynamics, First Law of Thermodynamics	2
2.3	Laws of Thermodynamics: Second law of Thermodynamics	1
2.4	Cyclic Heat Engine and Heat Pump	2
2.5	Carnot Cycle and Entropy	2
3.0	**Heat Transfer**	
3.1	Introduction to Heat Transfer	1
3.2	Modes of Heat Transfer: Conduction, Convection and Radiation	1
3.3	Laws of Conduction - Types of Convection– Laws of Radiation	1
3.4	Radiation Shields	1
3.5	Fourier Law of Heat Conduction in Simple Wall	1
3.6	Fourier Law of Heat Conduction in Composite Wall	1
3.7	Types of Boundary and Initial Conditions	1
3.8	Fins: Types and Efficiency	2
4.0	**Refrigeration and Air-Conditioning**	
4.1	Introduction to Refrigeration and Air-Conditioning and its Terminology	2
4.2	Working Principle of Vapour Compression	1
4.3	Working Principle of Absorption System	1
4.4	Layout of typical Domestic Refrigerator	2
4.5	Window and Split air Conditioners.	2
4.6	Central Air Conditioners	1
5.0	**Sources of Energy and Power Plants**	
5.1	Introduction to Energy Resources and Classification	1
5.2	Working Principle of Thermal and Gas Power Plants	2
5.3	Working Principle of Diesel and Hydro-Electric Power Plants	2
5.4	Nuclear Power Plants	1
5.5	Working Principle of Solar and Wind Power Plants	2
5.6	Tidal and Geothermal Power Plants.	1

Course Designer(s)

1. Dr.A.Murugesan – murugesana@ksrct.ac.in
2. Mr.M.Gnanaseakran – gnanasekaran@ksrct.ac.in

60 EC 201	Electronic Devices Common to ECE and EE	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To understand the physics of junction diodes and to learn to implement them in various applications
- To learn different configurations of BJT and FET and applications of MOSFET
- To identify the use of various transducers and sensors.
- To study the construction and operation of various opto devices
- To familiarize the operation of power devices and convertors

Pre-requisites

- Physics for Electrical Engineering

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Construct circuits with diodes for various applications	Apply
CO2	Discuss the operation of transistors and their configurations	Understand
CO3	Identify the type of transducers and sensors used for various application	Understand
CO4	Explain the operation of various opto devices	Understand
CO5	Discuss the operation of power electronics devices and convertors and their applications	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO2	3	3	-	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	2	-	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	2	-	-	-	-	-	3	3	3	-	-	3	2	3
CO5	3	3	-	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	50	50
Understand	40	50	40	40
Apply	10	-	10	10
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022

Common to ECE and EE

60 EC 201 – Electronic Devices

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Diodes* PN junction Diode – Current Voltage Characteristics and Analysis, Diode Logic Gates, Modelling the Diode Forward Characteristics – Graphical Analysis, Small Signal model, Zener Diode, Varactor Diode and Diode applications. **Hands - on:** 1. Simulation of VI characteristics of PN junction diode	[9]
Transistors* Construction and Operation of a Transistor, Input and Output Characteristics of a Transistor in CE Configuration, Operation of CB and CC Configurations, Construction and Characteristics of n Channel JFET, Basic MOSFET Operation, Characteristics of Depletion type MOSFET and Enhancement type MOSFET and **MOSFET applications.**** **Hands - on:** 1. Simulation of input- output characteristics of BJT 2. Simulation of I-V characteristics of MOSFET	[9]
Transducers and Sensors* Classification of Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Noise introduced by transducers and their reduction. smart sensors, fiber optic sensors, MEMS, Ultrasonic Sensors and their typical applications	[9]
Opto Devices* Introduction, Photo Emitters, **LASER, LED, Photoconductive Cell, Opto Coupler, Solid State Relays (light operated relay) and Optical Fibre***.**	[9]
Power Devices and Convertors* Construction and Operation of Switching Devices – **SCR, MOSFET and IGBT**** – Static characteristics of SCR – Switching Mode Regulators: **Buck regulator, Boost regulator, Buck-Boost Regulators, Chopper*****	[9]
Total Hours:	**45**

Text Book(s):

1.	Anil K. Maini, Varsha Agrawal, ‘‘Electronics Devices and Circuits’’, 2nd Edition, Wiley India Pvt.Ltd, 2019.
2.	Patranabis. D, “Sensors and Transducers”, Prentice Hall of India, 1999.
3.	Mohammad H Rashid, “Power Electronics, Circuits, Devices and Applications”, 3rd /4th Edition, Pearson Education Inc, 2014, ISBN: 978-93-325-1844-5.

Reference(s):

1.	Robert L. Boylestad, Louis Nashelsky, ‘‘Electronic Devices and circuit theory’’,11th Edition, Pearson Education, 2017.
2.	Singh M.D and Khanchandani K.B, “Power Electronics”, 2nd Edition, Tata Mc-Graw Hill, 2009.
3.	Umanand L, “Power Electronics, Essentials and Applications”, John Wiley India Pvt. Ltd, 2009.
4.	Dr. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, Delhi, 2012.

*SDG 4 - Quality Education

**SDG 8 - Decent work and economic growth

***SDG 9 - Industry innovation and Infrastructure

Assignment activity:

Assignment 1 Covers Module 1 & 2:

1. Problems on PN junction diode, Relation between α &β of the BJT, parameters of JFET.
2. Simulation on diode logic gates and diode applications like two way clipper, voltage tripler, Zener diode as voltage regulator using Multisim.

Assignment 2 Covers Module 3,4 & 5:

1. Problems on Resistive, Capacitive, Inductive and Hall Effect transducers, LED and optical fibre.
2. Simulate MOSFET model and describe the switching application of MOSFET with its IV characteristics using Simulink.

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Course Contents and Lecture Schedule		
S.No	**Topic**	**No. of Hours**
1	**Diodes**	
1.1	PN Junction Diode	1
1.2	Current Voltage Characteristics and Analysis	1
1.3	Diode Logic Gates	1
1.4	Modelling the Diode Forward Characteristics	1
1.5	Graphical Analysis, Small Signal Model	1
1.6	Zener Diode	1
1.7	Varactor Diode	1
1.8	Diode Applications	2
2	**Transistors**	
2.1	Construction and Operation of a Transistor	1
2.2	Input and Output Characteristics of a Transistor in CE Configuration	1
2.3	Operation of CB and CC Configurations	1
2.4	Construction and Characteristics of n Channel JFET	1
2.5	Basic MOSFET Operation	1
2.6	Characteristics of Depletion type MOSFET	1
2.7	Characteristics of Enhancement type MOSFET	1
2.8	MOSFET applications	2
3	**Transducers and Sensors**	
3.1	Classification of Transducers	1
3.2	Transducers Actuating Mechanisms	1
3.3	Resistance Transducers, Variable Inductance Transducers	1
3.4	Capacitive Transducers, Piezoelectric Transducers	1
3.5	Hall Effect Transducers	1
3.6	Noise Introduced by Transducers and their Reduction	1
3.7	Smart Sensors, Fiber Optic Sensors, MEMS	1
3.8	Ultrasonic Sensors	1
3.9	Applications	1
4	**Optodevices**	
4.1	Introduction	1
4.2	Photo Emitters	1
4.3	LASER.	1
4.4	LED	1
4.5	Photoconductive Cell	1
4.6	Opto Coupler	1
4.7	Solid State Relays (light operated relay)	1
4.8	Optical Fibre	2
5	**Power Devices and Convertors**	
5.1	Construction and Operation of Switching Devices - SCR	2
5.2	MOSFET.	1
5.3	IGBT	1
5.5	Static Characteristics of SCR	1

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5.6	Switching Mode Regulators: Buck Regulator	1
5.7	Boost Regulator	1
5.8	Buck-Boost Regulators	1
5.9	Chopper	1

Course Designer(s)

1. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in
2. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in

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60 GE 001	Heritage of Tamils (Common to all Branches)	Category	L	T	P	Credit
		GE	1	0	0	1

Objectives

- To learn the extensive literature of classical Tamil.
- To review the fine arts heritage of Tamil culture.
- To realize the contribution of Tamils in Indian freedom struggle.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Recognize the extensive literature of Tamil and its classical nature.	Understand
CO2	Apprehend the heritage of sculpture, painting and musical instruments of ancient people.	Understand
CO3	Review on folk and martial arts of Tamil people.	Understand
CO4	Insight thinai concepts, trade and victory of Chozha dynasty.	Understand
CO5	Realize the contribution of Tamil in Indian freedom struggle, self-esteem movement and siddha medicine.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	3	2	-	-	1	-	-	3
CO2	-	-	-	-	-	1	1	1	-	-	-	3	-	-	3
CO3	-	-	-	-	-	2	-	3	3	2	-	2	-	-	3
CO4	2	-	-	-	-	1	1	2	1	2	-	1	-	-	3
CO5	-	-	-	-	-	-	-	3	2	2	-	2	-	-	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Model Examination (Marks)	End Semester Examination (Marks)
Remember	40	No End Semester Examination
Understand	60	
Apply	-	
Analyze	-	
Evaluate	-	
Create	-	
Total	100	

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Common to all Branches

60 GE 001 – Heritage of Tamils

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	1	0	0	15	1	100	-	100

Language and Literature* Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.	[3]
Heritage - Rock Art Paintings to Modern Art – Sculpture* Hero Stone to Modern Sculpture – Bronze Icons – Tribes and their Handicrafts – Art of Temple Car Making – Massive Terracotta Sculptures, Village Deities, Thiruvalluvar Statue at Kanyakumari, Making of Musical Instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.	[3]
Folk and Martial Arts* Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger Dance - Sports and Games of Tamils.	[3]
Thinai Concept of Tamils* Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.	[3]
Contribution of Tamils to Indian National Movement and Indian Culture* Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.	[3]
Total Hours:	**15**

Text Book(s):

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் கே. கே . பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு).
4.	பொருநை - ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு).
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - "Sangam City Civilization on the banks of river Vaigai" (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

* *SDG 4 - Quality Education

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60 GE 001	தமிழர் மரபு (அனைத்து துறைகளுக்கும் பொதுவானது)	Category	L	T	P	Credit
		GE	1	0	0	1

பாடத்தின் நோக்கங்கள்:

- தமிழ் மொழியின் இலக்கணச் செறிவைக் கற்றுணர்தல்.
- தமிழர் பண்பாட்டின் நுண்கலைகள் பற்றிய ஒரு மீள்பார்வை.
- தமிழர்களின் நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்து அறிதல்
- தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்களை தெரிதல்.
- இந்திய சுதந்திரப் போராட்டத்தில் தமிழர்களின் பங்களிப்பை உணருதல்

முன்கூட்டிய துறைசார் அறிவு:

- தேவை இல்லை

பாடம் கற்றதின் விளைவுகள்:

பாடத்தை வெற்றிகரமாக கற்று முடித்த பின்பு, மாணவர்களால் முடியும் விளைவுகள்

CO1	தமிழ் மொழியின் செந்தண்மை மற்றும் இலக்கியம் குறித்த தெரிதல்.	புரிதல்
CO2	தமிழர்களின் சிற்பக்கலை, ஓவியக்கலை மற்றும் இசைக்கருவிகள் குறித்த தெளிவு.	புரிதல்
CO3	தமிழர்களின் நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்த தெளிவு.	புரிதல்
CO4	தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்கள்.	புரிதல்
CO5	இந்திய தேசிய இயக்கம், சுயமரியாதையை இயக்கம் மற்றும் சித்த மருத்துவம் பற்றிய புரிதல்.	புரிதல்

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	3	2	-	-	1	-	-	3
CO2	-	-	-	-	-	1	1	1	-	-	-	3	-	-	3
CO3	-	-	-	-	-	2	-	3	3	2	-	2	-	-	3
CO4	2	-	-	-	-	1	1	2	1	2	-	1	-	-	3
CO5	-	-	-	-	-	-	-	3	2	2	-	2	-	-	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Model Examination (Marks)	End Semester Examination (Marks)
Remember	40	No End Semester Examination
Understand	60	
Apply	-	
Analyze	-	
Evaluate	-	
Create	-	
Total	100	

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60 GE 001 – தமிழர் மரபு								
(அனைத்து துறைகளுக்கும் பொதுவானது)								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	1	0	0	15	1	100	-	100

மொழி மற்றும் இலக்கியம்: இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள் - தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.	[3]
மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை–சிற்பக் கலை: நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.	[3]
நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	[3]
தமிழர்களின் திணைக் கோட்பாடுகள்: தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.	[3]
இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.	[3]
Total Hours:	**15**

Text Book(s):

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் கே. கே . பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு).
4.	பொருநை - ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு).
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi, ‘‘Sangam City Civilization on the banks of river Vaigai”, (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

* SDG 4 - Quality Education

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

60 CP 0P2	Engineering Physics and Chemistry Laboratory (CSE, IT, AIML, EEE, ECE, EE)	Category	L	T	P	Credit
		BS	0	0	4	2

Objectives

- To infer the practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To demonstrate an ability to make physical measurements and understand the limits of precision in measurements
- To analyze the behavior and characteristics of various materials for its optimum utilization
- Test the knowledge of theoretical concepts and develop the experimental skills of the learners
- To facilitate data interpretation and expose the learners to various industrial and environmental Applications

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Analyze the properties of semiconducting materials for its potential applications	Apply
CO2	Realize the interference and diffraction phenomena by Air wedge and laser experiments	Apply
CO3	Recognize the magnetic properties by experimental verification	Apply
CO4	Apply different techniques of qualitative and quantitative chemical analysis to generate experimental skills and apply these skills to various analysis	Apply
CO5	Explain and analyze instrumental techniques for chemical analysis	Analyze

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	10	-	10	10
Understand	30	30	30	30
Apply	40	40	40	40
Analyse	20	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
Total	100	100	100	100

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

<table>
<tr><th colspan="9">K.S.Rangasamy College of Technology – Autonomous R2022</th></tr>
<tr><th colspan="9">Common to CSE, IT, EEE, ECE, EE</th></tr>
<tr><th colspan="9">60 CP 0P2 - Engineering Physics and Chemistry Laboratory</th></tr>
<tr><th rowspan="2">Semester</th><th colspan="3">Hours/Week</th><th rowspan="2">Total Hrs</th><th>Credit</th><th colspan="3">Maximum Marks</th></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>II</td><td>0</td><td>0</td><td>4</td><td>60</td><td>2</td><td>60</td><td>40</td><td>100</td></tr>
</table>

List of Experiments(Physics):*

1. Determination of Hall coefficient of a given semiconductor and its charge carrier density
2. V-I Characteristics of Zener diode and Solar cell
3. Air wedge - Determination of thickness of a thin sheet/wire
4. a) Laser- Determination of the wave length of the laser using grating
   b) Optical fibre -Determination of numerical aperture and acceptance angle
5. Magnetic field along the axis of current carrying coil – Stewart and Gee.

* SDG 4- Quality Education

List of Experiments(Chemistry):*

1. Estimation of HCl by pH meter.
2. Estimation of mixture of acids by conductivity meter
3. Determination of ferrous ion by Potentiometric titration.
4. Determination of corrosion by weight loss method.
5. Estimation of ferrous ion by spectrophotometer.

Case studies/Activity report

1. Activity using chemdraw software.
2. Activity report on cheminformatic structure.
3. Case study on ion selective electrodes.
4. Assembling of cell or battery.

* SDG 6 - Improve Clean Water and Sanitation
* SDG 9 - Industry, Innovation, and Infrastructure
* SDG 8 - Decent Work and Economic Growth

Lab Manual	
1.	“Engineering Physics Lab Manual”, Department of Physics, KSRCT.
2.	“Chemistry Lab Manual Volume I & II”, Department of Chemistry, KSRCT.

Course Designer(s) - Physics

1. Dr. V. Vasudevan - vasudevanv@ksrct.ac.in
2. Mr. S. Vanchinathan - vanchinathan@ksrct.ac.in
3. Dr. P. Suthanthira Kumar - suthanthirakumar@ksrct.ac.in

Course Designer(s) - Chemistry

1. Dr.T.A.Sukantha – sukantha@ksrct.ac.in
2. Dr.B.Srividhya - srividyab@ksrct.ac.in
3. Dr.S.Meenachi - meenachi@ksrct.ac.in

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60 EC 2P1	Electronic Devices Laboratory Common to ECE and EE	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To analyse the operation of the circuits with diodes in series and parallel combinations
- To design and implement various circuits using diodes
- To design and implement various circuits using BJT& FET
- To analyse the characteristics of various Optical devices
- To implement the application circuits using Power devices

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Analyse the circuits with diodes in series and parallel	Understand
CO2	Implement the application circuits using diodes	Apply
CO3	Implement the application circuits using BJT& FET	Apply
CO4	Analyse the characteristics of optical devices	Understand
CO5	Implement the application circuits using power devices	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
CO2	3	3	3	3	3	3	-	3	3	3	-	3	3	3	3
CO3	3	3	3	3	3	3	-	3	3	3	-	3	3	3	3
CO4	3	3	-	-	-	-	-	3	3	3	-	3	3	3	3
CO5	3	3	3	3	-	3	-	3	3	3	-	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)	
	Lab	Activity			
Remember	-	-	-	-	-
Understand	25	-	50		50
Apply	25	25	50		50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-
Total	50	25	100	-	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ECE and EE								
60 EC 2P1 - Electronic Devices Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

List of Experiments:

Students have to design application circuits using analog electronic components /MOKU GO Kit/ Multisim software

1. *Diode circuit analysis
2. *Application circuits using Diodes***
3. *Application circuits using BJT & FET
4. *Analyse the characteristics of Optical devices
5. *Application circuits using Power devices**

*SDG 4 – Quality Education

** SDG 8 – Decent work and economic growth

***SDG 9 – Industry innovation and infrastructure

Course Designer(s)

1. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in

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60 CG 0P1	Career Skill Development – I	Category	L	T	P	Credit
		CG	0	0	2	1

Objectives

- To help learners improve their vocabulary and to enable them to use words appropriately in different academic and professional contexts
- To help learners develop strategies that could be adopted while reading texts
- To help learners acquire the ability to speak effectively in English in real life and career related situations
- To equip students with effective speaking and listening skills in English
- To facilitate learners to enhance their writing skills with coherence and appropriate format effectively

Pre-requisites

- Basic knowledge of reading and writing in English.

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Listen and comprehend complex academic texts	Understand
CO2	Read and infer the denotative and connotative meanings of technical texts	Analyze
CO3	Write definitions, descriptions, narrations, and essays on various topics	Apply
CO4	Speak fluently and accurately in formal and informal communicative contexts	Apply
CO5	Appraise the verbal ability skills in the career development and professional contexts	Analyze

Mapping with Programme Outcomes

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	2	3	3	2	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	3	2	3	-	2	-
CO3	-	-	-	-	-	-	-	2	3	3	2	3	-	2	-
CO4	-	-	-	-	-	-	-	2	3	3	2	3	2	-	-
CO5	-	-	-	-	-	-	-	2	3	3	2	3	2	2	3
3 - Strong; 2 - Medium; 1 – Some															

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 CG 0P1 - Career Skill Development - I								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	2	30	1	100	00	100

Listening* Listening For General Information - Specific Details - Audio / Video (Formal & Informal) - Listen to Podcasts/ TED Talks/ Anecdotes / Stories / Event Narration / Documentaries and Interviews with Celebrities - Listen to a Product and Process Descriptions, Advertisements About Products or Services.	[6]
Speaking* Self Introduction; Introducing a Friend; Conversation - Politeness Strategies - Narrating Personal Experiences / Events; Interviewing A Celebrity; Reporting / And Summarizing of Documentaries / Podcasts/ Interviews - Picture Description; Giving Instruction to Use the Product; Presenting A Product - Small Talk; Mini Presentations - Group Discussions, Debates & Role Plays.	[6]
Reading* Loud Reading Vs Silent Reading, Skimming & Scanning of Passages, Reading Brochures (Technical Context), Social Media Messages Relevant to Technical Contexts and Emails - Biographies, Travelogues, Newspaper Reports and Travel & Technical Blogs - Advertisements, Gadget Reviews and User Manuals - Newspaper Articles and Journal Reports - Editorials; and Opinion Blogs	[6]
Writing* Writing Letters - Informal and Formal - Basics and Format Orientation - Paragraph Texting, Short Report on An Event (Field Trip Etc.) - Definitions; Instructions; and Product /Process Description - Note-Making / Note-Taking; Recommendations; Transferring Information from Non-Verbal (Charts, Graphs to Verbal Mode) - Essay Texting	[6]
Verbal Ability I* Reading Comprehension (MCQS) - Cloze Test - Sequencing of Sentences - Summarizing And Paraphrase - Error Detection - Spelling Test - Sentence Improvement - Preposition	[6]
Total Hours:	30

Reference(s):

1.	"English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020
2.	Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020
3.	Michael McCarthy and Felicity O Dell, "English Vocabulary in Use: Upper Intermediate", Cambridge University Press, N.York, 2012
4.	Lakshmi Narayanan, "A Course Book on Technical English", Scitech Publications (India) Pvt. Ltd. 2020.

* SDG 4 - Quality Education

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Listening**	
1.1	Listening for General Information and Specific Details	1
1.2	Listening to Podcasts, Documentaries and Interviews with Celebrities	1
1.3	Narrating Personal Experiences	1
1.4	Reading Relevant to Technical Contexts and Emails	1
1.5	Listen to a Product and Process Descriptions	2
2	**Speaking**	
2.1	Self-Introduction	1
2.2	Summarizing of Documentaries& Picture Narration	1
2.3	Small Talk; Mini Presentations	1
2.4	Group Discussions, Debates & Role Plays.	1
2.5	Group Discussions	2
3	**Reading**	
3.1	Loud Reading Vs Silent Reading, Skimming & Scanning of Passages	1
3.2	Reading Social Media Messages Relevant to Technical Contexts	1
3.3	Reading Newspaper Reports and Travel & Technical Blogs	1
3.4	Reading Advertisements, Gadget Reviews and User Manuals	1
3.5	Reading Newspaper Articles and Journal Reports	2
4	**Writing**	
4.1	Writing Letters – Informal and Formal	1
4.2	Paragraph Texting	1
4.3	Definitions and Instructions	1
4.4	Note-Making / Note-Taking	1
4.5	Essay Texting	2
5	**Verbal Ability**	
5.1	Reading Comprehension (MCQS) and Cloze Test	1
5.2	Sequencing of Sentences	1
5.3	Paraphrasing and Summarizing	1
5.4	Error Detection and Spelling Test	1
5.5	Prepositions	2

Course Designer(s)

1. Dr.A.Palaniappan - palaniappan@ksrct.ac.in

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Approved in Academic Council Meeting held on 07/01/2023

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

THIRD SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 MA 009	Linear Algebra and Numerical Methods	2	40	60	100	45	100
2.	60 CS 002	Data Structures and Algorithms	2	40	60	100	45	100
3.	60 EC 301	Electronic Circuits	2	40	60	100	45	100
4.	60 EC 303	Digital System Design	2	40	60	100	45	100
5.	60 MY 002	Universal Human Values	2	100	-	100	-	100
6.	60 GE 002	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	2	100	-	100	-	100
THEORY CUM PRACTICAL								
7.	60 EC 302	Circuit Analysis	2	50	50	100	45	100
PRACTICAL								
8.	60 EC 3P1	Analog and Digital Electronics Laboratory	3	60	40	100	45	100
9.	60 CS 0P2	Data Structures and Algorithms Laboratory	3	60	40	100	45	100
10.	60 CG 0P2	Career Skill Development – II	2	100	00	100	00	100
11.	60 CG 0P6	Internship	-	100	-	100	-	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

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Department of ECE
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60 MA 009	Linear Algebra and Numerical Methods	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To acquire knowledge about vector spaces.
- To get exposed to the basic concepts of linear transformation
- To know the concepts of interpolation and numerical integration.
- To learn the basics concepts of initial value problems.
- To acquire knowledge of various methods to solve partial differential equations with
- boundary conditions

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Apply the concept of vector spaces.	Apply
CO2	Interpret the concepts of linear transformation	Apply
CO3	Apply different techniques to find the intermediate values and to evaluate single definite integrals.	Apply
CO4	Compute the solution for initial value problems using single and multi-step methods.	Apply
CO5	Apply various methods to solve partial differential equations with boundary conditions.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	10	10
Understand	10	10	20	20
Apply	40	40	70	70
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

Common to ECE & EE

60 MA 009 - Linear Algebra and Numerical Methods

Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	3	1	0	60	4	40	60	100

Vector Space* Vector Space – Subspace – Null Space – Row and Column Space - Linear Combinations – Linear Independence and Linear Dependence – Basis and Dimension. **Hands - on:** Find a basis and dimension for the vector subspace.	[9]
Linear Transformation and Inner Product Spaces* Linear Transformation - Matrix Representation of a Linear Transformation - Inner Product - Norm – Gram-Schmidt Orthogonalization Process. **Hands - on:** Matrix representation of a linear transformation	[9]
Interpolation and Numerical Integration** Lagrange's and Newton's Divided Difference Interpolation (Unequal Intervals) - Newton's Forward and Backward Interpolation (Equal Intervals) - Two Point and Three Point Gaussian Quadrature – Trapezoidal, Simpson's 1/3 and 3/8 Rule (Single Integral). **Hands - on:** Simpson 1/3 method for definite integral	[9]
Numerical Solution of Ordinary Differential Equations** Single Step Methods: Taylor's Series Method - Euler's Method - Modified Euler's Method-Fourth Order Runge-Kutta , Method for Solving First Order Equations - Multi Step Methods: Milne's Predictor and Corrector Method - Adam's Predictor and Corrector Method. **Hands - on:** Runge – Kutta method for solving first order equations.	[9]
Numerical Solution of Partial Differential Equations*** Classifications of Partial Differential Equations of Second Order - Finite Difference Method - Laplace's Equations - Liebmann's Process - Poisson's Equation - Hyperbolic Equation. **Hands - on:** Solution of one dimensional wave equation	[9]
Total Hours: (Lecture - 45; Hands - on - 05; Tutorial - 10)	**60**

Text Book(s):

1.	David C. Lay, "Linear Algebra and its Applications", 6th Edition, Pearson Education, 2022.
2.	B.S.Grewal and Grewal J.S., "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, 2015.

Reference(s):

1.	Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, 2014.
2.	Gilbert Strang, "Linear Algebra and Its Applications", 4th Edition, Brooks/Cole/Cengage, 2006.
3.	Gerald C.F and Wheatley P.O, "Applied Numerical Analysis", 7th Edition, Pearson Education (Asia), 2007.
4.	Kandasamy P, Thilagavathy K and Gunavathi K, "Numerical Methods", 3rd Edition, S.Chand & Company Ltd, 2013.

*SDG 4 - Quality Education
**SDG 9 - Industry, Innovation, and Infrastructure
***SDG 7- Affordable and Clean Energy

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1.0	**Vector Spaces**	
1.1	Vector Space	2
1.2	Subspace	1
1.3	Null Space, Row and Column Space	1
1.4	Linear Combinations	2
1.5	Linear Independence	1
1.6	Linear Dependence	1
1.7	Basis And Dimension.	1
1.8	Tutorial	2
1.9	Hands on	1
2.0	**Linear Transformation and Inner Product Spaces**	
2.1	Linear Transformation	2
2.2	Matrix Representation of A Linear Transformation	1
2.3	Inner Product	1
2.4	Problems	1
2.5	Gram-Schmidt Orthogonalization Process	2
2.6	Problems	2
2.7	Tutorial	2
2.8	Hands on	1
3.0	**Interpolation and Numerical Integration**	
3.1	Lagrange’s Interpolation	1
3.2	Newton’s Divided Difference Methods	1
3.3	Newton’s Forward and Backward Difference Methods.	2
3.4	Two Point and Three Point Gaussian Quadratures	2
3.5	Trapezoidal Rule	1
3.6	Simpson’s1/3 And 3/8 Rules	2
3.7	Tutorial	2
3.8	Hands on	1
4.0	**Numerical Solution of Ordinary Differential Equations**	
4.1	Taylor Series Method	1
4.2	Euler And Modified Euler Methods	1
4.3	Fourth Order Runge – Kutta Method	2
4.4	Milne’s Predictor and Corrector Methods.	2
4.5	Problems	1
4.6	Adam’s Predictor and Corrector Methods.	1
4.7	Problems	1
4.8	Tutorial	2
4.9	Hands on	1
5.0	**Numerical Solution of Partial Differential Equations**	
5.1	Classifications Of Partial Differential Equations of Second Order	1
5.2	Finite Difference Method	1
5.3	Laplace’s Equations	2
5.4	Liebmann’s Process	1
5.5	Poisson’s Equation	2
5.6	Hyperbolic Equation.	1
5.7	Problems	1

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5.8	Tutorial	2
5.9	Hands on	1

Course Designer(s)

1. Mr. D.Senthil Raja -senthilrajad@ksrct.ac.in
2. Mrs. D.Padmavathi -padmavathi@ksrct.ac.in

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60 CS 002	Data Structures and Algorithms	Category	L	T	P	Credit
		ES	3	0	0	3

Objectives

- To study the asymptotic performance of algorithms and choose the appropriate data structure for a specified application
- To design and implement abstract data types such as linked list, stack, queue and trees
- To learn and implement the hashing techniques
- To design a priority queue ADT and its applications
- To demonstrate various sorting, searching and graph algorithms

Pre-requisites

- Nil

Course Outcomes

On the Successful Completion of the Course, Students will be Able to

CO1	Analyse the asymptotic performance of algorithms and apply linear data structures to solve real time applications	Analyse
CO2	Experiment with trees with its operations	Apply
CO3	Apply algorithm for solving problems like sorting, searching	Apply
CO4	Implement priority queue with its operations and hashing techniques	Apply
CO5	Analyse shortest path algorithms, minimum spanning tree algorithms, biconnectivity and algorithmic design paradigms	Analyze

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	2	-	-	2	2	-	-	2	3	2	3
CO2	3	3	2	3	2	-	-	2	3	-	-	2	3	2	3
CO3	3	3	2	2	2	2	-	2	3	2	-	2	3	2	3
CO4	3	3	2	3	2	-	-	3	2	2	-	2	3	2	3
CO5	3	3	2	3	2	2	2	3	3	2	-	2	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	10	10	20	20
Apply	30	40	40	40
Analyse	10	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

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Common to ECE & EE								
60 CS 002 – Data Structures and Algorithms								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Lists, Stacks and Queues Abstraction - Abstract Data Types - Data Representation - Elementary Data Types - Mathematical Preliminaries: Big-Oh Notation - Efficiency of Algorithms - Notion of Time and Space Complexity - Performance Measures for Data Structures - **The List ADT – The Stack ADT – The Queue ADT***.	[9]
Trees Preliminaries – Binary Trees – The Search Tree ADT – Binary Search Trees – AVL Trees – Tree Traversals – B–Trees – B+ Trees.	[9]
Sorting and Searching Preliminaries – Insertion Sort – Shell Sort – Heap Sort – Merge Sort – Quick Sort – External Sorting – Searching: Sequential Search - Binary Search – Hashed List Searches	[9]
Hashing and Priority Queues (Heaps) **Hashing – Hash Function – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing*** – Priority Queues (Heaps) – Model – Simple Implementations – Binary Heap – Applications of Priority Queues – D-Heaps.	[9]
Graphs Definitions – **Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths – Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm, Kruskal's Algorithm – Applications of Depth-First Search*** – Undirected Graphs – Bi-connectivity. Algorithm Design Paradigms - Greedy, Divide and Conquer, Dynamic Programming, Backtracking	[9]
Total Hours:	**45**

Text Book(s):

1.	Weiss M.A, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Asia, 2008.
2.	Langsam Y, Augenstein M.J and Tenenbaum A.M, "Data Structures Using C", Pearson Education Asia, 2009.

Reference(s):

1.	Rajesh K.Sukla, "Data Structure Using C & C++", Wiley India, 2012.
2.	Tannenbaum A, "Data Structure Using C", Pearson Education, 2003.
3.	Goodrich and Tamassia, "Data Structures and Algorithms in C++", 2nd Edition, John Wiley and Sons, 2011.
4.	Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford Higher Education, 2014.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Lists, Stacks and Queues**	
1.1	Abstract Data Type (ADT), Mathematical preliminaries: big-Oh notation	1
1.2	Efficiency of algorithms, Notion of time and space complexity - performance measures for data structures	1
1.3	List ADT	4
1.4	Stack ADT	3
1.5	Queue ADT	3
2	**Trees**	
2.1	Preliminaries	1
2.2	Binary Trees	1
2.3	The Search Tree ADT	1
2.4	Binary Search Trees	1
2.5	AVL Trees	1
2.6	Tree Traversals	1
2.7	B-Trees	2
2.8	B+ Trees	1
3	**Sorting and Searching**	
3.1	Preliminaries, Insertion Sort	1
3.2	Shell Sort, Heap sort	1
3.3	Merge Sort, Quick sort	1
3.4	External Sorting	1
3.5	Sequential Searching	1
3.6	Binary Searching	1
3.7	Hashed List Searches	1
4	**Hashing and Priority Queues (Heaps)**	
4.1	Hashing, Hash Function	1
4.2	Separate Chaining, Open Addressing	1
4.3	Rehashing, Extendible Hashing	1
4.4	Priority Queues (Heaps)	1
4.5	Simple Implementations, Binary Heap	1
4.6	Applications of Priority Queues	1
4.7	d –Heaps	1
5	**Graphs**	
5.1	Graph Definitions - Topological Sort	1
5.2	Shortest-Path Algorithms - Unweighted Shortest Paths	1
5.3	Dijkstra's Algorithm	1
5.4	Minimum Spanning Tree	1
5.5	Prim's Algorithm	1
5.6	Kruskal's Algorithm	1
5.7	Applications of Depth-First Search	1
5.8	Undirected Graphs	1
5.9	Biconnectivity	1
5.10	Algorithm Design Paradigms	1

Course Designer(s)

1. Ms.K.Poongodi - poongodik@ksrct.ac.in

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K.S.Rangasamy College of Technology,
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60 EC 301	Electronic Circuits (Common to ECE & EE)	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To understand the operation of different transistor amplifiers
- To design and analyse the feedback amplifiers and oscillators
- To understand the operation of power amplifiers and differential amplifier
- To acquire the basic knowledge of operational amplifier
- To implement application circuits using op-amp.

Pre-requisites

- Electronic Devices

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the operation of different transistor amplifier circuits	Understand
CO2	Describe and analyse the characteristics of negative feedback amplifiers and oscillators	Apply
CO3	Describe the concepts and characteristics of power amplifiers and design differential amplifier	Apply
CO4	Understand the basic concepts of op-amp	Understand
CO5	Design and analyse the various application of op-amp	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	3	-	-	3	3	3	-	3	3	3	3
CO2	3	3	-	3	3	-	-	3	3	3	-	3	3	3	3
CO3	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
CO4	3	3	-	-	3	-	-	3	3	3	-	3	3	3	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	35	40	60	60
Apply	15	10	20	20
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ECE & EE								
60 EC 301 - Electronic Circuits								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Content	Hours
Transistor Amplifiers* Biasing Schemes for BJT and FET - Overview of Single Stage BJT Amplifiers: Common Emitter, Common Base, Common Collector - Hybrid-pi Model - Miller Effect - Frequency Response of Single Stage MOSFET amplifier - Cascade and Cascode Amplifiers.	[9]
Feedback Amplifiers and Oscillators * Different Topologies: Voltage Series, Voltage Shunt, Current Series and Current Shunt, Effect on Gain and Frequency Response, Stability Considerations and Frequency Compensation - Basic Concept of Oscillators, RC and LC Sinusoidal Oscillators	[9]
Power Amplifier & Differential Amplifier* Different Modes of Operation of Amplifiers and their Power Efficiency: Class A, Class B, Class AB and Class C, **Push-Pull Amplifiers and Applications**.** Differential Amplifier: Basic Structure and Principle of Operation – Calculation of Differential Gain, Common Mode Gain, CMRR and ICMR, Design of Differential Amplifier for a Given Specification.	[9]
Basics of Operational Amplifiers* Ideal Op-amp Characteristics, General Operational Amplifier Stages and Internal Circuit Diagrams of IC 741, DC Characteristics, AC Characteristics, Frequency Response of Op-amp, Slew rate.	[9]
Applications of Operational Amplifiers* Basic Applications of Op-amp – Inverting and Non-inverting Amplifiers, Voltage Follower, Scale changer, Summer, Subtractor, Basic Comparator, **Precision Rectifier, Clipper and Clamper, Peak Detector, V/I & I/V Converters, Switched Capacitor circuits**: Basic Concept, Practical Configurations**, Application in Amplifier****.	[9]
Total Hours:	**45**

Text Book(s):

1.	David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University press, 2018.
2.	Robert L. Boylestad, Louis Nashelsky, “Electronic Devices and circuit theory”, 11th Edition, Pearson Education, 2017.
3.	RoyChoudry D , Shail Jain , ‘Linear integrated Circuits’, 5th Edition, New Age International Pvt Ltd, 2018.

Reference(s):

1.	Anil K. Maini, VarshaAgrawal, “Electronics Devices and Circuits”, 2nd Edition, Wiley India Pvt.Ltd, 2019.
2.	Salivahanan S, Sureshkumar N, “Electronic Devices and circuits”, 4th Edition, McGraw-Hill, 2017.
3.	Ramakant A., Gayakwad, “Op – Amps and Linear Integrated Circuits”, 4th Edition, Prentice Hall, 2017.

*SDG 4 - Quality Education
**SDG 9 - Industry innovation and infrastructure

Assignment 1 – Covers Module 1 & 2

1. Simulation of biasing circuits, common emitter amplifier for the given specifications.
2. Simulation of feedback amplifiers with and without feedback and compare the measured gain.
3. Problems in RC and LC oscillators.

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Assignment 2 – Covers Module 3, 4 & 5

1. Problems in differential amplifier.
2. Comparison of op-amp 741 with another op-amp to analyze the features.
3. Simulation of inverting amplifier, non-inverting amplifier, voltage follower, level shifter and comparator circuit using op-amp.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Transistor Biasing**	
1.1	Introduction To Biasing Schemes for BJT	1
1.2	FET	1
1.3	Overview of Single Stage BJT Amplifiers	1
1.4	Common Emitter Amplifier	1
1.5	Common Base, Common Collector	1
1.6	Hybrid-Pi Model, Miller Effect	1
1.7	Frequency Response of Single Stage MOSFET Amplifier	1
1.8	Cascade Amplifier	1
1.9	Cascode Amplifier	1
2.0	**Feedback Amplifiers and Oscillators**	
2.1	Different Topologies: Voltage Series	1
2.2	Voltage Shunt	1
2.3	Current Series	1
2.4	Current Shunt	1
2.5	Effect on Gain and Frequency Response, Stability Considerations and Frequency Compensation	1
2.6	Basic Concept of Oscillators	1
2.7	RC Oscillators	1
2.8	LC Sinusoidal Oscillators	2
3.0	**Power Amplifier & Differential Amplifier**	
3.1	Different Modes of Operation of Amplifiers	1
3.2	Their Power Efficiency: Class A, Class B,	1
3.3	Class AB And Class C	1
3.4	Push-Pull Amplifiers and Applications	1
3.5	Differential Amplifier: Basic Structure and Principle of Operation	1
3.6	Calculation Of Differential Gain, Common Mode Gain, CMRR And ICMR.	1
3.7	Design Of Differential Amplifier for A Given Specification	1
4.0	**Basics of Operational Amplifiers**	
4.1	Ideal Op-Amp Characteristics	2
4.2	General Operational Amplifier Stages	
4.3	Internal Circuit Diagrams of IC 741	1
4.4	DC Characteristics	1
4.5	AC Characteristics	2
4.6	Frequency Response of Op-Amp	1
4.7	Slew Rate	1
5.0	**Applications of Operational Amplifiers**	
5.1	Basic Applications of Op-Amp – Inverting and Non-Inverting Amplifiers	1
5.2	Voltage Follower, Scale Changer	1
5.3	Summer, Subtractor	1

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5.4	Basic Comparator, Precision Rectifier	
5.5	Clipper And Clamper	1
5.6	Peak Detector	1
5.7	V/I & I/V Converters	1
5.8	Switched Capacitor Circuits: Basic Concept, Practical Configurations	1
5.9	Application In Amplifier	1

Course Designer(s)

1. Dr.K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in

60 EC 302	Circuit Analysis (Common to ECE & EE)	Category	L	T	P	Credit
		PC	2	1	2	4

Objectives

- To learn the basic concepts and behaviour of DC circuits
- To understand the various network theorems and two port network parameters
- To learn the basic concepts and behaviour of AC circuits
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations
- To learn the concept of coupling in circuits and the frequency response of resonant circuits

Pre-requisite:

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Apply the basic laws to analyses the electric circuits using circuit analysis techniques.	Understand
CO2	Apply network theorems and analyse the two-port network behaviour	Apply
CO3	Analyse the steady state response of AC circuits with phasor diagram	Understand
CO4	Apply Laplace Transform for steady state and transient analysis of RC, RL, and RLC networks	Apply
CO5	Analyse the frequency response of electric circuits under resonance and coupled circuits	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	3	-	-	-	3	3	-	2	3	2	3
CO2	3	3	3	-	3	-	-	-	3	3	-	2	3	2	3
CO3	3	3	-	-	2	-	-	-	3	3	-	2	3	2	3
CO4	3	3	3	-	3	-	-	-	3	3	-	2	3	2	3
CO5	3	3	-	3	2	-	-	-	3	3	-	2	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)		End Sem Examination (Marks)	
	Test 1		Test 2					
	Theory	Lab	Theory	Lab	Theory	Lab	Theory	Lab
Remember	10	-	10	-	15	-	15	-
Understand	10	40	10	40	25	40	25	40
Apply	40	60	40	60	60	60	60	60
Analyse	-	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100	100

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Common to ECE & EE								
60 EC 302 - Circuit Analysis								
Semester	Hours / Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	2	1	2	75	4	50	50	100

DC Circuit Analysis* Laws: Ohms Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law, Connections: Sources, Resistors, Inductors and Capacitors in Series and Parallel, Star and Delta Transformations, Voltage, Current Source Conversions. Voltage and Current Division Rules, Nodal Analysis and Mesh Analysis in DC Circuits.	[6]
Network Theorems and Two Port Network* Theorems- Superposition, Thevenin's, Norton's, and Maximum Power Transfer Theorems. Network Parameters - Impedance, Admittance, Transmission and Conversion Formulae.	[6]
Sinusoidal Steady State Analysis * Sinusoidal Steady – State Analysis, Characteristics of Sinusoids, The Phasor, Phasor Relationship For R, L, And C, Impedance and Admittance, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, Apparent Power and Power Factor, Complex Power, Star and Delta Connections.	[6]
Transients* Transient Analysis of RC, RL, And RLC Networks with and without Initial Conditions with Laplace Transforms Evaluation of Initial Conditions for DC & AC Inputs, State Equations for Networks.	[6]
Resonance and Coupled Circuits* Behaviour of Series and Parallel Resonant Circuits, Frequency Response, Quality Factor and Bandwidth. Magnetically Coupled Circuits, Mutual Inductance, Coefficient of Coupling, Dot Rule- Analysis of Coupled Circuits.	[6]
Practical: 1. Measurements of current and voltage and power of a specific branch in a circuit 2. Verification of Mesh and Nodal Analysis 3. AC circuit various power calculation 4. Verification of Theorems – Thevenien, Notrons, Superposition theorem 5. Check the transient response of RL, RC and RLC circuits.	[30]
Total Hours: (Lecture - 30; Practical - 30; Tutorial - 15)	**75**

Text Book(s):

1.	Sudhakar A and Shyam Mohan S, "Circuits & Network Analysis and Synthesis", 4th Edition, McGraw Hill, 2021.
2.	Singh R R, "Network Analysis and Synthesis", 2nd Edition, McGraw Hill Education Pvt Limited, 2021.

Reference(s):

1.	Mahmood Nahvi and Joseph Edminister, "Electric Circuits", 6th Edition, Schaum's Outline series, Tata McGraw-Hill, 2014.
2.	William H Hayt& Jack E Kemmerly, "Engineering Circuit Analysis", 8th Edition, McGraw Hill Education, 2013.
3.	Franklin F. Kuo, "Network Analysis and Synthesis", 5th Edition, Wiley International, 2012.
4.	John D Ryder, "Networks, Lines and Fields", 2nd Edition, Pearson Education, 2015.

*SDG 4 – Quality Education

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**DC Circuit Analysis**	
1.1	Basic Components of Electric Circuits: Charge, Current, Voltage and Power	1
1.2	Voltage and Current Sources. Laws: Ohms Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law,	1
1.3	Voltage and Current Division Rule, Connections: Series and Parallel Connected Sources, Resistors, Inductors and Capacitors	1
1.4	Star and Delta Transformation, Voltage, Current Sources Conversion.	1

1.5	Nodal Analysis	1
1.6	Mesh Analysis	1
1.7	Tutorial	3
2	**Network Theorems and Two Port Network**	
2.1	Superposition Theorem	1
2.2	Thevenin's Theorem, Nortons Theorem	1
2.3	Maximum Power Transfer Theorems.	1
2.4	Impedance Parameter, Admittance Parameter	1
2.5	Transmission Parameter, Hybrid Parameter	1
2.6	Conversion Formula Between Two Port Parameters	1
2.7	Tutorial	3
3	**Sinusoidal Steady State Analysis**	
3.1	Sinusoidal Steady – State Analysis, Characteristics of Sinusoids	1
3.2	The Phasor Relationship For R, L and C	1
3.3	Impedance and Admittance Diagram, Phasor Diagrams	1
3.4	Ac Circuit Power Analysis, Instantaneous Power, Average Power, Apparent Power and Power, Factor, Complex Power	1
3.5	Problems on Various Power	1
3.6	Star and Delta Connection	1
3.7	Tutorial	3
4	**Transients**	
4.1	Transient Analysis of RC Without Initial Conditions	1
4.2	Transient Analysis of RC With Initial Conditions	1
4.3	Transient Analysis of RL Without / With Initial Conditions	1
4.4	Transient Analysis of RLC Networks Without Initial Conditions	1
4.5	Transient Analysis of RLC Networks with Initial Conditions	1
4.6	State Equations for Networks.	1
4.7	Tutorial	3
5	**Resonance and Coupled Circuits**	
5.1	Behaviour of Series Resonant Circuits, Frequency Response, Quality Factor and Bandwidth of Series Resonance	1
5.2	Behaviour of Parallel Resonant Circuits, Frequency Response, Quality Factor and Bandwidth of Parallel Resonance Circuit	1
5.3	Magnetically Coupled Circuits, Mutual Inductance, Coefficient Of Coupling, Dot Rule- Analysis of Coupled Circuits.	1
5.4	Introduction to Filters, Classification	1
5.5	T' Filter Network and Its Equation	1
5.6	'Π' Filter Network and Its Equation	1
5.7	Tutorial	3
Practical:		
1.	Measurements of current and voltage and power of a specific branch in a circuit	6
2.	Verification of Mesh and Nodal Analysis	6
3.	AC circuit various power calculation	6
4.	Verification of Theorems – Thevenien, Notrons, Superposition theorem	6
5.	Check the transient response of RL, RC and RLC circuits.	6

Course Designer(s)

1. Mr S.Jayamani - jayamani@ksrct.ac.in

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

60 EC 303	Digital System Design	Category	L	T	P	Credit
		PC	2	1	0	3

Objectives

- To introduce number systems and codes, basic postulates of Boolean algebra and show the correlation between Boolean expressions.
- To design and analyse combinational circuits
- To study the concept of sequential circuits.
- To introduce the concept of HDL
- Reinforce theory and techniques taught in the classroom through experiments and projects in laboratory

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the fundamentals of numbering system and apply Boolean algebra to design digital systems	Understand
CO2	Design and analyze combinational circuits and semiconductor memories	Apply
CO3	Design and analyze synchronous sequential logic circuits	Apply
CO4	Analyse the asynchronous sequential circuits.	Understand
CO5	Design and verify the digital circuits using HDL.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO4	3	3	-	3	3	-	-	-	-	-	-	-	3	2	-
CO5	2	2	-	-	3	-	-	-	-	-	-	-	3	2	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	20	20	20	20
Apply	30	30	60	60
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ECE & EE								
60 EC 303 - Digital System Design								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	2	1	0	45	3	40	60	100

Digital Fundamentals* Review of Number Systems – Representation-Conversions – Boolean Postulates and Laws – De-Morgan's Theorem – Logic Gates – Minimization of Boolean Expressions – Sum of Products (SoP) – Product of Sums (PoS) – Canonical Forms – Karnaugh Map Minimization – Implementation of Boolean Expressions Using Universal Gates.	[6]
Combinational Circuits* Combinational Logic Circuits – Adders, Subtractors, Decoders, Encoders, Multiplexers, Demultiplexers, Code Convertor, Realization of Boolean Expressions – Using Multiplexers. Memories – ROM Types, RAM Types, PLDs. **Hands - on:** Simulation of Combinational Circuits.	[6]
Sequential Circuits* Flip Flops SR, JK, T, D And Master Slave – Characteristic Table and Equation – Flip Flop Conversion, Application Table – Edge Triggering – Level Triggering – Ripple Counters – Synchronous Counters – Modulo – N Counter – **Design of Synchronous FSM – Analysis of Clocked Sequential Circuits*****: State Equation – State Table – State Diagram – State Reduction & Assignment – Register: Shift Registers – Universal Shift Register– Shift Counters **Hands - on:** Simulation of sequential circuit	[6]
Asynchronous Sequential Circuits Analysis Procedure – Transition Table – Flow Table – Race Conditions – Design of Fundamental Mode Circuits – Primitive Flow Table – Reduction of State and Flow Table – Race Free State Assignment – Hazards – Overview and Comparison of Logic Families.	[6]
Introduction to HDL** **Design Flow of VLSI, Different Modelling Styles in Verilog HDL, Structural, Dataflow and Behavioural Modelling of Combinational and Sequential Logic Circuits****	[6]
Total Hours: (Lecture - 30; Tutorial - 15)	**45**

Text Book(s):

1.	M. Morris Mano, Michael D. Ciletti, "Digital Design", 5th Edition, Pearson Education, New Delhi, 2016.
2.	Samir Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2016.

Reference(s):

1.	Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition, Prentice Hall, 2016.
2.	Donald P.Leach and Albert Paul Malvino, GoutamSaha, "Digital Principles and Applications", 8th Edition, Tata McGraw-Hill, New Delhi, 2016.
3.	Salivahanan S and Arivazhagan S, "Digital Circuits and Design",5th Edition, Oxford University press, 2018.
4.	John F.Wakerly, "Digital Design: principles and practices", 5th Edition, Pearson Education, 2018.

*SDG 4 - Quality Education
**SDG 8 - Decent work and economic growth
***SDG 9 - Industry, innovation and infrastructure

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Digital Fundamentals**	
1.1	Review of Number Systems, Conversions, Boolean postulates and laws	1
1.2	Boolean postulates and laws, De-Morgan’s Theorem, Logic Gates	1
1.3	Minimization of Boolean expressions	1
1.4	Sum of Products (SOP) – Product of Sums (POS)	1
1.5	Canonical forms- Karnaugh map Minimization	1
1.6	Implementation of Boolean expressions using universal gates.	1
1.7	Tutorial	3
2.0	**Combinational Circuits**	
2.1	Combinational Logic Circuits, Adders, Subtractors,	1
2.2	Decoders, Encoders	1
2.3	Multiplexers, Demultiplexers	1
2.4	Code Convertor	1
2.5	Realization of Boolean Expressions-Using Multiplexers	1
2.6	Memories –ROM types, RAM types, PLDs	1
2.7	Tutorial	3
3.0	**Sequential Circuits**	
3.1	Flip flops SR, JK, T, D and Master slave, Characteristic Table and Equation	1
3.2	Flip flop conversion, Application table, Edge triggering – Level Triggering	1
3.3	Ripple counters – Synchronous counters, Modulo – N counter- Design of Synchronous FSM	1
3.4	Analysis of clocked sequential circuits: state equation – State table – State diagram	1
3.5	State reduction & assignment	1
3.6	Register: Shift Registers – Universal Shift Register– Shift counters	1
3.7	Tutorial	3
4.0	**Asynchronous Sequential Circuits**	
4.1	Analysis Procedure, Transition Table – Flow Table, Race Conditions	1
4.2	Design of Fundamental Mode Circuits, Primitive Flow Table	1
4.3	Reduction of State and Flow Table, Race Free State Assignment	2
4.4	Hazards	1
4.5	Overview and Comparison of Logic Families	1
4.6	Tutorial	3
5.0	**Introduction to HDL**	
5.1	Design Flow of VLSI	1
5.2	Different Modelling Styles in Verilog HDL,	2
5.3	Structural, Dataflow and Behavioural Modelling of Combinational and Sequential Logic Circuit	3
5.4	Tutorial	3

Course Designer(s)

1. Dr.S.Malarkhodi – malarkhodi@ksrct.ac.in

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60 MY 002	Universal Human Values	Category	L	T	P	Credit
		MC	3	0	0	3

Objectives

- To identify the essential complementarily between 'values' and 'skills'
- To ensure core aspirations of all human beings.
- To acquire ethical human conduct, trustful and mutually fulfilling human behaviour
- To enrich interaction with Nature
- To achieve holistic perspective towards life and profession

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the significance of value inputs in formal education and start applying them in their life and profession	Understand
CO2	Evaluate coexistence of the "I" with the body	Analyze
CO3	Identify and evaluate the role of harmony in family, society and universal order	Analyze
CO4	Classify and associate the holistic perception of harmony at all levels of existence and Nature	Analyze
CO5	Develop appropriate human conduct and management patterns to create harmony in professional and personal lives.	Create

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	3	2	-	2	3	3	1	1
CO2	-	-	-	-	-	3	-	3	3	-	-	3	3	1	1
CO3	-	-	-	-	-	3	3	3	3	-	-	3	3	1	2
CO4	-	-	-	-	-	3	3	3	3	-	-	3	3	1	2
CO5	-	-	-	-	-	3	3	3	3	3	-	3	3	1	2
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	No End Semester Examination
Understand	10	10	20	
Apply	20	20	30	
Analyse	20	20	30	
Evaluate	-	-	-	
Create	-	-	-	
Total	60	60	100	

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

Common to All Branches

60 MY 002 – Universal Human Values

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	100	-	100

Introduction to value Education* Understanding Value Education - Self Exploration as the Process for Value Education-Continuous Happiness and Prosperity - the Basic Human Aspirations - Right Understanding - Relationship and Physical Facility - Happiness and Prosperity - Current Scenario - **Method to Fulfill the Basic Human Aspirations****	[9]
Harmony in the Human Being* Understanding Human Being as the Co-Existence of the Self and the Body - Distinguishing Between the Needs of the Self and the Body - **the Body as an Instrument of the Self-Understanding Harmony in the Self-Harmony of the Self with the Body**** - Programme to Ensure Self-Regulation and Health	[9]
Harmony in the Family and Society* Harmony In the Family - The Basic Unit of Human Interaction - Values in Human- to - Human Relationship - 'Trust' The Foundation Value in Relationship - 'Respect' - as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order.	[9]
Harmony in the Nature/Existence* Understanding Harmony in the Nature - Interconnectedness, Self-Regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Co-Existence at All Levels - The Holistic Perception of Harmony in Existence.	[9]
Implications of the Holistic Understanding* Natural Acceptance of Human Values - Definitiveness of Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models -Typical Case Studies - Strategies for Transition Towards Value Base Life and Profession.	[9]
Total Hours:	**45**

Text Book(s):

1.	Gaur R R, Asthana R, Bagaria G P, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
2.	Gaur R R, Asthana R, Bagaria G P Teachers, "Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

Reference(s):

1.	EkParichaya, Nagaraj A, Jeevan Vidya Prakashan, Amarkantak, "Jeevan Vidya", 1999.
2.	Tripathi A.N, "Human Values", New Age International. Publishers, New Delhi, 2004.

*SDG 3 – Good Health and Well-Being

**SDG 5 – Quality Education

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Introduction to Value Education**	
1.1	Discussion on Present Education System and Skill Based Education	1
1.2	Understanding Value Education	1
1.3	Self-Exploration as the Process for Value Education	1
1.4	Basic Human Aspirations - Continuous Happiness and Prosperity	1
1.5	Basic Requirements to Fulfill Human Aspirations - Right Understanding, Relationship and Physical Facility	1
1.6	Transformation From Animal Consciousness to Human Consciousness	1
1.7	Sources of Happiness and Prosperity – Harmony and Disharmony	1
1.8	Current Scenario and Role of Education	1
1.9	Outcome of Human Education and Method to Fulfill the Basic Human Aspirations	1
2.0	**Harmony In the Human Being**	
2.1	Understanding Human Being - As Co-Existence of The Self and The Body – The Needs of The Self and The Body	1
2.2	Understanding Human Being - As Co-Existence of The Self and The Body - The Activities and Response of The Self and The Body	2
2.3	The Body as An Instrument of The Self	1
2.4	Understanding Harmony in The Self	1
2.5	Harmony of the Self with The Body	2
2.6	Programme To Ensure Self-Regulation and Health	1
2.7	My Participation (Value) Regarding Self and My Body - Correct Appraisal of Our Physical Needs	1
3.0	**Harmony in The Family and Society**	
3.1	Harmony in the Family - Understanding Values in Human Relationships	1
3.2	Family as the Basic Unit of Human Interaction	1
3.3	Values In Human Relationships	1
3.4	Trust - The Foundation Value in Relationship	1
3.5	Respect as the Right Evaluation, The Basis for Respect, Assumed Bases for Respect Today	1
3.6	Harmony From Family to World Family: Undivided Society	1
3.7	Extending Relationship from Family to Society, Identification of The Comprehensive Human Goal	1
3.8	Programs Needed to Achieve the Comprehensive Human Goal: The Five Dimensions of Human Endeavour	1
3.9	Harmony From Family Order to World Family Order – Universal Human Order	1
4.0	**Harmony in The Nature / Existence**	
4.1	The Four Orders in Nature	1
4.2	Participation of Human Being in Entire Nature	1
4.3	Natural Characteristics - Tendency of Human Living with Animal Consciousness / The Holistic Perception of Harmony in Existence	1
4.4	Present Day Problems	1
4.5	Recyclability And Self-Regulation in Nature	1
4.6	Relationship of Mutual Fulfillment	1
4.7	An Introduction to Space, Co-Existence of Units in Space	1
4.8	Harmony In Existence – Understanding Existence as Co- Existence	1
4.9	Natural Characteristic of Human Living with Human Consciousness	1
5.0	**Implications of the Holistic Understanding**	
5.1	Natural Acceptance of Human Values	1
5.2	Definitiveness of Ethical Human Conduct - Development of Human	1

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	Consciousness	
5.3	Identification of Comprehensive Human Goal	1
5.4	Basis For Humanistic Education and Humanistic Constitution	1
5.5	Ensuring Competence in Professional Ethics	1
5.6	Issues In Professional Ethics-The Current Scenario	1
5.7	Holistic Technologies and Production Systems and Management Models - Typical Case Studies	2
5.8	Strategies For Transition Towards Value-Based Life and Profession	1

Course Designer(s)

1. Dr.G.Vennila - vennila@ksrct.ac.in
2. Dr.K.Raja - rajak@ksrct.ac.in

60 GE 002	Tamils and Technology (Common to all Branches)	Category	L	T	P	Credit
		GE	1	0	0	1

Objectives

- To learn weaving, ceramic and construction technology of Tamils.
- To understand the agriculture, irrigation and manufacturing technology of Tamils.
- To realize the development of scientific Tamil and Tamil computing.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the weaving and ceramic technology of ancient Tamil people nature.	Understand
CO2	Comprehend the construction technology, building materials in sangam period and case studies.	Understand
CO3	Infer the metal process, coin and beads manufacturing with relevant archeological evidence.	Understand
CO4	Realize the agriculture methods, irrigation technology and pearl diving.	Understand
CO5	Apply the knowledge of scientific Tamil and Tamil computing.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	3	3	3	2	-	3	-	-	3
CO2	3	-	-	-	-	-	2	3	2	2	-	3	-	-	3
CO3	3	-	-	-	-	-	3	3	3	2	-	3	-	-	3
CO4	3	-	-	-	-	2	3	3	2	2	-	3	-	-	3
CO5	3	-	-	-	3	-	-	3	-	3	-	3	-	-	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Model Examination (Marks)	End Semester Examination (Marks)
Remember	40	No End Semester Examination
Understand	40	
Apply	20	
Analyze	-	
Evaluate	-	
Create	-	
Total	100	

Passed in BoS Meeting held on 24/12/2022
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Department of ECE
K.S.Rangasamy College of Technology
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Syllabus

K. S. Rangasamy College of Technology – Autonomous R2022								
Common to all Branches								
60 GE 002 – Tamils and Technology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	1	0	0	15	1	100	-	100

Weaving and Ceramic Technology* Weaving Industry during Sangam Age – Ceramic Technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.	[3]
Design and Construction Technology* Designing and Structural construction House & Designs in Household Materials during Sangam Age – Building Materials and Hero Stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other Worship places – Temples of Nayaka Period – Type Study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal – Chetti Nadu Houses , Indo – Saracenic Architecture at Madras during British Period.	[3]
Manufacturing Technology* Art of Ship Building – Metallurgical studies – Iron Industry – Iron smelting ,Steel - Copper and Gold Coins as Source of History – Minting of Coins – Beads Making – Industries Stone Beads – Glass beads – Terracotta beads – Shell beads/Bone beats – Archeological evidences - Gem stone types Described in Silappathikaram.	[3]
Agriculture and Irrigation Technology* Dam,Tank,Ponds, Sluice,Significance of KumizhiThoompu of CholaPeriod,Animal Husbandry – Wells Designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea- Fisheries – Pearl – Conche diving -Ancient Knowledge of Ocean – Knowledge Specific Society.	[3]
Scientific Tamil & Tamil Computing* Development of Scientific Tamil – Tamil Computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy- Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.	[3]
Total Hours:	**15**

Text Book(s):

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் கே. கே . பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு).
4.	பொருநை - ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு).
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - "Sangam City Civilization on the banks of river Vaigai" (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

*SDG 4- Quality Education

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

60 GE 002	தமிழரும்தொழில்நுட்பமும் (அனைத்து துறைகளுக்கும் பொதுவானது)	Category	L	T	P	Credit
		GE	1	0	0	1

பாடத்தின் நோக்கங்கள்:

- தமிழர்களின் சங்ககால நெசவு, பானை வனைதல் குறித்து அறிதல்.
- தமிழர்களின் கட்டிடத் தொழில் நுட்பம் குறித்து அறிதல்.
- தமிழர்களின் உற்பத்தி முறைகள் குறித்து அறிதல்.
- தமிழர்களின் சங்ககால வேளாண்மை, நீர்ப்பாசனம் குறித்து கற்றல்.
- நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிதல்.

முன்கூட்டிய துறைசார் அறிவு:

தேவை இல்லை

பாடம் கற்றதின் விளைவுகள்:

பாடத்தை வெற்றிகரமாக கற்று முடித்த பின்பு, மாணவர்களால் முடியும் விளைவுகள்

CO1	சங்ககாலத்தமிழர்களின் நெசவுமற்றும் பானைவனைதல் தொழில்நுட்பம் குறித்த கற்றுணர்தல்	புரிதல்
CO2	சங்ககாலத்தமிழர்களின் கட்டிட தொழில்நுட்பம் கட்டுமானப் பொருட்கள் மற்றும் அவற்றை விளக்கும் தளங்கள் குறித்த அறிவு.	புரிதல்
CO3	சங்ககாலத்தமிழர்களின் உலோகத்தொழில், நாணயங்கள் மற்றும் மணிகள் சார்ந்த தொல்லியல் சான்றுகள் பற்றிய அறிவு.	புரிதல்
CO4	சங்ககாலத்தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள் மற்றும் முத்து குளித்தல் குறித்த தெளிவு.	புரிதல்
CO5	நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிந்து கொள்ளலும் மற்றும் பயன்படுத்துதலும்.	செயல்படுத்துதல்

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	3	3	3	2	-	3	-	-	3
CO2	3	-	-	-	-	-	2	3	2	2	-	3	-	-	3
CO3	3	-	-	-	-	-	3	3	3	2	-	3	-	-	3
CO4	3	-	-	-	-	2	3	3	2	2	-	3	-	-	3
CO5	3	-	-	-	3	-	-	3	-	3	-	3	-	-	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Model Examination (Marks)	End Semester Examination (Marks)
Remember	40	No End Semester Examination
Understand	40	
Apply	20	
Analyze	-	
Evaluate	-	
Create	-	
Total	100	

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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Syllabus

K. S. Rangasamy College of Technology – Autonomous R2022								
(அனைத்து துறைகளுக்கும் பொதுவானது)								
60 GE 002 – தமிழரும்தொழில்நுட்பமும்								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	1	0	0	15	1	100	-	100

நெசவு மற்றும் பானைத் தொழில்நுட்பம்: சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.	[3]
வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கல் - நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.	[3]
உற்பத்தித் தொழில் நுட்பம்: கப்பல் கட்டும் கலை – உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் , கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.	[3]
வேளாண்மை மற்றும் நீர்பாசனத் தொழில் நுட்பம்: அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்கான வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.	[3]
அறிவியல் தமிழ் மற்றும் கணித்தமிழ் அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.	[3]
Total Hours:	**15**

Text Book(s):

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் கே. கே . பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு).
4.	பொருநை - ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு).
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - ''Sangam City Civilization on the banks of river Vaigai''(Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

60 EC 3P1	Analog and Digital Electronics Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To illustrate the working of transistor biasing circuits
- To understand and analyse the operation of single stage and multistage amplifiers
- To understand and analyse the applications of op-amp
- To design and implement combinational and sequential circuits for practical applications
- To simulate combinational and sequential circuits using HDL

Pre-requisites

- Electronic Devices Laboratory

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Design and construct different biasing circuits for BJT & MOSFET	Apply
CO2	Design, implement and obtain the frequency response of single stage CE amplifier and feedback amplifiers.	Apply
CO3	Design and implement an application circuit using power amplifier	Apply
CO4	Design and implement application circuit using combinational and sequential logic circuits	Apply
CO5	Design and simulate combinational and sequential logic circuits using HDL	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	3	3	-	3	3	3	3
CO2	3	3	3	-	2	-	-	-	3	3	-	3	3	3	3
CO3	3	3	3	3	2	-	-	-	3	3	-	3	3	3	3
CO4	3	3	3	-	3	-	-	-	3	3	-	3	3	3	3
CO5	2	2	3	-	3	-	-	-	3	3	-	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom''s Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)	
	Lab	Activity			
Remember	-	-	-	-	-
Understand	25	-	50		50
Apply	25	25	50		50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-
Total	50	25	100	-	100

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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Tiruchengode - 637 215.

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ECE & EE								
60 EC 3P1 – Analog and Digital Electronics Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	0	0	4	60	2	60	40	100

List of Experiments*:

Students have to design application circuits using analog electronic components / MOKU GO Kit / multisim software

Analog experiments*

1. Design and simulation of BJT & MOSFET biasing circuits
2. Design and implementation of MOS amplifier circuits**
3. Analysis of frequency response of feedback amplifiers/ multistage amplifier
4. Design and implementation of application circuits using op-amp**

Digital experiments*

5. Design and implementation of combinational circuits using logic gates**
6. Design and implementation of synchronous sequential circuits**
7. Design and implementation of asynchronous sequential circuits**
8. Design and implementation of FSM (Finite State Machine)**
9. Design and simulation of combinational / synchronous & asynchronous sequential circuits using HDL**

Lab Manual

1.	“Analog and Digital Electronics Laboratory”, Department of Electronics Engineering (VLSI Design and Technology), KSRCT.

*SDG 4 – Quality Education
**SDG 9 – Industry innovation and Infrastructure

Course Designer(s)

1. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in
2. Dr.S.Malarkhodi - malarkhodi@ksrct.ac.in

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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60 CS 0P2	Data Structures and Algorithms Laboratory	Category	L	T	P	Credit
		ES	0	0	4	2

Objectives

- To design and implement simple linear and nonlinear data structures
- To strengthen the ability to identify and apply the suitable data structure for the given real-world problem
- To program for storing data as tree structure and implementation of various traversal techniques
- To implement sorting and searching techniques
- To gain knowledge of graph applications

Pre-requisites

- Programming knowledge in C language

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Demonstrate the implementation of linear data structures and its applications	Apply
CO2	Investigate balanced parenthesis and postfix expressions with the help of stack ADT	Apply
CO3	Implement non-linear data structure	Apply
CO4	Implement sorting and searching techniques	Apply
CO5	Implement shortest path and minimum spanning tree algorithm	Analyse

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	-	2	-	-	2	3	3	3
CO2	3	3	2	3	-	-	-	-	3	-	-	2	3	3	3
CO3	3	3	2	2	2	2	-	-	3	2	-	2	3	3	3
CO4	3	3	2	3	2	-	-	3	2	2	-	2	3	3	3
CO5	3	3	2	-	2	2	2	3	3	2	-	2	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)	
	Lab	Activity			
Remember	-	-	-	-	-
Understand	-	-	-	-	-
Apply	50	15	80	-	80
Analyse	-	10	20	-	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-
Total	50	25	100	-	100

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ECE & EE								
60 CS 0P2 - Data Structures and Algorithms Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	0	0	4	60	2	60	40	100

List of Experiments*:

1. **Implementation of List Abstract Data Type (ADT)***
2. **Implementation of Stack ADT***
3. **Implementation of Queue ADT***
4. Implementation of stack applications:
   (a) Program for 'Balanced Parenthesis'
   (b) Program for 'Evaluating Postfix Expressions'
5. Implementation Search Tree ADT
6. Implementation of Internal Sorting
7. Develop a program for external sorting
8. Develop a program for various Searching Techniques
9. **Implementation of Shortest Path Algorithm***
10. **Implementation of Minimum Spanning Tree Algorithm***

*SDG 4 - Quality Education

Course Designer(s)

1. Dr.K.Poongodi - poongodik@ksrct.ac.in

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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60 CG 0P2	Career Skill Development - II	Category	L	T	P	Credit
		CG	0	0	2	1

Objectives

- To help learners improve their vocabulary and enable them to use words appropriately in different academic and professional contexts.
- To help learners develop strategies that could be adopted while reading texts.
- To help learners acquire the ability to speak and write effectively in english in real life and career related situations.
- To improve listening, observational skills, and problem-solving capabilities
- To develop message generating and delivery skills

Pre-requisites

- Basic knowledge of reading and writing in English.

Course Outcomes

On the Successful Completion of the Course, Students will be Able to

CO1	Compare and contrast products and ideas in technical texts	Analyze
CO2	Identify cause and effects in events, industrial processes through technical texts	Analyze
CO3	Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.	Analyze
CO4	Report events and the processes of technical and industrial nature.	Apply
CO5	Articulate their opinions in a planned and logical manner, and draft effective résumés in context of job search.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	2	3	3	2	3	2	-	-
CO2	-	-	-	-	-	-	-	2	3	3	2	3	2	-	-
CO3	-	-	-	-	-	-	-	2	3	3	2	3	2	2	2
CO4	-	-	-	-	-	-	-	2	3	3	2	3	-	-	-
CO5	-	-	-	-	-	-	-	2	3	3	2	3	2	2	2
3 - Strong; 2 - Medium; 1 – Some															

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

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Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 CG 0P2 - Career Skill Development - II								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	0	0	2	30	1	100	00	100

Listening* Evaluative Listening: Advertisements, Product Descriptions, - Audio / Video; Filling A Graphic Organiser (Choosing A Product or Service by Comparison) - Listening to Longer Technical Talks and Completing - Gap Filling Exercises. Listening Technical Information from Podcasts - Listening to Process/Event Descriptions to Identify Cause & Effects, Documentaries Depicting a Technical Problem and Suggesting Solutions - Listening to TED Talks	[6]
Speaking* Marketing a Product, Persuasive Speech Techniques - Describing and Discussing the Reasons of Accidents or Disasters Based on News Reports, Group Discussion (Based on Case Studies), Presenting Oral Reports, Mini Presentations on Select Topics with Visual Aids, Participating in Role Plays, Virtual Interviews	[6]
Reading* Reading Advertisements, User Manuals and Brochures - Longer Technical Texts - Cause and Effect Essays, and Letters / Emails of Complaint - Case Studies, Excerpts from Literary Texts, News Reports etc. - Company Profiles, Statement of Purpose (SoPs)	[6]
Writing* Professional Emails, Email Etiquette - Compare and Contrast Essay - Writing Responses to Complaints Precis Writing, Summarizing and Plagiarism- Job / Internship Application - Cover Letter & Resume	[6]
Verbal Ability II* Reading Comprehension (Inferential fillups) - Spotting Errors - Verbal Analogies - Theme Detection - Change of Voice - Change of Speech - One word substitution	[6]
Total Hours:	**30**

Reference(s):

1.	"English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020
2.	Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020
3.	Raman. Meenakshi, Sharma. Sangeeta, "Professional English". Oxford University Press. New Delhi. 2019
4.	Arthur Brookes and Peter Grundy, "Beginning to Write: Writing Activities for Elementary and Intermediate Learners", Cambridge University Press, New York, 2003

*SDG 4 - Quality Education

Passed in BoS Meeting held on 24/12/2022
Approved in Academic Council Meeting held on 07/01/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Listening**	
1.1	Evaluative Listening: Advertisements, Product Descriptions	1
1.2	Listening to Longer Technical Talks and Completing – Gap Filling Exercises.	1
1.3	Listening Technical Information from Podcasts	1
1.4	Listening to Process/Event Descriptions to Identify Cause & Effects and Documentaries Depicting a Technical Problem and Suggesting Solutions	1
1.5	Listening to TED Talks	2
2.0	**Speaking**	
2.1	Marketing a Product, Persuasive Speech Techniques	1
2.2	Describing and Discussing the Reasons of Accidents or Disasters Based on News Reports	1
2.3	Group Discussion (Based on Case Studies)	1
2.4	Presenting Oral Reports, Mini Presentations on Select Topics with Visual Aids	1
2.5	Participating in Role Plays and Virtual Interviews	2
3.0	**Reading**	
3.1	Reading Advertisements, User Manuals and Brochures	1
3.2	Reading - Longer Technical Texts – Cause and Effect Essays, and Letters / Emails of Complaint	1
3.3	Case Studies, Excerpts from Literary Texts, News Reports Etc.	1
3.4	Company Profiles	1
3.5	Statement of Purpose (SoPs)	2
4.0	**Writing**	
4.1	Professional Emails, Email Etiquette	1
4.2	Compare and Contrast Essay	1
4.3	Writing Responses to Complaints	1
4.4	Precis Writing, Summarizing and Plagiarism	1
4.5	Job / Internship Application – Cover Letter & Résumé	2
5.0	**Verbal Ability II**	
5.1	Reading Comprehension (Inferential Fillups) And Theme Detection	1
5.2	Spotting Errors	1
5.3	Verbal Analogies	1
5.4	Change of Voice and Change of Speech	1
5.5	One Word Substitution	2

Course Designer(s)

1. Dr.A.Palaniappan - palaniappan@ksrct.ac.in

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Tiruchengode - 637 215.

K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

FOURTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 MA 016	Probability and Inferential Statistics	2	40	60	100	45	100
2.	60 EC 401	Signals and Systems	2	40	60	100	45	100
3.	60 EC 402	Linear Integrated Circuits	2	40	60	100	45	100
4.	60 EC 403	Electromagnetic Waves	2	40	60	100	45	100
5.	60 OE L1*	Open Elective I	2	40	60	100	45	100
THEORY CUM PRACTICAL								
6.	60 EC 404	Analog Communication	2	50	50	100	45	100
PRACTICAL								
7.	60 EC 4P1	Linear Integrated Circuits and Electromagnetics Laboratory	3	60	40	100	45	100
8.	60 EC 4P2	Electronic Design Project Laboratory	3	60	40	100	45	100
9.	60 CG 0P3	Career Skill Development – III	2	100	00	100	00	100
10.	60 CG 0P6	Internship	-	100	-	100	-	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
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Tiruchengode - 637 215.

60 MA 016	Probability and Inferential Statistics	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To learn the basic concepts of probability
- To get exposed to some standard distributions
- To familiarize the concepts of correlation and regression
- To familiarize various methods in hypothesis testing
- To get exposed to various statistical methods for time series

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Interpret the basics of probability.	Apply
CO2	Interpret the concepts of standard distributions.	Apply
CO3	Calculate coefficient of correlation and regression.	Apply
CO4	Apply Student's t test, F test and Chi-square test for testing the statistical hypothesis.	Apply
CO5	Apply suitable methods for measuring trend values.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	10	10
Understand	10	10	20	20
Apply	40	40	70	70
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022								
B.E - Electronics and Communication Engineering								
60 MA 016 - Probability and Inferential Statistics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	3	1	0	60	4	40	60	100

Probability and Random Variables* Axioms of Probability – Conditional Probability – Baye's Theorem – Random Variable – Expectation – Probability Mass Function – Probability Density Function – Moment Generating Function. **Hands – on:** Calculate the mean and variance for discrete distributions.	[9]
Standard Distributions Discrete Distributions: Binomial, Poisson*** and Geometric Distributions – Continuous Distributions: Uniform, Exponential and Normal Distributions – Properties. **Hands - on:** Fit the Normal distribution.	[9]
Two Dimensional Random Variables* Joint Distributions – Marginal and Conditional Distributions – Covariance – Correlation and Regression – Rank Correlation. **Hands - on:** Calculate the correlation coefficient and lines of regression	[9]
Testing of Hypothesis** Type I and Type II Errors – Test of Significance of Small Samples: Student's 'T' Test – Single Mean – Difference of Means – F- Test – Chi-Square Test – Goodness of Fit – Independence of Attributes. **Hands - on:** Applied Chi-square test to real data set.	[9]
Time Series* Components of a Time Series – Method of Least Square – Parabolic Trend – Exponential Trend – Method of Seasonal Variations – Ratio to Trend Method – Link Relative Method. **Hands - on:** Fit a curve to the given data using method of least squares.	[9]
Total Hours: (Lecture - 45; Hands - on - 05; Tutorial - 10)	**60**

Text Book(s):

1.	Richard A Johnson, "Miller & Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education Limited, New Delhi, 2018.
2.	P N Arora and S Arora, "Statistics for Management", 5th Edition, Sultan Chand & Sons, New Delhi, 2015.

Reference(s):

1.	Sheldon Ross, "A first course in Probability", 10th Edition, Pearson Education, New Delhi, 2019.
2.	Veerarajan T, ''Probability, Statistics and Random process'',4th Edition, Tata McGraw-Hill Education, 2015.
3.	Gupta S.P, "Statistical Methods", 45th Edition, Sultan Chand & sons, New Delhi, 2017.
4.	Montgomery D.C, Cheryl L.Jennings and Murat Kulahci "Introduction to Time Series Analysis and Forecasting", 2nd Edition, John Wiley and Sons, 2015.

*SDG 4 – Quality Education
**SDG 9 – Industry, Innovation, and Infrastructure
***SDG 2 – Zero Hunger

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**Probability and Random Variables**	
1.1	Axioms of Probability	1
1.2	Conditional Probability	1
1.3	Baye's Theorem	2
1.4	Random Variable, Expectation	2
1.5	Probability Mass Function	1

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

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1.6	Probability Density Function	1
1.7	Moments Generating Function.	1
1.8	Tutorial	2
1.9	Hands on	1
2	**Standard Distributions**	
2.1	Discrete Distributions- Binomial Distribution	2
2.2	Poisson Distribution	1
2.3	Geometric Distribution	1
2.4	Continuous Distributions - Uniform Distribution	2
2.5	Exponential Distribution	1
2.6	Normal Distribution	1
2.7	Properties	1
2.8	Tutorial	2
2.9	Hands on	1
3	**Two Dimensional Random Variables**	
3.1	Joint Distributions	1
3.2	Marginal Distribution	1
3.3	Conditional Distribution	1
3.4	Covariance	1
3.5	Correlation	2
3.6	Regression	1
3.7	Rank Correlation	2
3.8	Tutorial	2
3.9	Hands on	1
4	**Testing of Hypothesis**	
4.1	Type I and Type II Errors	1
4.2	Test of Significance of Small Samples -Student's 'T' Test	1
4.3	Single Mean	1
4.4	Difference of Means.	2
4.5	F- Test	2
4.6	Chi-Square Test – Goodness of Fit	1
4.7	Independence of Attributes.	1
4.8	Tutorial	2
4.9	Hands on	1
5	**Time Series**	
5.1	Components of a Time Series	1
5.2	Method of Least Square	1
5.3	Parabolic Trend	2
5.4	Exponential Trend	1
5.5	Method of Seasonal Variations	2
5.6	Ratio to Trend Method	1
5.7	Link Relative Method	1
5.8	Tutorial	2
5.9	Hands on	1

Course Designer(s)

1. Mrs. D.Padmavathi - padmavathi@ksrct.ac.in
2. Mr. D.Senthil Raja - senthilrajad@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

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Tiruchengode - 637 215.

60 EC 401	Signals and Systems (Common to ECE & EE)	Category	L	T	P	Credit
		PC	2	1	0	3

Objectives

- To understand the basic properties of signals & systems and analysis of LTI systems
- To understand the sampling and reconstruction of CT signals.
- To analyse continuous time and discrete time signals and systems in the Fourier series and Fourier transform.
- To analyse discrete time signals and systems using z-transform.
- To study DFT and FFT algorithms

Pre-requisites

- Integrals, Partial Differential Equations and Laplace transform.

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the classification of signals and systems with their properties and analyse LTI systems.	Apply
CO2	Analyse the concepts of sampling and reconstruction of CT signals.	Apply
CO3	Analyse continuous-time and discrete-time signals and systems using Fourier series and Fourier transform	Apply
CO4	Analyse discrete-time signals and systems using z-transform	Apply
CO5	Computation of DFT and FFT algorithms	Apply

Mapping with Programme Outcomes

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	2	2	-	-	3	3	-	-	3	3	2
CO2	3	3	3	-	2	2	-	-	3	3	-	-	3	3	2
CO3	3	3	3	-	2	2	-	-	3	3	-	-	3	3	2
CO4	3	3	3	-	2	2	-	-	3	3	-	-	3	3	2
CO5	3	3	3	3	2	2	-	-	3	3	-	-	3	3	2
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	10	10
Understand	10	10	30	30
Apply	40	40	60	60
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology.
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022								
Common to ECE and EE								
60 EC 401 - Signals and Systems								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	2	1	0	45	3	40	60	100

Introduction to Signals and Systems* Basic Continuous – Time (CT) & Discrete – Time (DT) Signals – Classification of CT & DT Signals – Basic CT and DT Signals – Signal Operations – Classification – Properties of CT & DT Systems – Analysis of LTI Systems: Convolution Sum – Convolution Integral – Properties. **Hands - on:** Signal generation & operations and verification of system properties	[6]
Sampling* Representation of CT Signals by Samples – Sampling Theorem – Impulse Train Sampling – Effects of Under Sampling – Reconstruction of CT Signal from Samples Using Interpolation. **Hands - on:** Sampling and Reconstruction.	[6]
Fourier Analysis of Continuous Time and Discrete Time Signals and Systems* Representation of Periodic Signals by Continuous Time Fourier Series (CTFS) and Discrete Time Fourier Series (DTFS) – Representation of CT Aperiodic and Periodic Signals by Continuous Time Fourier Transform – Representation of DT Aperiodic and Periodic Signals by Discrete Time Fourier Transform – Properties – Frequency Response of Systems Characterized by Differential Equations and Difference Equations. **Hands - on:** Analysis and Synthesis of CT and DT signals and systems using Fourier Transform	[6]
Z Transform Analysis of Discrete Time Signals and Systems* Z Transform – Two Sided and One-Sided Z Transform – Properties of Z Transform – Properties of ROC – Inverse Z Transform, Analysis of LTI Systems Using Z Transform – Stability and Causality in Z-Domain – Solution of Difference Equations – Frequency Response and Impulse Response. **Hands - on:** Analysis of DT systems using z-transform.	[6]
DFT and FFT Algorithms* Introduction – Frequency Domain Sampling: Discrete Fourier Transform (DFT) - Properties of DFT – Efficient Computation of the DFT: FFT Algorithms – Radix 2 FFT Algorithms: Decimation in Time and Decimation in Frequency **Hands - on:** Verification of properties of DFT	[6]
Total Hours: (Lecture - 30; Tutorial - 15):	45

Text Book(s):

1.	Alan V.Oppenheim, Alan S.Willsky with S.Hamid Nawab, ‘‘Signals & Systems”, 2nd Edition, Pearson Education, 2013.
2.	Lathi B.P, ‘‘Signal processing and Linear systems”, Oxford University Press, 2010.

Reference(s):

1.	John G.Proakis and Dimitris G.Manolakis, ‘‘Digital Signal Processing, Principles, Algorithms and Applications”, 4th Edition, Prentice Hall, 2013.
2.	Roberts M.J, ‘‘Signals and Systems Analysis using Transform method and MATLAB”, 3rd Edition, Tata McGraw-Hill, 2018.
3.	Simon Haykin and Barry Van Veen, ‘‘Signals and Systems”, 2nd Edition, John Wiley & Sons, 2012.

* SDG 4 – Quality Education

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K.S.Rangasamy College of Technology,
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Course Contents and Lecture Schedule		
S.No	**Topic**	**No. of Hours**
1	**Introduction to signals and systems**	
1.1	Basic Continuous-Time (CT) & Discrete-Time (DT) Signals	1
1.2	Classification of CT Signals	1
1.3	Classification of DT Signals	1
1.4	Basic CT and DT Signals -Signal Operations, Classification	1
1.5	Properties of CT Systems, Properties of DT Systems	1
1.6	Analysis of LTI Systems: Convolution Sum, Convolution Integral, Properties	1
1.7	Tutorial and Hands on	3
2	**Sampling**	
2.1	Representation of CT Signals by Samples- Sampling Theorem	1
2.2	Sampling theorem Problems	1
2.3	Impulse Train Sampling	1
2.4	Effects of Under Sampling	1
2.5	Effects of Under Sampling Problems	1
2.6	Reconstruction of CT Signal from Samples Using Interpolation	1
2.7	Tutorial and Hands on	3
3	**Fourier Analysis of Continuous Time and Discrete Time Signals and Systems**	
3.1	Representation of Periodic Signals by Continuous Time Fourier Series (CTFS)	1
3.2	Representation of Periodic Signals by Discrete Time Fourier Series (DTFS)	1
3.3	Representation of CT Aperiodic and Periodic Signals by Continuous Time Fourier Transform	1
3.4	Representation of DT Aperiodic and Periodic Signals by Discrete Time Fourier Transform, Properties	1
3.5	Frequency Response of Systems Characterized by Differential Equations	1
3.6	Frequency Response of Systems Characterized by Difference Equations	1
3.7	Tutorial and Hands on	3
4	**Z Transform Analysis of Discrete Time Signals and Systems**	
4.1	Z Transform - Two Sided and One-Sided Z Transform	1
4.2	Properties of Z Transform and Properties of ROC	1
4.3	Inverse Z Transform	1
4.4	Analysis of LTI Systems Using Z Transform	1
4.5	Stability and Causality In Z-Domain	1
4.6	Solution of Difference Equations-Frequency Response and Impulse Response	1
4.7	Tutorial and Hands on	3
5	**DFT And FFT Algorithms**	
5.1	Frequency Domain Sampling	1
5.2	Discrete Fourier Transform (DFT)	1
5.3	Properties of DFT	1
5.4	Efficient Computation of the DFT	1
5.5	FFT Algorithms - Radix 2 FFT Algorithms: Decimation in Time (DIT)	1
5.6	Decimation in Frequency (DIF)	1
5.7	Tutorial and Hands on	3

Course Designer(s)

1. Dr.P.Babu - pbabu@ksrct.ac.in
2. Ms.C.Saraswathy - saraswathy@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

60 EC 402	Linear Integrated Circuits	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To study the circuit configuration of linear integrated circuits.
- To introduce practical applications of linear integrated circuits.
- To introduce the concept of analog multiplier and Phase Locked Loop with applications.
- To study the application of ADC and DAC in real time systems.
- To introduce special function ICs and its construction.

Pre-requisites

- Electronic Circuits

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the circuit configuration of linear integrated circuits.	Understand
CO2	Design linear and non-linear circuits using op-amps	Apply
CO3	Explain the operation and applications of analog multiplier and PLL	Understand
CO4	Design ADC and DAC circuits using op-amps	Apply
CO5	Explain the working principle of special function ICs	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	-	-	-	3	3	3	-	-	3	3	-
CO2	2	2	3	-	3	-	-	-	-	-	-	3	3	3	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
CO5	3	3	-	-	3	-	-	-	-	-	-	3	3	3	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	20	20
Understand	25	25	40	40
Apply	25	25	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

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Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R 2022								
B.E - Electronics and Communication Engineering								
60 EC 402 - Linear Integrated Circuits								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	40	60	100

Circuit Configuration for Linear ICs* Current Sources, Analysis of Differential Amplifiers with Active Loads, Supply and Temperature Independent Biasing, Band Gap References, Monolithic IC Operational Amplifiers, Specifications, Frequency Compensation, Slew Rate and Methods of Improving Slew Rate. Interpretation of TL082 Datasheet. **Hands - on:** 1. Design and Simulation of Differential amplifier	[9]
Linear and Non-Linear Applications of Op-Amp* Linear and Nonlinear Circuits Using Operational Amplifiers and their Analysis, Differentiator, Integrator, Instrumentation Amplifier, Sine Wave Oscillators, Low Pass, High Pass and Band Pass Filters, Multivibrator and Schmitt Trigger, Triangle Wave Generator, Log and Antilog Amplifiers. **Hands - on:** 1. Design and Simulation of Differentiator	[9]
Analog Multiplier and PLL* Analysis of Four Quadrants and Variable Transconductance Multipliers, Analog Multiplier MPY634 Features, Voltage Controlled Oscillator, Closed Loop Analysis of PLL, AM, PM and FSK Modulators and Demodulators.	[9]
Analog to Digital and digital to Analog Convertors * Sample and Hold Circuit -Digital to Analog Converters – Binary Weighted and R-2R Ladder Types – Analog to Digital Converters – Flash - Counter Ramp, Successive Approximation, Single, Dual Slope – DAC/ADC Performance Characteristics and Comparison. **Hands - on:** 1. AD/DA converters	[9]
Special Function ICs **555 Timers, Voltage Regulators - Linear and Switched Mode Types, Switched Capacitor Filter, SMPS, Frequency to Voltage Converters, Power Amplifiers and Isolation Amplifiers, sources for Noises, Op-Amp Noise Analysis and Low noise Op-Amps. ****	[9]
Total Hours:	**45**

Text Book(s):

1.	RoyChoudry D, Shail Jain, ‘‘Linear integrated Circuits”, 5th Edition, New Age International Pvt Ltd, 2018.
2.	Ramakant A, Gayakwad, ‘‘Op – Amps and Linear Integrated Circuits”, 4th Edition, Prentice Hall, 2017.

Reference(s):

1.	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Mc Graw Hill Education, 2014.
2.	Sergio Franco., ‘‘Design with Operational Amplifiers and Analog Integrated Circuit”, 4th Edition, Tata McGraw-Hill, 2014.
3.	Salivahanan S & V.S. KanchanaBhaskaran V.S, ‘‘Linear Integrated Circuits”, 3rd Edition, TMH, 2018.
4.	Gray and Meyer, ‘‘Analysis and Design of Analog Integrated Circuits”, 5th Edition, Wiley International, 2010.

*SDG 4 – Quality Education

**SDG 9 – Industry, Innovation and Infrastructure

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

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K.S.Rangasamy College of Technology,
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Assignment activity:

Assignment 1- Covers module 1 & 2: Questions Related to Hands-on and Case Study & presentation on different types of op amps

1. Design RC Phase shift oscillator, Clipper & clamper using Op-amp 741.
2. Discuss and analyse the following parameters of ALM2403-Q1 IC & Compare with LM741,
   i) Features, ii) Applications.

Assignment 2-Covers module 3 & 4: Questions related to Hands-on and Case study & presentation on different types of ADC/DAC:

1. Design monostable multivibrator using 555 timer and 8-bit SAR Analog to digital converter.
2. Discuss and analyse the following parameters of ADC0804 8-Bit Analog to Digital A/D Converter IC DIP-20 Package IC i) Features, ii) Specifications

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**Circuit Configuration for Linear ICs**	
1.1	Current Sources	2
1.2	Analysis of Differential Amplifiers with Active Loads	2
1.3	Supply and Temperature Independent Biasing	1
1.4	Monolithic IC Operational Amplifiers, Specifications	1
1.5	Frequency Compensation	1
1.6	Slew Rate and Methods of Improving Slew Rate.	1
1.7	Interpretation of TL082 Datasheet	1
2	**Application of Operational Amplifiers**	
2.1	Differentiator, Integrator	1
2.2	Instrumentation Amplifier	1
2.3	Sine Wave Oscillators	2
2.4	Low Pass, High Pass And	1
2.5	Band Pass Filters	
2.6	Schmitt Trigger	1
2.7	Multivibrator, Triangle Wave Generator	1
2.8	Log and Antilog Amplifiers.	1
3	**Analog Multiplier And PLL**	
3.1	Analysis of Four Quadrants and Variable Transconductance Multipliers	2
3.2	Analog Multiplier MPY634 Features	1
3.3	Voltage Controlled Oscillator	1
3.4	Closed Loop Analysis Of PLL	2
3.5	AM, PM Modulators and Demodulators	2
3.6	FSK Modulators and Demodulators	1
4	**Analog To Digital and Digital to Analog Convertors**	
4.1	Digital to Analog Converters - Binary Weighted	1
4.2	Digital to Analog Converters - R-2R Ladder Types	1
4.3	Sample and Hold Circuit	2
4.4	Continuous - Counter Ramp Type ADC	1
4.5	Successive Approximation	1
4.6	Single, Dual Slope	2
4.7	DAC/ADC Performance Characteristics and Comparison.	1
5	**Special Function ICs**	
5.1	555 Timers	2
5.2	Voltage Regulators - Linear and Switched Mode Types	1

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5.3	Voltage Regulators -Switched Capacitor Filter	1
5.4	SMPS	1
5.5	Frequency to Voltage Converters	1
5.6	Power Amplifiers and Isolation Amplifiers	1
5.7	Op-Amp Noise Analysis	1
5.8	Low Noise Op-Amps	1

Course Designer(s)

1. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in
2. Mr.D.Poornakumar - poornakumard@ksrct.ac.in

60 EC 403	Electromagnetic Waves	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To introduce the concept of vector analysis
- To develop an understanding of electromagnetic laws and its application in boundaries
- To study Maxwell's equation, plane wave propagation in free space
- To introduce the concept of signal propagation through transmission lines and high frequency lines
- To illustrate the propagation of TE, TM and TEM rectangular, circular waveguides and cavity resonators

Pre-requisites

- Circuit Analysis

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the vector quantities and apply vector integration and differentiation in different coordinate systems	Apply
CO2	Apply the laws of electromagnetics to evaluate the boundary conditions for electric and magnetic fields and describe the propagation of plane electromagnetic waves	Apply
CO3	Apply Faraday's law to find the electromotive force and calculate displacement current using Maxwell's equation for time varying magnetic field	Apply
CO4	Evaluate the characteristics and wave propagation in high frequency transmission lines	Apply
CO5	Describe rectangular and circular waveguides and understand the propagation of electromagnetic waves	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	3	3	-	-	-	3	3	3	-	3	3	3	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	30	30
Understand	20	20	30	30
Apply	30	30	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E- Electronics and Communication Engineering								
60 EC 403 - Electromagnetic Waves								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	3	1	0	60	4	40	60	100

Vector Analysis * Vectors Analysis: Vector Algebra, Vector Calculus – Divergence, Gradient, Curl, Laplacian; Coordinate Systems – Cartesian, Cylindrical and Spherical **Hands - on:** 1. Generate electromagnetic wave 2. Find the electrostatic potential in an air-filled annular quadrilateral frame	[9]
Electromagnetics * Coulomb's Law, Gauss's Law, Electric Scalar Potential, Laplace and Poisson's Equations, Conduction and Polarization, Boundary Conditions, Biot-Savart Law, Ampere's Law **Hands - on:** Solve a 2-D magnetostatic model for a ferromagnetic frame with an h–shaped cavity	[9]
Electrodynamics* Maxwell's Equations, Faraday's Induction, Displacement Current, Plane Wave Propagation in Free Space and in Materials; Poynting Vector, Reflection and Transmission of Plane Waves at Media Boundary	[9]
Transmission Lines* Transmission-Line General Solution – Loading. Impedance Transformation and Matching. Smith Chart, Quarter-Wave and Half-Wave Transformers. Single Stub Matching	[9]
Waveguides* Classification of Guided Wave Solutions – TE, TM and TEM Waves. Rectangular and Circular Waveguides. Excitation of Waveguides. Rectangular and Circular Cavity Resonators	[9]
Total Hours: (Lecture - 45; Tutorial - 15)	**60**

Text Book(s):	
1.	Matthew N.O.Sadiku , "Elements of Electromagnetics", 7th Edition , Oxford University Press , 2018.
2.	E.C. Jordan & K.G. Balmain, "Electromagnetic waves & Radiating Systems", 2nd Edition, Prentice Hall, 2013.
Reference(s):	
1.	William H.Hayt, John A.Buck , "Engineering Electromagnetics", 8th Edition, McGraw Hill Education, 2017.
2.	John. D. Ryder, "Network Lines and Fields", 2nd Edition, Pearson Education India, 2015.
3.	David K.Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson Education, 2015.
4.	Umesh Sinha, "Transmission Lines and Networks", Satya Prakashan Publishing Company, New Delhi, 2010.

***SDG 4 - Quality Education**

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Vector Analysis**	
1.1	Electromagnetic Waves – Introduction	1
1.2	Vectors, Position & Distance Vector, Component of Vectors	1
1.3	Cartesian and Cylindrical Coordinate Systems	1
1.4	Spherical Coordinates-Constant Coordinate Surface	1
1.5	Vector Calculus-Differential Length, Area, Volume	1
1.6	Line, Surface & Volume Integrals – Del Operator	1
1.7	Gradient of Scalar-Divergence of a Vector	1
1.8	Divergence Theorem-Curl of a Vector	1
1.9	Stokes Theorem- Laplacian of Scalar and Vector Field	1
1.10	Tutorial	3
2.0	**Electromagnetics**	
2.1	Coulomb's Law	1
2.2	Gauss's Law	1
2.3	Electric Scalar Potential	1
2.4	Laplace and Poisson's Equations	1
2.5	Conduction and Polarization	2
2.6	Boundary Conditions	1
2.7	Biot-Savart Law	1
2.8	Ampere's Law	1
2.9	Tutorial	3
3.0	**Electrodynamics**	
3.1	Maxwell's Equations	2
3.2	Faraday's Induction	1
3.3	Displacement Current	1
3.4	Plane Wave Propagation in Free Space and In Materials	2
3.5	Poynting Vector	1
3.6	Reflection of Plane Waves at Media Boundary	1
3.7	Transmission of Plane Waves at Media Boundary	1
3.8	Tutorial	3
4.0	**Transmission Lines**	
4.1	Transmission Line – V & I Equation of Transmission Line	2
4.2	Propagation Constant & Characteristic Impedance	1
4.3	Reflection Coefficient & VSWR	1
4.4	Impedance Transformation and Matching	1
4.5	Smith Chart	1
4.6	Admittance Smith Chart, Applications of Smith Chart	1
4.7	Quarter-Wave and Half-Wave Transformers	1
4.8	Single Stub Matching	1
4.9	Tutorial	3
5.0	**Waveguides**	
5.1	Classification of Waveguides	1
5.2	TM Waves in Rectangular Waveguides	1
5.3	TE Waves in Rectangular Waveguides	1
5.4	Characteristics of TE, TM Waves	1

5.5	Cut-Off Wavelength, Phase Velocity and Impossibility of TEM Waves	1
5.6	TM and TE Waves in Circular Waveguides	1
5.7	Excitation of Waveguides	1
5.8	Rectangular Cavity Resonators	1
5.9	Circular Cavity Resonators	1
5.10	Tutorial	3

Course Designer(s)

1. Mr Saravanan S - saravanan.s@ksrct.ac.in

60 EC 404	Analog Communication	Category	L	T	P	Credit
		PC	2	0	2	3

Objectives

- To understand the mathematical basis of random process in communication
- To impart the fundamentals of basic communication system and describe the amplitude modulation techniques
- To introduce the different angle modulation techniques
- To describe different types of noise and predict its effect on analog communication systems.
- To study the function of various radio receivers

Prerequisite

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the mathematical basis of random process in communication	Understand
CO2	Illustrate the generation of different amplitude modulation waveforms	Apply
CO3	Describe the generation of different angle modulation waveforms	Apply
CO4	Analyze the noise in continuous wave modulation systems	Apply
CO5	Discuss the parameters involved in various radio transmitters and receivers	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	3	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
CO3	3	3	-	-	3	-	-	-	3	3	-	3	3	2	3
CO4	3	3	-	-	3	-	-	-	3	3	-	3	3	2	3
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)		End Sem Examination (Marks)	
	Test 1		Test 2					
	Theory	Lab	Theory	Lab	Theory	Lab	Theory	Lab
Remember	10	-	10	-	20	-	20	-
Understand	40	30	40	30	60	30	60	30
Apply	10	70	10	70	20	70	20	70
Analyse	-	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 404 - Analog Communication								
Semester	Hours / Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	2	0	2	60	3	50	50	100

Random Process Mathematical Definition of Random Process – Stationary process – Mean, Correlation and Covariance function, Ergodic Process, Transmission of Random processes through a LTI filter, **Power Spectral Density***, Gaussian process.	[6]
Amplitude Modulation Techniques* Introduction to communication system, Elements of a Communication System, Need for modulation- Theory of Amplitude Modulation Techniques, Generation of AM Signal, DSBSC Signal, SSB Signal, VSB Signal.	[6]
Angle Modulation Techniques* Theory of Angle Modulation Techniques- Frequency Modulation, Phase Modulation, Practical Issues in Frequency Modulation, Generation of FM: FM Methods, Direct Methods, Indirect Method.	[6]
Noise * External Noise, Internal Noise, Noise Calculations, Noise Figure, Noise Temperature, Noisy receiver model, **Noise in AM and FM Receivers***	[6]
Radio Transmitter and Receivers* Introduction to radio communication, **Radio Transmitters** - AM Transmitters****, SSB Transmitters, FM Transmitters, Receiver types: TRF Receiver, **Superheterodyne Receiver****, **AM Receivers**, FM Receivers****	[6]
Practical: 1. Probability Density Function Estimation of a given Data 2. Simulation of AM &SSB Modulation** 3. Generation and Detection of FM wave** 4. Noise Spectrum Analysis using Simulation Tool** 5. Simulation of Low Noise Amplifier **	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	George Kennedy, Bernard Davis, Prasanna S R M, "Electronic Communication Systems", 5th Edition, McGraw-Hill, 2012.
2.	Simon Haykin, "Communication Systems", 5th Edition, John Wiley & sons, 2010.

Reference(s):

1.	Lathi B.P, "Communication Systems", BS publications, 2013.
2.	Joy Laskar, Babak Matinpour, Sudipto Chakraborty, "Modern Receiver Front- Ends Systems, Circuits, and Integration", Wiley- Interscience, 2007
3.	Bruce Carlson A and Paul Crilly, "Communication System", 5th Edition, McGraw-Hill, 2013.
4.	Taub, Donald Schilling, Gowtham Saha, "Principles of Communication Systems", 4th Edition, McGraw-Hill, 2013.

*SDG 4 - Quality education
**SDG 9 - Industry, Innovation and Infrastructure

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Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Amplitude Modulation**	
1.1	Introduction To Communication System, Need for Modulation, Amplitude Modulation, Definition	1
1.2	Spectrum of AM Wave, Power Relations in AM Waves	1
1.3	Switching Modulator,	1
1.4	Envelope Detector, Limitations of Amplitude Modulation	1
1.5	DSBSC Modulation - Ring Modulator	1
1.6	Coherent Detection	1
2	**SSB & VSB Modulation**	
2.1	Single Side Band Modulation- Spectrum of SSB Wave	1
2.2	Discrimination Method	1
2.3	Demodulation of SSB Waves	1
2.4	Vestigial Side Band Modulation – Filtering Method	1
2.5	Coherent detector, VSB transmission in TV broadcasting,	1
2.6	Frequency translation, Comparison of AM Techniques	1
3	**Angle Modulation**	
3.1	Basic Definitions	1
3.2	Properties of Angle Modulated Wave	1
3.3	Frequency Modulation- Narrow Band FM	1
3.4	Wide Band FM	1
3.5	Generation of FM Signal,	1
3.6	Detection of FM Signal, FM Stereo Multiplexing, Nonlinear Effects In FM Systems	1
4	**Noise**	
4.1	Noisy Receiver Model	1
4.2	Noise in DSB-SC Receiver	1
4.3	Noise in AM Receivers	1
4.4	Noise in FM Receivers	1
4.5	Capture Effect and Threshold Effect	1
4.6	Pre-Emphasis and De-Emphasis In FM	1
5	**Radio Receivers**	
5.1	Heterodyne Receivers	1
5.2	Image Reject Receivers	1
5.3	Hartley Architecture	1
5.4	Low IF Receivers	1
5.5	Issues in Direct Conversion Receivers – Noise, LO Leakage and Radiation,	1
5.6	Phase and Amplitude Imbalance, DC Offset, Intermodulations	1
Practical:		
1.	Probability Density Function Estimation of a given Data	6
2.	Simulation of AM &SSB Modulation**	6
3.	Generation and Detection of FM wave**	6
4.	Noise Spectrum Analysis using Simulation Tool**	6
5.	Simulation of Low Noise Amplifier **	6

Course Designer(s)

1. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in

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60 EC 4P1	Linear Integrated Circuits and Electromagnetics Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To design and test the various circuits using Op-amp
- To design and test the various circuits using 555 timers
- To construct and test the phase locked loop
- To construct and test different data convertor circuits
- To demonstrate the field configurations in different geometries and waveguides

Pre-requisites

- Electronic Circuits

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Design and test the various applications of op-amp	Apply
CO2	Design and test the various applications of 555 timer	Apply
CO3	Design and test the various applications of PLL	Apply
CO4	Design and test the different data convertors	Apply
CO5	Simulate the field configurations in different geometries and waveguides	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	3	-	-	3	3	-	3	3	3	3
CO2	3	3	3	-	3	3	-	-	3	3	-	3	3	3	3
CO3	3	3	3	-	3	3	-	-	3	3	-	3	3	3	3
CO4	3	3	3	3	3	3	-	-	3	3	-	3	3	3	3
CO5	3	3	3	-	3	2	-	-	3	3	-	-	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	20	20
Apply	50	25	80	80
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 4P1- Linear Integrated Circuits and Electromagnetics Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	0	0	4	60	2	60	40	100

List of Experiments:

1. Application circuits using Op-Amp*
2. Application circuits using 555 timer*
3. Application circuits using PLL*
4. Application circuits using data convertors*
5. Simulation of the variation of electric field in point charge geometry and parallel plate capacitor geometry*
6. Simulation of Transverse electric modes in rectangular waveguide*

*SDG 4 – Quality Education

Course Designer(s)

1. Mr D.Poornakumar - poornakumard@ksrct.ac.in
2. Mr.S.Saravanan - saravanan.s@ksrct.ac.in

60 EC 4P2	Electronic Design Project Laboratory	Category	L	T	P	Credit
		CG	0	0	4	2

Objectives

- To illustrate the design, application and limitations of electronic circuits through laboratory experience
- To introduce the analysis, testing and prototyping of electronic circuits
- To design various power supply blocks needed for electronic circuits
- To design various modules needed for a signal transmitter
- To stimulate student interests and help solve circuit problems using basic concepts

Pre-requisites

- Analog and Digital Electronics Laboratory

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Design & build electronic circuits/systems using discrete components, FET transistors, Operational amplifiers, IC 555 timer and other Linear ICs to meet the desired specifications	Apply
CO2	Design and develop digital circuits for the given specifications	Apply
CO3	Exhibit creativity in the design of systems, circuits or processes and implement them	Apply
CO4	Design regulated power supplies	Apply
CO5	Switch to design mode of thinking for signal transmitter design with increased competence and success in circuit Implementation	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	-	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	-	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	50	25	50	50
Analyse	-	-	50	50
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 4P2 - Electronic Design Project Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	0	0	4	60	2	60	40	100

Students have to design application circuits/systems using analog and digital electronic components. Circuits can be chosen from the given list but need not be confined to it.

1. Design of low-noise, high-performance analog circuits*
2. Digital circuit design*
3. Electronic circuit prototyping, circuit debugging, and testing*
4. Design of power supply**
5. Design of signal transmitter**

*SDG 4 – Quality Education
**SDG 9 – Industry, innovation and Infrastructure

Course Designer(s)

1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in

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60 CG 0P3	Career Skill Development - III	Category	L	T	P	Credit
		CG	0	0	2	1

Objectives

- To help learners improve their logical reasoning skills at different academic and professional contexts.
- To help learners relate basic quantitative problems and solve them.
- To help learners Infer critically the statements with optimal conclusions and assumptions.
- To solve the quantitative problems pertaining to calculations of averages, ratio and proportions, and profit and loss effectively
- To compute quantitative problems related to time and work, speed and distance, and simple and compound interest

Pre-requisites

- Basic knowledge of Arithmetic and Logical Reasoning

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Deduce the topics in logical reasoning at the preliminary and intermediate level.	Analyze
CO2	Relate basic quantitative problems and solve them effectively at the preliminary level	Apply
CO3	Infer critically the statements with optimal conclusions and assumptions with the data and information given.	Analyze
CO4	Solve the quantitative problems pertaining to calculations of averages, ratio and proportions, and profit and loss effectively at the pre-intermediate level.	Apply
CO5	Compute quantitative problems related to time and work, speed and distance, and simple and compound interest at intermediate level.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	3	-	3	-	-	-	2	3	3	2	3	3
CO2	3	3	3	3	-	2	-	-	-	2	3	3	2	3	3
CO3	2	2	2	2	-	3	-	-	-	2	3	3	2	3	3
CO4	3	3	3	3	-	2	-	-	-	2	3	3	2	3	3
CO5	3	3	3	3	-	2	-	-	-	2	3	3	2	3	3
3 - Strong; 2 - Medium; 1 - Some															

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 CG 0P3 - Career Skill Development - III								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	0	0	2	30	1	100	00	100

Logical Reasoning* Analogies - Alpha and Numeric Series - Number Series - Coding and Decoding - Blood Relations - Coded Relations - Order and Ranking – Odd Man Out - Direction and Distance	[6]
Quantitative Aptitude – Part 1* Number System - Squares & Cubes - Divisibility - Unit Digits - Remainder Theorem - HCF & LCM - Geometric and Arithmetic Progression - Surds & Indices	[6]
Critical Reasoning* Syllogism - Statements and Conclusions, Cause and Effect, Statements and Assumptions - Identifying Strong Arguments and Weak Arguments – Cause and Action -Data Sufficiency	[6]
Quantitative Aptitude – Part 2* Average - Ratio and Proportion – Ages – Partnership– Percentage - Profit & Loss – Discount - Mixture and Allegation	[6]
Quantitative Aptitude – Part 3* Time & Work - Pipes and Cistern – Time, Speed & Distance - Trains - Boats and Streams - Simple Interest and Compound Interest	[6]
Total Hours:	**30**

Reference(s):

1.	Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2.	Abhijit Guha, “Quantitative Aptitude”, 6th Edition, McGraw Hill Education, 2016.
3.	Dinesh Khattar, “Quantitative Aptitude for Competitive Examinations”, Pearson Education 2020.
4.	Anne Thomson, “Critical Reasoning: A Practical Introduction”, 3rd Edition, Lexicon Books, 2022.

*SDG 4 – Quality Education
*SDG 8 – Decent work and Economic growth
*SDG 9 – Industry, innovation and Infrastructure

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Logical Reasoning**	
1.1	Analogies - Alpha and Numeric Series	1
1.2	Number Series - Coding and Decoding	1
1.3	Blood Relations - Coded Relations	1
1.4	Order and Ranking – Odd Man Out	1
1.5	Direction and Distance	2
2.0	**Quantitative Aptitude – Part 1**	
2.1	Number System	1
2.2	Squares & Cubes - Divisibility	1
2.3	Unit Digits - Remainder Theorem	1
2.4	HCF & LCM- Geometric and Arithmetic Progression	1
2.5	Surds & Indices	2
3.0	**Critical Reasoning**	
3.1	Syllogism	1
3.2	Statements and Conclusions, Cause and Effect	1
3.3	Statements and Assumptions	1
3.4	Identifying Strong Arguments and Weak Arguments	1
3.5	Cause and Action - Data Sufficiency	2
4.0	**Quantitative Aptitude – Part 2**	
4.1	Average - Ratio and Proportion	1
4.2	Ages – Partnership	1
4.3	Percentage	1
4.4	Profit & Loss	1
4.5	Discount - Mixture and Allegation	2
5.0	**Quantitative Aptitude – Part 3**	
5.1	Time & Work	1
5.2	Pipes and Cistern	1
5.3	Time, Speed & Distance - Trains	1
5.4	Boats and Streams	1
5.5	Simple interest and Compound interest	2

Course Designer(s)

1. R. Poovarasan - poovarasan@ksrct.ac.in

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CHAIRMAN BOARD OF STUDIES
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60 EC L01	Internet of Things	Category	L	T	P	Credit
		OE	1	0	4	3

Objectives

- To understand basics of an IoT System,
- To understand and Evaluate sensors available for IoT applications
- To analysis best IoT hardware and communication protocols for specified applications
- To understand and realize data storage, data analysis for IoT applications
- To design and develop real time IoT enabled applications

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe basic premise of an IOT System	Understand
CO2	Compare types of sensors available based on IoT applications	Analyse
CO3	Demonstrate the communication protocols for IoT	Apply
CO4	Implement cloud storage, data analysis and management	Analyse
CO5	Analysis the potential business model and viable market for IoT products	Analyse

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	3	-	-	-	-	3	3	3	-	-	3	-	3
CO2	3	2	3	2	-	-	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	-	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Assessment 1 (Presentation)		Assessment 2 (CA Test)	Assessment 3 (Model – Presentation)	
Assessment Parameters	Marks	Marks	Assessment Parameters	Marks
Problem Identification	10	Questions from CO1 to CO4 As per CA Test Pattern	Innovation	30
Innovation	30		Clarity in Presentation	10
Solution for problem	10		Demo	30
Clarity in Presentation	05		Completion of Report	20
Viva	05		Viva	10
Total	**60**	**60**	**Total**	**100**

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Open Elective								
60 EC L01 - Internet of Things								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
	1	0	4	75	3	50	50	100

Internet of Things* Functional Blocks of an IoT System (Sensors, Data Aggregation, Communication, Analysis, Decision Making, Actuation) IoT Architecture Layers, IoT Enabled Domains, M2M, Difference Between IoT, Embedded Systems and M2M, Industry 4.0 Concepts.	[3+12]
IoT Sensors and Hardware* Passive and Active Sensors, Types of Sensors (Temperature, Humidity, Pressure, Obstacle, Water Flow, Accelerometer, Colour, Gyro, Load Cell, Finger Print-Touch, Motion, Ultrasonic Distance, Magnetic Vibration, Eye Blink, Hear Beat, PPG, Glucose, Body Position, Blood Pressure), IoT Front End Hardware - Microcontrollers, Programming ESP32, Interfacing of Sensors.	[3+12]
IoT Protocols* Infrastructure (6LoWPAN, IPv4/IPv6, RPL), Identification (EPC, uCode, IPv6, URIs), Communication/ Transport (Wi-Fi, Bluetooth, Zigbee, LPWAN-LoRA), Data Protocols (MQTT, CoAP, AMQP, WebSocket, Node, LoRaWAN), Programming MQTT.	[3+12]
IoT Cloud and Data Analytics * Collecting Data from Sensors, Data Ingress, Cloud Storage, IoT Cloud Platforms (Amazon AWS, Microsoft Azure, Google APIs), Data Analytics for IoT, Software and Management Tool for IoT, Dashboard Design.	[3+12]
IoT and Entrepreneurship* Business Models for IoT Product, Lean Canvas, Market Analysis, Startup Policy and Fundings, Idea Pitching, Entity Formation, Legal and IPR.	[3+12]
Total Hours: (Lecture - 15; Practical - 60)	**75**

Text Book(s):

1.	Arshdeep Bahga, Vijay Madisetti, “Internet – of- Things – A Hands on Approach”, Universities Press, 2015.
2.	Raj kamal, “Internet of Things, Architecture and Design Principles”, McGraw-Hill, 2017.

Reference(s):

1.	Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.
2.	Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, Wiley, Nov 2013.

*SDG 9 – Industry Innovation and Infrastructure

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Internet of Things**	
1.1	Functional Blocks of an IoT System	1
1.2	IoT Architecture Layers	1
1.3	Industry 4.0 Concepts	1
2	**IoT Sensors and Hardware**	
2.1	Passive and Active Sensors	1
2.2	IoT Front End Hardware	1
2.3	Interfacing of Sensors	1
3	**IoT Protocols**	
3.1	Infrastructure	1
3.2	Data Protocols	1
3.3	Programming MQTT	1
4	**IoT Cloud and Data Analytics**	
4.1	Collecting Data from Sensors	1
4.2	IoT Cloud Platforms	1
4.3	Software And Management Tool for IoT	1
5	**IoT And Entrepreneurship**	
5.1	Business Models for IoT Product	1
5.2	Startup Policy and Fundings	1
5.3	Legal And IPR	1
6	**Project**	
6.1	Problem Identification	10
6.2	Solution for Problem	15
6.3	Implementation	20
6.4	Presentation	5
6.5	Report	5
6.6	Demo	5

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC L02	Wearable Devices	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To learn the field of wearable devices and applications
- To study the various components and technologies used in wearable devices
- To discuss the product development and design factors in wearable device
- To understand the security issues, privacy concerns
- To learn about the psychological effects, and social impact, health issues related to wearable devices

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the history, current devices used as wearables and their applications	Understand
CO2	Describe the key functions and basic principles of various components and technologies used in wearable devices	Understand
CO3	Illustrate the development process and design considerations in wearable products	Understand
CO4	Review security and privacy issues in wearable technology	Understand
CO5	Explore the psychological and social impact, health concerns related to wearable devices	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	-	2	2	3	3	3	-	3	3	2	3
CO4	3	3	3	-	-	2	2	3	3	3	-	3	3	2	3
CO5	3	3	3	-	-	2	2	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	15	15	20
Understand	45	45	80
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Open Elective								
60 EC L02 - Wearable Devices								
Semester	Hours / Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
	3	0	0	45	3	40	60	100

Evolution of Wearables Evolution of Wearable Technology - Role of Wearables - Applications of Wearable Technology in Industry Sectors' Overview - Wearables: Challenges and Opportunities, Future and Research - Wearable Biomedical Devices and Its Applications Case Study: Google glass, Health monitoring.	[9]
Components and Technologies** Wearable Components and Technologies: Microcontrollers and Microprocessors, Operating Systems, Sensors, Wireless Connectivity Unit, Battery Technology, User Interface Elements - Artificial intelligence - Machine learning - IoT - Data mining - Virtual and Augmented Reality - Voice Recognition.	[9]
Product Development and Design Considerations Product Development Process - Engineering Analysis, Prototyping, Testing and Validation, Production. Design considerations- Various Factors and Requirements – Operational, Power Packaging and Material, Maintenance.	[9]
Security Issues and Privacy Concerns Security and Privacy Issues in Wearable Technology, Correlation between Product and Security Related Factors, Functionality vs. Perceived Security and Privacy, System Vulnerabilities and Potential Attack, Attack Categories - Potential Solutions - Product Case Examples.	[9]
Psychological and Social Impact, Health Concern* Psychological Effects of Wearables, Social Implications, Technology Acceptance Factors, Electromagnetic Radiation, Specific Absorption Rate, Thermal Effects, Cancer - Fertility, - Vision and Sleep Disorder - Pain and Discomfort - Electromagnetic Intolerance and Other Risks.	[9]
Total Hours	**45**

Text Book(s):

1.	HaiderRaad, "The Wearable Technology Handbook", United Scholars Publication, 2017.
2.	Hang,Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013.

Reference(s):

1.	http://www.medgadget.com
2.	https://www.wareable.com
3.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability", Cambridge University Press, 2013.
4.	Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications", Elsevier, 2014.

*SDG 3 - Good Health and Well Being
** SDG 9 - Sustainable industrialization and foster innovation

Assignment Activity:

Assignment 1:
1. Prepare a case study on wearable applications.
2. Poster Presentation components and technologies.

Assignment 2:
1. Group discussion in product development process.

Assignment 3:
1. Video presentation on security and privacy issues.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1	**Evolution of Wearables**	
1.1	Evolution of wearable technology	1
1.2	Role of Wearables	1
1.3	Applications of wearable Technology in industry sectors' overview	1
1.4	Wearables: challenges and opportunities	1
1.5	Future and research	1
1.6	Wearable Biomedical Devices	1
1.7	Biomedical Devices Applications	1
1.8	Case Study: Google glass	1
1.9	Case Study: Health monitoring	1
2	**Components and Technologies**	
2.1	Wearable Components and Technologies	1
2.2	Microcontrollers and Microprocessors	1
2.3	Operating Systems, Sensors	1
2.4	Wireless Connectivity Unit, Battery technology	1
2.5	User Interface Elements	1
2.6	Artificial Intelligence, Machine Learning	1
2.7	IoT, Data Mining	1
2.8	Virtual and Augmented Reality	1
2.9	Voice Recognition	1
3	**Product Development and Design Considerations**	
3.1	Product Development Process	1
3.2	Engineering Analysis	1
3.3	Prototyping	1
3.4	Testing and Validation, Production	1
3.5	Design Considerations	1
3.6	Various Factors and Requirements	1
3.7	Operational	1
3.8	Power Packaging and Material	1
3.9	Maintenance	1
4	**Security Issues and Privacy Concerns**	
4.1	Security issues	1
4.2	Privacy issues in wearable technology	1
4.3	Correlation between Product and Security Related Factors	1
4.4	Functionality vs. Perceived Security and Privacy	1
4.5	System Vulnerabilities and Potential Attack	1
4.6	Attack Categories	1
4.7	Potential solutions	1
4.8	Product case examples	2
5	**Psychological and Social Impact, Health Concern**	
5.1	Psychological Effects of Wearables	1
5.2	Social Implications	1
5.3	Technology Acceptance Factors	1
5.4	Electromagnetic Radiation, Specific Absorption Rate	1
5.5	Thermal Effects, Cancer	1

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5.6	Fertility, Vision	1
5.7	Sleep Disorder	1
5.8	Pain and Discomfort	1
5.9	Electromagnetic Intolerance and Other Risks	1

Course Designer(s)

1. Ms.R.Ramya - rramya@ksrct.ac.in

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CHAIRMAN BOARD OF STUDIES
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60 EC L03	Next Generation Wireless Networks	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To study about advanced wireless networks, 4G/5G
- To study about SDN basics and architecture
- To study about NFV basics and architecture
- To study about Network Slicing & Radio access network
- To understand the recent trends and various applications in Next generation wireless networks

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the principles of latest 4G/5G networks	Understand
CO2	Explain the SDN basics and architecture	Understand.
CO3	Describe the NFV basics and architecture	Understand.
CO4	Discuss about the concepts of network slicing & radio access network	Understand.
CO5	Illustrate the recent trends and various applications in Next generation wireless networks	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	40	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

Open Elective

60 EC L03 – Next Generation Wireless Networks

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
	3	0	0	45	3	40	60	100

Wireless Networks 3G, 4G(LTE) and 5G - Evolving LTE to 5G Capability - 5G NR and 5G Core Network (5GCN) - 5G Standardization - 5G Architecture - Spectrum for 5G - 5G Deployment - Options, Challenges and Applications. **Hands - on:** 1. Implementation of Time Division Multiplexing. 2. Implementation of CDMA. 3. Modeling a 4G LTE System.	[9]
Software-defined networking* SDN Origins and Evolution, - Background on Implantation of SDN for 5G -Hybrid Architecture of SDN and SDR - SDN Based Network Configuration to Deliver Content Intelligently over LTE.	[9]
Network functions virtualization* Network Functions Virtualization - Features of NFV-NFV and SDN Relationship - NFV Architecture, Evolution & Background - NFV Layers and Architecture	[9]
Network Slicing & Radio access network* Network Slicing - Key Concepts – Architecture - Benefits of 5G infrastructure in Network Slicing - RAN Architecture - Advantages and Challenges of the Cloud (or Centralized) RAN (C-RAN) and the Virtualized RAN (V-RAN).	[9]
Recent Trends and applications* Massive IoT and Ultra - Low-Latency Applications, Narrow - Band IoT (NB-IoT) and Machine to Machine (M2M) Communications, 6G Applications - Unmanned Aerial Vehicles (UAV), Optical Wireless Communication (OWC).	[9]
Total Hours:	**45**

Text Book(s):

1.	Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, 1st Edition, CRC Press, 2019.
2.	Ulrich Trick, “An Introduction to the 5th Generation Mobile Networks”, Walter de Gruyter ,2021.

Reference(s):

1.	Afif osseiran, Jose F. Monserrat, Patrick marsch, “5G Mobile and wireless communications technology“, Cambridge university, 2016.
2.	Ying Zhang, “Network Function Virtualization: Concepts and Applicability in 5G Networks”, John Wiley & Sons, 2018.
3.	Guy Pujolle, “Software Networks: Virtualization, SDN, 5G and Security”, John Wiley & Sons, 2015.
4.	Dr. William Stallings, “5G Wireless A Comprehensive Introduction”, Addison-wesley, 2021.

*SDG 9 - Build resilient infrastructure and foster innovation

Assignment activity:

Assignment 1:
1. Chart work and presentation on Electromagnetic spectrum.

Assignment 2:
1. Implementation of SDN using simulator.

Assignment 3:
1. Mini project on M2M communication.

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Course Contents and Lecture Schedule		
S. No.	Topics	No. of hours
1.0	**Wireless Networks**	
1.1	3G and 4G(LTE)	1
1.2	5G	1
1.3	Evolving LTE to 5G Capability	1
1.4	5G NR and 5G Core Network (5GCN)	1
1.5	5G Standardization	1
1.6	5G Architecture	1
1.7	Spectrum for 5G	1
1.8	5G Deployment	1
1.9	Options, Challenges and Applications	1
2.0	**Software-defined networking**	
2.1	Introduction	1
2.2	SDN Origins	1
2.3	SDN Evolution	1
2.4	SDN Architecture	1
2.5	Background on Implantation of SDN for 5G	1
2.6	Hybrid Architecture of SDN and SDR	1
2.7	Hybrid Architecture of SDN and SDR	1
2.8	SDN Based Network Configuration to Deliver Content Intelligently over LTE.	1
2.9	SDN Based Network Configuration to Deliver Content Intelligently over LTE.	1
3.0	**Network functions virtualization**	
3.1	Introduction	1
3.2	Network Functions Virtualization	1
3.3	Features of NFV	1
3.4	NFV and SDN Relationship	1
3.5	NFV Architecture,	1
3.6	Evolution	1
3.7	NFV Layers	1
3.8	Background	1
3.9	Applications	1
4.0	**Network Slicing & Radio access network**	
4.1	Introduction to Network Slicing	1
4.2	Key Concepts	1
4.3	Network Slicing Architecture	1
4.4	Benefits of 5G infrastructure in Network Slicing	1
4.5	Architecture	1
4.6	Advantages and Challenges of the Cloud (or Centralized) RAN (C-RAN)	1
4.7	Advantages and Challenges of the Virtualized RAN (V-RAN).	1
4.8	C-RAN Architecture	1
4.9	V-RAN Architecture	1
5.0	**Recent Trends and applications**	
5.1	Massive IoT	1
5.2	Ultra-Low-Latency Applications	1
5.3	Narrow-Band IoT (NB-IoT)	1
5.4	Machine To Machine (M2M) Communication	1

5.5	6G Applications	1
5.6	Unmanned Aerial Vehicles (UAV)	1
5.7	Unmanned Aerial Vehicles (UAV)-Challenges	1
5.8	Optical Wireless Communication (OWC)	1
5.9	Optical Wireless Communication (OWC) -Challenges	1

Course Designer(s)

1. Mr.R.Satheesh kumar - satheeshkumar@ksrct.ac.in

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60 EC L04	Microprocessor and Microcontroller	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To introduce the architecture and programming of 8085 microprocessor
- To introduce the architecture, programming and interfacing of 8051 micro controller
- To understand the special function registers of 8051 and to perform an assembly level programming.
- To introduce the AI boards
- To develop microcontroller-based Applications

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs	Understand
CO2	Discuss the architecture and features of 8051	Understand
CO3	Discuss the functions of the special function registers	Understand
CO4	Discuss the Edge AI development KIT	Understand
CO5	Develop microcontroller-based system and interface various input and output peripherals.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	3	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	40	40
Apply	-	-	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022								
Open Elective								
60 EC L04 – Microprocessor and Microcontroller								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
	3	0	0	45	3	40	60	100

8085 – 8 Bit Microprocessor* 8085 Architecture – Instruction Set – Addressing Modes – Interrupt Structure – Timing Diagrams – Memory Interfacing – Interfacing I/O Devices – Assembly Language Programming.	[9]
8051 – 8 Bit Microcontroller* 8051 – Architecture, Clock and RESET Circuits, PSW, Stack and Stack Pointer, Program Counter, I/O Pins Ports and Circuits, Instruction Set, Addressing Modes.	[9]
8051 Special Purpose Registers and Programming* Special Function Register – Interfacing of Memory Devices – Timer Programming, Serial Data Transfer – UART – I/O Ports and Port Expansion, Programing on Interrupts. Assembly Language Programs, C Language Programs using SFR**	[9]
Peripheral Interfacing** Standard Interfaces – RS232, USB, SPI and I2C, Interfacing of Sensors, DAC, ADC, PWM, DC Motor, Stepper Motor and LCD Interfacing.	[9]
AI Based Board* Basic Principles of OS – OS Architecture – Overview of an Edge AI Hardware, Basic Setup and OS Installation, Python and C Programming, Linux Library Installation, Executing AI Models in Edge AI Hardware**.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Ramesh S Gaonkar, “Microprocessor Architecture, Programming and application with 8085”, 6th Edition, Penram International Publishing, 2015.
2.	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011.
Reference(s):	
1.	Krishna Kant, “Microprocessors and microcontrollers Architecture, Programming and System design 8085, 8086, 8051, 8096”, 3rd Reprint, Prentice Hall of India, 2014.
2.	Ayala K.J, “8051 Microcontroller”, Delmar Cengage Learning, 3rd Edition, 2007.
3.	NPTEL video lectures by M. Krishna Kumar, IISc.

*SDG 4 - Quality Education
**SDG 9 - Industry Innovation and Infrastructure

Assignment Activity:

Assignment 1 – Covers Module 1 & 2 Questions related to the problems and simulation / Hands on
1. Arithmetic operation for 8085 processor.

Assignment 2 - Covers Module 1 & 2 Questions related to the problems and simulation / Hands on
1. Embedded C program for configuring the Ports and Peripheral interface with 8051.

Assignment 3 – Mini Project

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**8085 – 8 Bit Microprocessor**	
1.1	8085 Architecture	1
1.2	Instruction set	1
1.3	Addressing modes	1
1.4	Interrupt structure	1
1.5	Timing diagrams	1

1.6	Interfacing basics	1
1.7	Memory interfacing	1
1.8	Interfacing I/O devices	1
1.9	Assembly language programming	1
2.0	**8051 – 8 Bit Microcontroller**	
2.1	8051 – Architecture	1
2.2	Clock Circuits	1
2.3	RESET circuits PSW	1
2.4	Stack and Stack Pointer	1
2.5	Program Counter	1
2.6	I/O Pins Ports	1
2.7	I/O Pins Ports and Circuits	1
2.8	Instruction set	1
2.9	Addressing modes	1
3.0	**8051 Special Purpose Registers and Programming**	
3.1	Special Function register	1
3.2	Interfacing of memory devices	1
3.3	Timer programming	1
3.4	Serial data transfer – UART	1
3.5	I/O ports and port expansion	1
3.6	I/O ports expansion	1
3.7	Programing on Interrupts	1
3.8	Assembly language programs,	1
3.9	C language programs using SFR	1
4.0	**Peripheral Interfacing**	
4.1	Standard interfaces – RS232	1
4.2	Standard interfaces – USB	1
4.3	I2C	1
4.4	Interfacing of sensors	1
4.5	DAC	1
4.6	ADC	1
4.7	PWM	1
4.8	DC motor, Stepper motor	1
4.9	LCD interfacing	1
5.0	**AI Based Board**	
5.1	Basic principles of OS	1
5.2	OS Architecture	1
5.3	Edge AI Hardware,	1
5.4	OS Setup	1
5.5	OS installation	1
5.6	Python Programming	1
5.7	C Programming	1
5.8	Linux library installation	1
5.9	Executing AI models in Edge AI Hardware.	1

Course Designer(s)

1. Dr. C. Rajasekaran – rajasekaran@ksrct.ac.in
2. Dr.T.Baranidharan - baranidharan@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

60 EC L05	5G Communications and MIMO	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To equip the participants with fundamental understanding of the key requirements, key capabilities and usage scenarios of 5G and the key innovations behind it.
- To guide the participants to identify the various opportunities offered by 5G.
- To provide awareness about the issues and challenges for 5G deployment.
- Understand the massive MIMO for 5G.
- Learn the different 5G applications and its security.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Recall the basic concepts of Wireless communication.	Understand
CO2	Apply the cellular concepts of 5G mobile Communication.	Apply
CO3	Contrast the concepts of different multiple access techniques and MIMO techniques.	Understand
CO4	Illustrate the massive MIMO of 5G technology.	Understand
CO5	Explain the concepts of 5G Application and Security.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	3	3	3	3	3	-	-	3	2	3
CO5	3	3	3	-	-	3	3	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	30	40	50
Apply	10	-	10
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Open Elective								
60 EC L05 - 5G Communications and MIMO								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
	3	0	0	45	3	40	60	100

Communication Systems General Communication Systems, Main Classification of Signals, Frequency and Wavelength, Bandwidth, Half Duplex and Full Duplex, Transmission Lines, MODEM, Multiplexing, Electromagnetic Spectrum, Evaluation of Mobile Technologies 1G to 4G. **Hands - on:** 1. Simulation of Time Division Multiple Access and Space Division Multiple Access 2. MIMO Wireless System Design for 5G using MATLAB 3. 5G Waveforms Generation using MATLAB	[9]
Cellular concepts* Frequency Reuse-System Architecture - Hand off - Interference & System Capacity - Reflection-Diffraction - Scattering-Fading - Coverage and Capacity Improvement: Cell Splitting-Sectoring – Repeaters - Microcell Zone Concepts.	[9]
Multiple Access Techniques* Multiple Access - Techniques: FDMA, TDMA, CDMA, SDMA, OFDM, Filter Banks, GFDM, OTFS, Packet Radio, Non-Orthogonal Multiple Accesses (NOMA).	[9]
MIMO* Point-to-Point MIMO, Virtual MIMO (relaying), Multiuse MIMO, Massive MIMO, Propagation Channel Model, Channel Estimation, Uplink and Downlink Data Transmission Capacity Bounds, Achievable Rate, Energy and Spectral Efficiency Trade-Off.	[9]
5G Applications** High Speed Mobile Network, Device-to-Device (D2D), Vehicle to Vehicle Communication (V2V), Vehicle to Infrastructure Communication (V2I), Smart Home, Smart Cities, Industrial IOT, Security and Surveillance, Indoor and Outdoor Positioning Accuracy Technologies, Enhanced Mobile Broadband (eMBB).	[9]
Total Hours:	**45**

Text Book(s):

1.	Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock, “Millimeter Wave Wireless Communications”, 1st Edition, Pearson,2014..
2.	Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, “5G Mobile Communications”, Springer, 2017.

Reference(s):

1.	W.C.Y.Lee, “Mobile Communications Engineering: Theory and applications”, 2nd Edition, McGraw-Hill International, 2009.
2.	David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge university press, 2005.
3.	Martin Sauter, “From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband”, Wiley-Blackwell, 2016.

*SDG 4 - Quality education

**SDG 9 - Industry, Innovation and Infrastructure

Assignment activity:

Questions related to the simulation / Hands on/chart preparation

Assignment 1 – Covers Module 1 &2

1. Electromagnetic Spectrum- Chart Preparation
2. Multiplexing- Simulation

Assignment 2 - Covers Module 3 &4

1. FDMA, TDMA, CDMA, SDMA, OFDM- Simulation

Assignment 3:

1. Case study - 5G Applications

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Course Contents and Lecture Schedule		
S. No.	Topics	No. of hours
1.0	**Communication Systems**	
1.1	General Communication Systems	1
1.2	Main Classification of Signals, Frequency and Wavelength	1
1.3	Bandwidth	1
1.4	Half Duplex and Full Duplex	1
1.5	Transmission Lines	1
1.6	MODEM	1
1.7	Multiplexing	1
1.8	Electromagnetic Spectrum	1
1.9	Evaluation of Mobile Technologies 1G to 4G	1
2.0	**Cellular concepts**	
2.1	Frequency Reuse-System Architecture	1
2.2	Hand Off	1
2.3	Interference & System Capacity	1
2.4	Reflection	1
2.5	Diffraction	1
2.6	Scattering	1
2.7	Fading	1
2.8	Coverage and Capacity Improvement: Cell Splitting	1
2.9	Sectoring, Repeaters, Microcell Zone Concepts	1
3.0	**Multiple Access Techniques**	
3.1	Multiple Access Techniques	1
3.2	FDMA, TDMA	1
3.3	CDMA, SDMA	1
3.4	OFDM	1
3.5	Filter Banks	1
3.6	GFDM	1
3.7	OTFS	1
3.8	Packet Radio	1
3.9	Non-Orthogonal Multiple Accesses (NOMA)	1
4.0	**MIMO**	
4.1	Point-to-Point MIMO	1
4.2	Virtual MIMO (relaying)	1
4.3	Multiuse MIMO	1
4.4	Massive MIMO	1
4.5	Propagation Channel Model	1
4.6	Channel Estimation	1
4.7	Uplink and Downlink Data Transmission Capacity Bounds	1
4.8	Achievable Rate	1
4.9	Energy and Spectral Efficiency Trade-Off	1
5.0	**5G Applications**	
5.1	High Speed Mobile Network	1
5.2	Device-to-Device (D2D)	1

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5.3	Vehicle to Vehicle Communication (V2V)	1
5.4	Vehicle to Infrastructure Communication (V2I), Smart Home	1
5.5	Smart Cities	1
5.6	Industrial IOT	1
5.7	Security and Surveillance,	1
5.8	Indoor and Outdoor Positioning Accuracy Technologies	1
5.9	Enhanced Mobile Broadband (eMBB)	1

Course Designer(s)

1. Mr.R.Satheesh Kumar - satheeshkumar@ksrct.ac.in

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60 EC L06	Mobile Robotics	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To broaden the importance of Robot Locomotion
- To learn the knowledge of mobile Robot kinematics and dynamics
- To broaden the importance of GPS and sensors
- To enhance the knowledge about Localization, Planning and Navigation
- To make the student design, fabricate, motion planning, and control of intelligent mobile robotic systems

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Summarize about the Robot Locomotion	Apply
CO2	Explain the Kinematics and Dynamics of Mobile Robots	Apply
CO3	Utilize the Sensors and GPS in Robots	Apply
CO4	Solve the Localization and Planning problems in Mobile Robots	Apply
CO5	Apply the knowledge of Navigation in Mobile Robots	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	2	2	2	-	2	3	2	3
CO2	3	3	3	-	3	-	-	2	2	2	-	2	3	2	3
CO3	3	3	3	-	2	-	-	2	2	2	-	2	3	2	3
CO4	3	3	3	-	3	-	-	2	2	2	-	2	3	2	3
CO5	3	3	3	-	2	-	-	2	2	2	-	2	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	20	20	33
Apply	20	20	-30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Open Elective								
60 EC L06 - Mobile Robotics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
	3	0	0	45	3	40	60	100

Robot Locomotion* Types of Locomotion - Hopping Robots, Legged Robots, Wheeled Robots - Stability - Manoeuvrability - Controllability.	[9]
Mobile Robot Kinematics and Dynamics* Forward And Inverse Kinematics - Holonomic and Nonholonomic Constraints - Kinematic Models of Simple Car and Legged Robots - Dynamics Simulation of Mobile Robots.	[9]
Perception* Proprioceptive/Exteroceptive and Passive/Active Sensors - Performance Measures of Sensors - Sensors For Mobile Robots Like Global Positioning System (GPS) - Doppler Effect Based Sensors - Vision Based Sensors - Uncertainty In Sensing – Filtering.	[9]
Localization* Odometric Position Estimation - Belief Representation - Probabilistic Mapping - Markov Localization - Bayesian Localization - Kalman Localization - Positioning Beacon Systems.	[9]
Planning and navigation* Path Planning Algorithms Based on A-Star - Dijkstra, Voronoi Diagrams- Probabilistic Roadmaps (PRM), Rapidly Exploring Random Trees (RRT), Markov Decision Processes (MDP) - Stochastic Dynamic Programming (SDP).	[9]
Total Hours:	**45**

Text Book(s):

1.	Siegwart R, Nourbakhsh I.R, “Introduction to Autonomous Mobile Robots”, The MIT Press, 2017.
2.	Peter Corke, “Robotics, Vision and Control: Fundamental Algorithms in MATLAB”, Springer Tracts in Advanced Robotics, 2018.

Reference(s):

1.	La Valle S.M, “Planning Algorithms”, Cambridge University Press, 2016.
2.	Thrun S, Burgard W and Fox D, “Probabilistic Robotics”, MIT Press, Cambridge MA, 2017.
3.	Melgar E.R and Diez C.C, “Arduino and Kinect Projects: Design”, Build Blow Their Minds, 2016.

*SDG 9 – Industry Innovation and Infrastructure

Assignment activity:

Assignment 1:
Create the actual framework of your mobile robot with open source CAD software, which includes components like as wheels, motors, sensors, and any other required pieces.

Assignment 2:
Provide a simulation of a real-world application in which GPS and navigation are crucial to improving the autonomy and performance of mobile robotics. Examine the limits and potential future improvements in GPS-based navigation for mobile robotics.

Assignment 3:
Poster presentation

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Robot locomotion**	
1.1	Introduction to Robot Locomotion	1
1.2	Hopping Robots	2
1.3	Legged Robots	2
1.4	Wheeled Robots	2
1.5	Stability – Maneuverability - Controllability	2
2.0	**Mobile Robot Kinematics and Dynamics**	
2.1	Introduction Mobile Robot Kinematics and Dynamics	1
2.2	Forward and Inverse Kinematics	2
2.3	Holonomic and Nonholonomic Constraints	2
2.4	Kinematic Models of Simple Car and Legged Robots	2
2.5	Dynamics Simulation of Mobile Robots	2
3.0	**Perception**	
3.1	Perception	1
3.2	Proprioceptive/Exteroceptive and Passive/Active Sensors	1
3.3	Performance Measures of Sensors	1
3.4	Sensors for Mobile Robots	1
3.5	Global Positioning System (GPS)	1
3.6	Doppler Effect-Based Sensors	1
3.7	Vision-Based Sensors	1
3.8	Uncertainty in Sensing	1
3.9	Filtering	1
4.0	**Localization**	
4.1	Localization	1
4.2	Odometric Position Estimation	1
4.3	Belief Representation	1
4.4	Probabilistic Mapping	1
4.5	Markov Localization	1
4.6	Bayesian Localization	2
4.7	Kalman Localization	1
4.8	Positioning Beacon Systems	1
5.0	**Introduction to planning and navigation**	
5.1	Introduction to Planning and Navigation	1
5.2	Path Planning Algorithms Based On A-Star	1
5.3	Dijkstra	1
5.4	Voronoi Diagrams	1
5.5	Probabilistic Roadmaps (PRM)	2
5.6	Rapidly Exploring Random Trees (RRT)	1
5.7	Markov Decision Processes (MDP)	1
5.8	Stochastic Dynamic Programming (SDP)	1

Course Designer(s)

1. Dr.D. Mugilan - mugilan@ksrct.ac.in

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

FIFTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 EC 501	Control Systems Engineering	2	40	60	100	45	100
2.	60 EC 502	VLSI and Chip Design	2	40	60	100	45	100
3.	60 EC 503	Digital Signal Processing	2	40	60	100	45	100
4.	60 EC 504	Microprocessors and Microcontrollers	2	40	60	100	45	100
5.	60 OE L2*	Open Elective II	2	40	60	100	45	100
6.	60 MY 003	Startups and Entrepreneurship	2	100	-	100	-	100
THEORY CUM PRACTICAL								
7.	60 EC E1*	Professional Elective I	2	50	50	100	45	100
PRACTICAL								
8.	60 EC 5P1	Microcontrollers Laboratory	3	60	40	100	45	100
9.	60 EC 5P2	VLSI Laboratory	2	60	40	100	45	100
10.	60 EC 5P3	Signal Processing Laboratory	3	60	40	100	45	100
11.	60 CG 0P4	Career Skill Development – IV	2	100	00	100	00	100
12.	60 CG 0P6	Internship	-	100	-	100	-	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

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60 EC 501	Control Systems Engineering	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To understand the concepts of mathematical models, transfer function, block diagram reduction techniques and signal flow graphs.
- To learn methods for improving system time response and frequency response and types of controllers.
- To learn the concepts of stability in time domain and frequency domain.
- To analyse the frequency domain response of the given systems.
- To analyse digital control system using the state space technique

Pre-requisites

- Integrals, Partial Differential Equations and Laplace Transform

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Derive the mathematical modelling of the physical systems and find out the transfer function using block diagram reduction techniques and signal flow graphs.	Apply
CO2	Apply standard test signals to a second order control system to determine their characteristics in time and frequency domain.	Apply
CO3	Analyse the control system behaviour using stability analysis technique.	Apply
CO4	Analyse the open loop control system using frequency response methods and various types of compensators to determine stability margins.	Apply
CO5	Analyse the state variable model of a discrete time control systems.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	2	-	-	-	3	3	-	-	3	2	3
CO2	3	3	3	-	2	-	-	-	3	3	-	-	3	2	3
CO3	3	3	3	3	2	-	-	-	3	3	-	-	3	2	3
CO4	3	3	3	3	2	-	-	-	3	3	-	-	3	2	3
CO5	3	3	3	-	2	-	-	-	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	30
Apply	40	40	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022
B.E - Electronics and Communication Engineering
60 EC 501 - Control Systems Engineering

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	1	0	60	4	40	60	100

Systems Modeling* Open loop and Closed loop Systems - Modeling of Electrical and Mechanical Systems - Translational and Rotational Systems - Block Diagram Reduction - Signal Flow Graph - Mason's Gain Formula - Applications of Control Systems - Drone Control System Design**.** **Hands - on:** Write a program to find the overall transfer function if the two system are connected to cascade system, parallel system and feedback system.	[9]
Time and Frequency Domain Analysis* Standard test signals - Time response of Second Order Systems - Performance Specifications on System Time Response - Types of systems - Steady State Error - Introduction to PID Controllers - Performance Specifications on System Frequency Response. **Hands - on:** Plot the time response and frequency response of the given system subjected to standard input	[9]
Stability Analysis* Concepts of Stability - Routh Stability Criterion - Concepts of Root Locus Technique - Guidelines for Sketching Root Locus. **Hands - on**: Sketch the root locus of the unity feedback systems governed by the open loop transfer function	[9]
Frequency Response and System Analysis* Polar plot - Nyquist stability Criterion - Bode Plot - Compensator Design using Bode Plot - Cascade Lead Compensation, Cascade Lag Compensation. **Hands - on:** Write a program to draw the polar plot and bode plot for various open loop transfer function and calculate gain margin and phase margin.	[9]
State Space Analysis of Digital Control Systems* State Space Representation of Discrete time Systems - Solution of Discrete Time State Space Equation - State Transition Matrix - Decomposition Techniques - Controllability and Observability, **Hands - on:** Write a program to determine the controllability and observability of the system governed by state model.	[9]
Total Hours: (Lecture - 45; Tutorial - 15)	**60**

Text Book(s):

1.	Gopal M, “Control Systems, Principles & Design”, 4th Edition, Tata McGraw Hill, 2012.
2.	Nagrath I.J & Gopal M, “Control Systems Engineering”, 6th Edition, New Age International Publishers, 2018.

Reference(s):

1.	Norman S.Nise, “Control Systems Engineering”, 8th Edition, Wiley, 2019.
2.	Ogata K, “Modern Control Engineering”, 5h Edition, Pearson Education India, 2015
3.	Ogata K, “Discrete Time Control Systems”, 2nd Edition, Pearson Education India, 2012
4.	Benjamin.C. Kuo, Farid Golnaraghi, “Automatic Control Systems”, 10th Edition, McGraw-Hill Education, 2017.

*SDG 4 - Quality Education

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Systems Modeling**	
1.1	Open Loop and Closed Loop Systems & Modeling of Electrical Systems	1
1.2	Modeling of Mechanical Systems	1
1.3	Translational Systems	1
1.4	Rotational Systems	1
1.5	Block Diagram Reduction - Rules	1
1.6	Block Diagram Reduction - Problems	1
1.7	Signal Flow Graph - Concept	1
1.8	Mason's Gain Formula - Problem	1
1.9	Applications of Control Systems - Drone Control System Design	1
1.10	Tutorial	3
2.0	**Time and Frequency Domain Analysis**	
2.1	Standard Test Signals	1
2.2	Time Response of Second Order Systems	1
2.3	Time Response of Second Order Systems- Problems	1
2.4	Performance Specifications on System Time Response- Concepts	1
2.5	Performance Specifications on System Time Response- Problems	1
2.6	Types of Systems & Steady State Error	1
2.7	Introduction to PID Controllers	1
2.8	Performance Specifications on System Frequency Response	1
2.9	Specifications on System Frequency Response - Problems	1
2.10	Tutorial	3
3.0	**Stability Analysis**	
3.1	Concepts of Stability	1
3.2	Routh Stability Criterion - Concepts	1
3.3	Routh Stability Criterion - Problems	1
3.4	Routh Stability Criterion - Problems	1
3.5	Concepts of Root Locus Technique	1
3.6	Guidelines for Sketching Root Locus	1
3.7	Sketching Root Locus	1
3.8	Sketch the Root Locus - Problems	1
3.9	Sketch the Root Locus - Problems	1
3.10	Tutorial	3
4.0	**Frequency Response and System Analysis**	
4.1	Polar Plot	1
4.2	Nyquist Stability Criterion	1
4.3	Bode Plot - Concepts	1
4.4	Bode Plot - Problems	1
4.5	Compensator Design Using Bode Plot - Concepts	1
4.6	Cascade Lead Compensation - Procedure	1
4.7	Cascade Lead Compensation - Problems	1
4.8	Cascade Lag Compensation - Procedure	1
4.9	Cascade Lag Compensation - Problems	1
4.10	Tutorial	3

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5.0	**State Space Analysis of Digital Control Systems**	
5.1	State Space Representation of Discrete Time Systems	1
5.2	Solution of Discrete Time State Space Equation - Concepts	1
5.3	Solution of Discrete Time State Space Equation - Problems	1
5.4	State Transition Matrix - Concepts	1
5.5	State Transition Matrix - Problems	1
5.6	Decomposition Techniques	1
5.7	Decomposition Techniques - Problems	1
5.8	Controllability and Observability - Concepts	1
5.9	Controllability and Observability - Problems	1
5.10	Tutorial	3

Course Designer(s)

1. Dr.P.Babu - pbabu@ksrct.ac.in
2. Ms.C.Saraswathy - saraswathy@ksrct.ac.in

60 EC 502	VLSI and Chip Design	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To study the fundamentals of IC technology components and their characteristics.
- To understand the combinational logic circuits and design principles.
- To understand sequential logic circuits and clocking strategies.
- To discuss the arithmetic building blocks and memory architecture.
- To learn the concept of testability and ASIC Design of VLSI circuits.

Pre-requisites

- Digital System Design

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the MOS technologies	Understand
CO2	Describe combinational logic circuits and design principles	Understand
CO3	Describe sequential logic circuits and clocking strategies	Understand
CO4	Design arithmetic building blocks and memory architecture	Apply
CO5	Illustrate the ASIC design process and testing	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	3	-	-	3	3	3	-	3	3	2	3
CO2	3	3	-	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	-	-	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	-	-	3	-	3	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	50	40	60
Apply	-	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 502 - VLSI and Chip Design								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

MOS Transistor Principles Long Channel I-V Characteristics - VTC Parameters (DC Characteristics) - Second Order Effects - CMOS Logic - CMOS Fabrication: n-Well Processes - Layout Design Rules - Technology Scaling* - Advanced Technologies*: FinFET, GAA and RibbonFET.	[9]
Combinational Logic Circuits Propagation Delays - Elmore's Constant - Power Dissipation - Low Power Design Principles - Static CMOS Design - Dynamic CMOS Design.	[9]
Sequential Logic Circuits and Clocking Strategies Static Latches and Registers - Dynamic Latches and Registers - Pipelines - Non-Bistable Sequential Circuits - Timing Classification of Digital Systems - Synchronous Design - Self Timed Circuit Design.	[9]
Arithmetic Building Blocks and Memory Architecture Adders – Multipliers - Shift Registers - Logic Implementation using Programmable Devices (ROM, PLA, FPGA) - Memory Architecture and Building Blocks - Memory Core and Memory Peripherals Circuitry*.	[9]
ASIC Design and Design for Testability ASIC Design Flow - ASIC Types: Full Custom, Semi-Custom, FPGA - Issues in Design for Testability - Fault Model Types - Automatic Test Pattern Generation - IC Packaging Technology: Chiplet/Dis-Aggregated Technologies*.	[9]
Total Hours:	**45**

Text Book(s):

1.	Jan M Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016.
2.	Neil H.E Weste, Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective", Addison Wesley, 2017.

Reference(s):

1.	Smith M.J, "Application Specific Integrated Circuits", Addison Wesley, 2002.
2.	Samir Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2011.
3.	Charles H Roth Jr, Lizy Kurian John and Byeong Kil Lee, "Digital Systems Design Using Verilog", 1st Edition, Cengage Learning, 2016.
4.	Parag K.Lala, "Digital Circuit Testing and Testability", Academic Press, 1997.

*SDG 9 - Industry Innovation and Infrastructure

Assignment Activity:

Assignment 1:
1. Simulation of various digital circuits with test bench code using EDA tools
2. Prepare case study report on advanced technologies
3. Poster presentation on low power design principles

Assignment 2:
1. Mini project using FPGA
2. Video presentation on memory core

Assignment 3:
1. Case Studies - ASIC Design

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**MOS Transistor Principles**	
1.1	Long channel I-V characteristics	1
1.2	VTC Parameters (DC characteristics)	1
1.3	Second Order Effects	1
1.4	CMOS Logic	1
1.5	CMOS Fabrication: n-Well Processes	1
1.6	Layout Design Rules	1
1.7	Technology Scaling	1
1.8	Advanced Technologies: Fin FET, GAA	1
1.9	Advanced Technologies: Ribbon FET	1
2.0	**Combinational Logic Circuits**	
2.1	Propagation Delays	1
2.2	Elmore's Constant	1
2.3	Power Dissipation	1
2.4	Low Power Design Principles	1
2.5	Static CMOS Design: Complementary CMOS	1
2.6	Static CMOS Design: Ratioed Logic	1
2.7	Static CMOS Design: Pass-Transistor Logic	1
2.8	Dynamic CMOS Design: Basic Principles, Speed and Power Dissipation of Dynamic Logic	1
2.9	Dynamic CMOS Design: Issues in Dynamic Design	1
3.0	**Sequential Logic Circuits and Clocking Strategies**	
3.1	Static Latches and Registers	1
3.2	Dynamic Latches and Registers	1
3.3	Pipelines	1
3.4	Non-Bistable Sequential Circuits: The Schmitt Trigger	1
3.5	Non-Bistable Sequential Circuits: Monostable Sequential Circuits	1
3.6	Non-Bistable Sequential Circuits: Astable Circuits	1
3.7	Timing Classification of Digital Systems	1
3.8	Synchronous Design	1
3.9	Self-Timed Circuit Design	1
4.0	**Arithmetic Building Blocks and Memory Architecture**	
4.1	Adders	1
4.2	Multipliers	1
4.3	Shift Registers	1
4.4	Logic Implementation using Programmable Devices (ROM, PLA)	1
4.5	Logic Implementation using Programmable Devices (FPGA)	1
4.6	Memory Architecture	1
4.7	Memory Building Blocks	1
4.8	Memory core	1
4.9	Memory peripherals circuitry	1
5.0	**ASIC Design and Design for Testability**	
5.1	ASIC Design Flow	1
5.2	ASIC Types: Full Custom, Semi-Custom	1
5.3	ASIC Types: FPGA	1
5.4	Issues in Design for Testability	1

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5.5	Fault Model Types: Stuck-At-0	1
5.6	Fault Model Types: Stuck-At-1	1
5.7	Automatic Test Pattern Generation	1
5.8	IC Packaging Technology: Chiplet Technologies	1
5.9	IC Packaging Technology: Dis-Aggregated Technologies	1

Course Designer(s)

1. Mrs.C.Saranya - saranyac@ksrct.ac.in
2. Mr.S.Saravanan – saravanan@ksrct.ac.in

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60 EC 503	Digital Signal Processing	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To analyse a DSP system and design FIR and IIR filters.
- To realise digital filters.
- To discuss multi rate signal processing.
- To understand finite word length effects.
- To study the architecture of digital signal processors.

Pre-requisites

- Signals and Systems

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Design IIR filters using Impulse Invariant and Bilinear Transformation Techniques.	Apply
CO2	Design linear phase FIR filters using Windowing Techniques and sampling method.	Apply
CO3	Explain the concept of multi rate signal processing	Apply
CO4	Analyse the effects of Finite word length on digital filters.	Analyse
CO5	Describe the architecture of TMS320C6x DSP processor.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	2	-	-	3	3	-	2	3	3	-
CO2	3	3	3	3	3	2	-	-	3	3	-	2	3	3	-
CO3	3	3	3	3	3	2	-	-	3	3	-	-	3	3	-
CO4	3	3	3	3	3	2	-	-	3	3	-	-	3	3	-
CO5	3	3	3	3	3	2	-	-	3	3	-	-	3	3	-
3 – Strong; 2 – Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	20	20	30
Apply	30	20	40
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.E - Electronics and Communication Engineering

60 EC 503 - Digital Signal Processing

Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	1	0	60	4	40	60	100

Design of IIR Filters* Design of IIR Filters from Analog Filters – Frequency Transformation – IIR Filters (Butterworth): Properties – Design: Impulse Invariant Technique – Bilinear Transformation – Realization of IIR filters.	[9]
Design of FIR Filters* Design of FIR Filters – Symmetric and Anti symmetric FIR Filters – Design of Linear Phase FIR Filters: Windowing Techniques (Rectangular, Hamming, Hanning) – Frequency Sampling – Realization of FIR Filters.	[9]
Multirate Signal Processing* Multirate Operations – Decimation and Interpolation – Fractional Sampling Rate Alteration – Interconnection of Building Blocks – The Noble Identities – The Poly Phase Representation – Efficient Structure of Decimation and Interpolation Filters.	[9]
Finite Word Length Effects* Representation of Numbers – Fixed Point and Floating Point Representation – Errors Resulting From Rounding and Truncation – Quantization Process and Error- Analysis of Coefficient Quantization Effects – A/D Conversion Noise Analysis – Quantization Noise Model – Signal to Quantization Noise Ratio – Round off Effects in Digital Filters – Limit Cycle Oscillations in Recursive Systems – Scaling to Prevent Overflow.	[9]
Digital Signal Processors* Programmable DSPs – TMS320C6X DSPs, Architectures Features – DSP Building Blocks– Memory Space Organization – External Bus Interfacing Signals – Memory Interface – Parallel I/O Interface– Programmed I/O – Interrupts and I/O – Direct Memory Access (DMA).	[9]
Total Hours: (Lecture - 45; Tutorial - 15)	**60**

Text Book(s):

1.	John G Proakis, Dimitris G Manolakis, “Digital Signal Processing Principles, Algorithms and Application”, 4th Edition, Pearson Educations, 2014.
2.	Venkataramani B & Bhaskar M, “Digital Signal Processor Architecture, Programming and Application”, 2nd Edition, McGraw Hill, 2014.

Reference(s):

1.	Mitra S.K, “Digital Signal Processing: A Computer based approach”, 4th Edition, McGraw Hill, 2013.
2.	Alan V Oppenheim, Ronald W Schafer, John R Back, “Discrete Time Signal Processing”, 3rd Edition, Pearson, 2013.
3.	Monson H.Hayes, “Statistical Digital Signal Processing and Modelling”, John Wiley & Sons, 2013.
4.	Thad B. Welch, Cameron H.G. Wright, Michael G. Morrow, “Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSPs”, CRC Press, 2016.

***SDG 9 – Industry Innovation and Infrastructure

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Design of IIR Filters**	
1.1	Design of IIR Filters From Analog Filters	1
1.2	Frequency Transformation (Low pass to high pass)	1
1.3	Frequency Transformation (Low pass to band pass)	1
1.4	IIR Filters (Butterworth): Properties	1
1.5	Impulse Invariant Technique	1
1.6	Bilinear Transformation	1
1.7	Design of Butterworth filter with Impulse Invariant Technique	1
1.8	Design of Butterworth filter with Bilinear Transformation	1
1.9	Realization of IIR Filters	1
1.10	Tutorial	3
2.0	**Design of FIR Filters**	
2.1	Design of FIR Filters	1
2.2	Symmetric	1
2.3	Anti symmetric FIR Filters	1
2.4	Design of Linear Phase FIR Filters	1
2.5	Windowing Techniques - Rectangular	1
2.6	Windowing Techniques - Hamming	1
2.7	Windowing Techniques - Hanning	1
2.8	Frequency Sampling	1
2.9	Realization of FIR Filters	1
2.10	Tutorial	3
3.0	**Multirate Signal Processing**	
3.1	Multirate Operations	1
3.2	Decimation	1
3.3	Interpolation	1
3.4	Fractional Sampling Rate Alteration	1
3.5	Interconnection of Building Blocks	1
3.6	The Noble Identities	1
3.7	The Poly Phase Representation	1
3.8	Efficient Structure of Decimation Filters	1
3.9	Efficient Structure of Interpolation Filters	1
3.10	Tutorial	3
4.0	**Finite Word Length Effects**	
4.1	Representation of Numbers – Fixed Point and Floating Point Representation	1
4.2	Errors Resulting from Rounding and Truncation	1
4.3	Quantization Process and Error	1
4.4	Analysis of Coefficient Quantization Effects	1
4.5	A/D Conversion Noise Analysis	1
4.6	Quantization Noise Model	1
4.7	Signal to Quantization Noise Ratio	1
4.8	Round off Effects in Digital Filters	1
4.9	Limit Cycle Oscillations in Recursive Systems – Scaling to Prevent Overflow	1
4.10	Tutorial	3

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5.0	**Digital Signal Processors**	
5.1	Programmable DSPs – TMS320C6X DSPs	1
5.2	Architectures Features	1
5.3	DSP Building Blocks	1
5.4	Memory Space Organization	1
5.5	External Bus Interfacing Signals	1
5.6	Memory Interface – Parallel I/O Interface	1
5.7	Programmed I/O	1
5.8	Interrupts and I/O	1
5.9	Direct Memory Access (DMA)	1
5.10	Tutorial	3

Course Designer(s)

1. Dr. P. Babu - pbabu@ksrct.ac.in
2. Mrs.K.Gogila Devi- gogiladevi@ksrct.ac.in

60 EC 504	Microprocessors and Microcontrollers	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To introduce the architecture and programming of 8085 microprocessor.
- To introduce the architecture, programming and interfacing of 8051 micro controller.
- To develop the simple simulation projects.
- To introduce the AI boards
- To develop microcontroller-based Applications.

Pre-requisites

- Digital System Design

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the architecture and instruction set of the 8085 microprocessor and develop assembly language programs	Understand
CO2	Explain the internal architecture and operation of the 8051 microcontroller	Understand
CO3	Analyze the functionality of special function registers and create simple simulation projects	Apply
CO4	Design and interface I/O peripherals	Apply
CO5	Execute AI models on Edge AI hardware using Python and C.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	3	-	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	20
Understand	40	20	40
Apply	-	30	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/11/2023
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Syllabus

K. S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 504 - Microprocessors and Microcontrollers								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

8085 – 8 Bit Microprocessor* 8085 Architecture - Instruction set - Addressing Modes - Interrupt Structure - Timing Diagrams - Memory Interfacing - Interfacing I/O Devices - Assembly Language Programming.	[9]
8051 – 8 Bit Microcontroller* 8051 - Architecture - Clock and RESET Circuits - PSW - Stack and Stack Pointer - Program Counter - I/O Pins Ports and Circuits - Instruction Set, - Addressing Modes.	[9]
8051 Special Purpose Registers and Programming* Special Function Register - Interfacing of Memory Devices - Timer Programming - Serial Data Transfer - UART. I/O Ports and Port Expansion - Programing on Interrupts. Assembly Language Programs, C Language Programs Using SFR**.	[9]
Peripheral Interfacing** Standard Interfaces - RS232 - USB - SPI and I2C, Interfacing of Sensors - DAC - ADC - PWM - DC Motor - Stepper Motor and LCD Interfacing	[9]
AI Based Board* Principles of OS - OS Architecture - Overview of an Edge AI Hardware, - Setup and OS Installation. Python and C Programming, Linux library installation, Executing AI models in Edge AI Hardware**.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Ramesh S Gaonkar, “Microprocessor Architecture, Programming and Application with 8085”, 6th Edition, Penram International Publishing, 2015.
2.	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011.
Reference(s):	
1	Krishna Kant, “Microprocessors and Microcontrollers Architecture, Programming and System Design 8085, 8086, 8051, 8096”, 3rd Reprint, Prentice Hall of India, 2014.
2	Ayala K.J, “8051 Microcontroller", 3rd Edition, Delmar Cengage Learning, 2007.
3	NPTEL video lectures by M. Krishna Kumar, IISc.

*SDG4 - Quality Education
**SDG9 - Industry Innovation and Infrastructure

Assignment Activity:

Assignment 1 - Covers Module 1 & 2 Questions related to the problems and simulation
Assignment 2 - Covers Module 3 & 4 Questions related to the problems and simulation
Assignment 3 - AI Boards hands on

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**8085 – 8 Bit Microprocessor**	
1.1	8085 Architecture	1
1.2	Instruction set	1
1.3	Addressing Modes	1
1.4	Interrupt Structure	1
1.5	Timing Diagrams	1
1.6	Memory Interfacing	1
1.7	Interfacing I/O Devices	1
1.8	Assembly Language Programming.	1
1.9	Assembly Language Programming.	1
2.0	**8051 – 8 Bit Microcontroller**	
2.1	8051 – Architecture	1
2.2	Clock and RESET Circuits	1
2.3	PSW	1
2.4	PUSH and POP	1
2.5	Stack and Stack Pointer	1
2.6	Program Counter	1
2.7	I/O Pins Ports and Circuits,	1
2.8	Instruction Set	1
2.9	Addressing Modes	1
3.0	**8051 Special Purpose Registers and Programming***	
3.1	Special Function Register-	1
3.2	Interfacing of Memory Devices	1
3.3	Timer Programming	1
3.4	Serial Data Transfer	1
3.5	UART	1
3.6	I/O Ports and Port Expansion	1
3.7	Programming on Interrupts	1
3.8	Assembly Language Programs	1
3.9	C Language Programs Using SFR	1
4.0	**Peripheral Interfacing****	
4.1	Standard Interfaces - RS232, USB, SPI and I2C,	1
4.2	USB	1
4.3	SPI	1
4.4	I2C	1
4.5	Interfacing of Sensors	1
4.6	DAC	1
4.7	ADC	1
4.8	Motor Interface	1
4.9	LCD Interface	1
5.0	**AI Based Board**	
5.1	Principles of OS	1
5.2	OS Architecture	1
5.3	Overview of an Edge AI Hardware	1
5.4	Setup and OS Installation	1

5.5	Python Programming	1
5.6	C Programming	1
5.7	Linux Installation	1
5.8	Linux library installation	1
5.9	Executing AI models in Edge AI Hardware	1

Course Designer(s)

1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Mr.S.Jayamani - jayamani@ksrct.ac.in

60 MY 003	Startups and Entrepreneurship	Category	L	T	P	Credit
		MC	2	0	0	2

Objectives

- To Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
- To provide practical proven tools for transforming an idea into a product or service that creates value for others.
- To Comprehend the process of opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution and prototypes
- To create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
- To prepare and present an investible pitch deck of their practice venture to attract stakeholders

Pre-requisites

- Basic knowledge of reading and writing in English

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Develop an entrepreneurial mindset and appreciate the concepts of design thinking, entrepreneurship and innovation	Understand
CO2	Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions	Apply
CO3	Understand market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product	Apply
CO4	Create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture	Apply
CO5	Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders	Create

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	1	3	1	2	1	-	2	2	2	2	2
CO2	2	3	3	2	2	-	2	2	2	-	2	2	3	3	3
CO3	3	2	3	1	2	-	-	-	1	3	1	3	3	3	3
CO4	3	3	3	3	3	2	2	1	-	1	3	3	3	3	3
CO5	3	2	3	3	3	-	-	2	-	-	3	2	2	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Pitch Deck final submission & Viva voce
	Milestone 1 (25 Marks)	Milestone 2 & 3 (25 Marks)	
Remember	10	-	50
Understand	05	10	
Apply	10	15	
Analyse	-	-	
Evaluate	-	-	
Create	-	-	
Total	25	25	

Passed in BoS Meeting held on 18/11/2023
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Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ALL Branches								
60 MY 003 – Startups and Entrepreneurship								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	2	0	0	30	2	100	-	100

Introduction to Entrepreneurship & Entrepreneur Meaning and concept of Entrepreneurship, the history of Entrepreneurship development, Myths of Entrepreneurship, role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management and Future of Entrepreneurship. The Entrepreneur: Meaning, the skills required to be an entrepreneur, the entrepreneurial decision process, Role models, Mentors and Support system.Innovation and Creativity, types of innovations, Innovations in current scenario	[6]
Problem-Opportunity Identification, Customers Discovery and competitive advantage Understanding the Problem and opportunity, define problem using Design thinking principles and validate problem. Exploring market types and estimating the market size, knowing your customer and consumer, Customer segmentation and creating customer personas. Importance of Value Proposition, Value Proposition Canvas, Developing Problem-solution fit, Competition analysis, Blue ocean strategy, Competitive positioning and understanding unique selling points.	[6]
Business model and build your MVP Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Prototyping, building a Minimum viable product, Hypothesis testing and MVP Validation, MVP Iteration-Importance of Build - Measure – Learn approach	[6]
Business Plan, Financial feasibility and Managing growth Business planning: components of Business plan- Sales plan, People plan and financial plan, Preparing a business plan. Financial Planning: Types of costs, preparing the financial plan using financial template, understanding basics of Unit economics and analyzing Growth and the financial performance	[6]
Go To Market Strategies and Funding Introduction to Go to market strategies, start-up branding and its elements, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options, Build an Investor ready pitch deck.	[6]
Total Hours:	**30**

Text Book(s):

1.	Stephen Key, “One Simple Idea for Startups and Entrepreneurs: Live Your Dreams and Create Your Own Profitable Company”, 1st Edition, Tata Mc Grawhill Company, New Delhi, 2013.
2.	Charles Bamford and Garry Bruton, “Entrepreneurship: The Art, Science, and Process for Success”, 2nd Edition, Tata Mc Grawhill Company, New Delhi, 2016.

Reference(s):

1.	Philip Auerswald, “The Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy”, Oxford University Press, 2012.
2.	Janet Kiholm Smith; Richard L. Smith Richard T. Bliss, “Entrepreneurial Finance: Strategy, Valuation and Deal Structure, Stanford Economics and Finance”, 2011.
3.	Edward D. Hess, “Growing an Entrepreneurial Business: Concepts and Cases”, Stanford Business Books, 2011.
4.	Ignite program, wadhwani platform, Entrepreneurship, NPTEL online course By Prof. C Bhaktavatsala Rao | IIT Madras

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Introduction to Entrepreneurship & Entrepreneur**	
1.1	Meaning and concept of Entrepreneurship and the history of Entrepreneurship development	1
1.2	The Entrepreneur: Meaning, the skills required to be an entrepreneur, the entrepreneurial decision process,	1
1.3	Myths of Entrepreneurship, How to Become a Successful Entrepreneur - Dr Romesh Wadhwani (Platform on boarding)	1
1.4	Role models, Mentors and Support system- Masterclass on My Story - Joshua Salins	1
1.5	Role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management and Future of Entrepreneurship	1
1.6	Innovation and Creativity, types of innovations, Innovations in current scenario, Concepts of Entrepreneurial Thinking, General Enterprising tendency test	1
2.0	**Problem-Opportunity Identification, Customers Discovery and competitive advantage**	
2.1	Understanding the Problem and opportunity, define problem using Design thinking principles and validate problem. Case study and Fireside chat – Desi Hangover	1
2.2	Identifying a problem for practice venture and filling Problem statement canvas (Handout week 1 - class activity)	1
2.3	Customer and markets discovery , knowing your customer and consumer, Customer segmentation and Exploring market types and estimating the market size. Case study and Fireside chat – Verloop	1
2.4	Creating customer personas & Market estimation (Handout week 2 - class activity)	1
2.5	Importance of Value Proposition, Introduce Value Proposition Canvas, Developing Problem-solution fit. Case study and Fireside chat – Honey Twigs	1
2.6	Competition analysis, Blue ocean strategy, Competitive positioning and understanding unique selling points. Case study and Fireside chat on Inzpira Fill Value Proposition Canvas (Handout week 3 - class activity) and Competition analysis framework (Handout week 5 - class activity) **Briefing on Assignment 1 - Milestone 1**	1
3.0	**Business model and Build your MVP**	
3.1	Introduction to Business model and types. Case study and Fireside chat – NUOS	1
3.2	Lean approach, 9 block lean canvas model, riskiest assumptions to Business models	1
3.3	Class Activity- Fill Lean canvas for you idea and understand revenue model (Handout week 6)	1
3.4	Prototyping, Meaning of MLP , Difference between MLP and MVP, How to build an MLP? Different types MLP that you can build. Case study and Fireside chat – KNORISH	1
3.5	Hypothesis testing and MVP Validation, MVP Iteration-Importance of Build - Measure – Learn approach	1
3.6	Class Activity- Fill MVP framework (Handout week 7) and learn validation	1
4.0	**Business Plan, Financial feasibility and Manging growth**	
4.1	Business planning: components of Business plan- Sales plan, People plan and financial plan, Preparing a business plan. Case study and Fireside chat – Bodh Gems	1
4.2	Financial Planning: Types of costs, preparing the financial plan using financial template (Handout week 9)	1
4.3	Class activity - starting up costs, COGS, Sales plan and people plan template.	1
4.4	Class activity - One year P&L projection, Breakeven Analysis, Five year projection	1

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4.5	Understanding basics of Unit economics and analyzing Growth and the financial performance	1
4.6	Class activity - Financial template - Unit economics (Handout week 12)	1
5.0	**Go To Market Strategies and Funding**	
5.1	Introduction to Go to market strategies, start-up branding and its elements, Selecting the Right Channel	1
5.2	Creating digital presence, building customer acquisition strategy.	1
5.3	Class activity: Handout week 10 - create your GTM strategy	1
5.4	Choosing a form of business organization specific to your venture	1
5.5	Identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options	1
5.6	Class activity - Visit relevant GOI websites, other sites to help students explore funding opportunities and **briefing on final submission of the pitch deck** Build an Investor ready pitch deck, What Should You Cover in Your Pitch Deck? Art of pitching and storytelling	1

Course Designer(s)

1. Dr.N.Tiruvenkadam - tiruvenkadam@ksrct.ac.in

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60 EC 5P1	Microcontrollers Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To familiarize the 8085,8051 processors architectures
- To give an exposure of assembling language programming and interfacing of various modules
- To use IDE for Programming and debugging
- To give an exposure of Embedded C programming for accessing the microcontroller internal registers and blocks.
- To understand the techniques to interface sensors and I/O circuits and to implement applications using these processors

Pre-requisites

- Microprocessors and Microcontrollers

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Perform arithmetic operations using 8085 and 8051 by developing assembly and C language	Understand
CO2	Compile, debug and execute C program for the given target board	Apply
CO3	Develop C code for accessing GPIO Port access and timers	Apply
CO4	Develop C code for interfacing the input and output peripherals	Apply
CO5	Design a system for temperature acquisition	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO5	3	3	3	3	3	-	-	-	3	3	-	-	3	2	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	40	40
Apply	50	25	60	60
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 5P1 - Microcontrollers Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Assembly Program for Arithmetic operation in 8085 & 8051*
2. Program for 8051 using KEIL IDE*
3. Developing C program for accessing GPIO and timers**
4. Developing a setup for a display unit, the data in LED, LCD and 7segment**
5. Develop a setup to receive an input and show the response with suitable peripherals**
6. Develop an analog data acquisition system for monitoring the outside temperature
7. Develop digital to analog conversion system using suitable 8-bit controllers.
8. Design a motor control application along with sensor**

Lab Manual

1.	"Microcontrollers Laboratory Manual", Department of Electronics and Communication Engineering, KSRCT.

* SDG 4 – Quality Education
** SDG 9 – Industry Innovation

Course Designer(s)

1. Mr S.Jayamani – jayamani@ksrct.ac.in

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60 EC 5P2	VLSI Laboratory	Category	L	T	P	Credit
		PC	0	0	2	1

Objectives

- To learn Hardware Descriptive Language (HDL)
- To learn the fundamental principles of digital system design using HDL and FPGA
- To learn the fundamental principles of VLSI circuit design in analog and digital domain using EDA tools
- To understand the layouts of digital circuits using EDA tools
- To provide hands on design experience with EDA platforms

Pre-requisites

- Digital System Design

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Develop HDL code for basic as well as advanced digital circuit	Apply
CO2	Implement various logic modules into FPGA	Apply
CO3	Synthesize place and route the digital IPs	Apply
CO4	Design, simulate and extract the layouts of digital circuits using EDA tools	Apply
CO5	Design various arithmetic building blocks using HDL	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	25	12	50	50
Apply	25	13	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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<table>
<tr><th colspan="10">K.S.Rangasamy College of Technology – Autonomous R2022</th></tr>
<tr><th colspan="10">B.E - Electronics and Communication Engineering</th></tr>
<tr><th colspan="10">60 EC 5P2 - VLSI Laboratory</th></tr>
<tr><th rowspan="2">Semester</th><th colspan="3">Hours/Week</th><th rowspan="2">Total Hrs</th><th>Credit</th><th colspan="3">Maximum Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th>CA</th><th>ES</th><th>Total</th></tr>
<tr><td>V</td><td>0</td><td>0</td><td>2</td><td>30</td><td>1</td><td>60</td><td>40</td><td>100</td></tr>
</table>

1. Design and verify basic combinational circuit with test bench code. Simulate it using the EDA tool and implement it using an FPGA.
2. Design and verify basic sequential circuit with test bench code. Simulate it using the EDA tool and implement it by FPGA.
3. Design and simulate DC transfer characteristics of CMOS inverter. Generate Layout.
4. Design and simulate a combinational circuit. Generate Layout.
5. Design and simulate a sequential circuit. Generate Layout.
6. Design carry save adder using arithmetic building blocks using HDL
7. Design multiplier using arithmetic building blocks using HDL.

- Mini project – ALU design / Finite State Machine /Memory design*

*SDG 9 - Industry Innovation and Infrastructure

Course Designer(s)

1. Mrs.C.Saranya – saranyac@ksrct.ac.in
2. Mr.S.Saravanan – saravanan@ksrct.ac.in

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60 EC 5P3	Signal Processing Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To implement FIR and IIR filters using simulation.
- To design a DSP system to demonstrate the multi-rate signal processing concepts.
- To analyse the effects of sampling and quantization errors in signals.
- To simulate waveforms and process of mathematical operations of Digital Signal Processing.
- To design and implement digital filters for given specifications and applications in DSP system.

Pre-requisites

- Signals and Systems

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Design of IIR and FIR filters and verify its performance using simulation	Apply
CO2	Design of multirate filters and verify its performance using simulation	Apply
CO3	Evaluate the effects of quantization errors in continuous time signals	Apply
CO4	Generate standard waveform and compute arithmetic operation using Digital Signal Processor	Apply
CO5	Design of IIR & FIR filter and verify its performance using Digital Signal Processor	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	-	-	3	3	3	-	3	3	3	2
CO2	3	3	3	3	3	-	-	3	3	3	-	3	3	3	2
CO3	3	3	3	3	3	-	-	3	3	3	-	3	3	3	2
CO4	3	3	3	-	-	-	-	3	3	3	-	3	3	3	2
CO5	3	3	3	3	3	-	-	3	3	3	-	3	3	3	2
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	20	12	30	30
Apply	30	13	70	70
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 5P3 - Signal Processing Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	3	45	1.5	60	40	100

List of Experiments*:
Using Simulation

1. Design of IIR filters
2. Design of FIR filters
3. Design of Multirate filters
4. Analyse the effect of quantization on continuous time analog signals

Using DSP Processor

5. Generation of standard waveforms
6. Implementation of arithmetic operations
7. Design and implementation of FIR filter for real time applications
8. Design and implementation of IIR filter for real time applications

- Mini Project

Lab Manual

1.	"Signal Processing Laboratory Manual", Department of Electronics and Communication Engineering, KSRCT.

* SDG 4- Quality Education

Course Designer(s)

1. Dr.P.Babu - pbabu@ksrct.ac.in
2. Ms.C.Saraswathy - saraswathy@ksrct.ac.in

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60 CG 0P4	Career Skill Development - IV	Category	L	T	P	Credit
		CG	0	0	2	1

Objectives

- To help learners improve their vocabulary and enable them to use words appropriately in different academic and professional contexts.
- To help learners develop strategies that could be adopted while reading texts.
- To help learners acquire the ability to speak and write effectively in english in real life and career related situations.
- Improve listening, observational skills, and problem-solving capabilities
- Develop message generating and delivery skills

Pre-requisites

- Basic knowledge of Arithmetic and Logical Reasoning

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Compare and contrast products and ideas in technical texts.	Analyse
CO2	Identify cause and effects in events, industrial processes through technical texts	Analyse
CO3	Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.	Analyse
CO4	Report events and the processes of technical and industrial nature.	Apply
CO5	Articulate their opinions in a planned and logical manner, and draft effective résumés in context of job search.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	3	-	3	-	-	-	2	3	3	3	2	2
CO2	3	3	3	3	-	2	-	-	-	2	3	3	3	2	2
CO3	2	2	2	2	-	3	-	-	-	2	3	3	3	2	2
CO4	3	3	3	3	-	2	-	-	-	2	3	3	3	2	2
CO5	3	3	3	3	-	2	-	-	-	2	3	3	3	2	2
3 - Strong; 2 - Medium; 1 - Some															

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to All Branches								
60 CG 0P4 - Career Skill Development - IV								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	2	30	1	100	-	100

Verbal & Analytical Reasoning* Seating Arrangements – Analytical Reasoning (PUZZELS) – Machin Input and Output - Coded Inequality – Eligibility Test.	[6]
Quantitative Aptitude - Part – 4* Permutation and Combination - Probability - Quadratic Equation – Geometry – Clock – Calendar – Logarithmic.	[6]
Non-Verbal Reasoning * Series Completion of Figures – Classification – Courting of figure – Figure matrix – Embedded Figure – Complete Figure – Paper Cutting and Folding – Mirror images and Water Images.	[6]
Quantitative Aptitude - Part – 5* Mensuration of Area, Volume and Surface area in 2D and 3D Shapes – 2D Shapes – Square, Rectangle, Triangle, Circle, etc. – 3D Shapes – Cube, Cuboid, Sphere, Cone, etc.	[6]
Data Interpretation and Analysis* Data interpretation Based on text – Data interpretation Based on Tabulation, Pie chart, Bar graph and Line graph – Venn Diagram – Data sufficiency.	[6]
Total Hours:	**30**

Reference(s):

1.	Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, S.Chand & Co Ltd., New Delhi, Reprint 2009.
2.	Abhijit Guha, “Quantitative Aptitude”, 6th Edition, McGraw Hill Education, 2016.
3.	Dinesh Khattar, “Quantitative Aptitude for Competitive Examinations”, Pearson Education, 2020.
4.	Anne Thomson, “Critical Reasoning: A Practical Introduction” Lexicon Books, 3rd Edition, 2022.

*SDG 4 – Quality Education
*SDG 8 – Decent work and Economic growth
*SDG 9 – Industry, innovation and Infrastructure

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Verbal & Analytical Reasoning**	
1.1	Seating Arrangements	1
1.2	Analytical Reasoning (Puzzels)	1
1.3	Machin Input and Output	1
1.4	Coded Inequality	1
1.5	Eligibility Test	2
2.0	**Quantitative Aptitude - Part – 4**	
2.1	Permutation And Combination	1
2.2	Probability	1
2.3	Quadratic Equation - Geometry	1
2.4	Clock – Calendar	1
2.5	Logarithmic	2
3.0	**Non-Verbal Reasoning**	
3.1	Series Completion of Figures – Classification	1
3.2	Courting of Figure – Figure Matrix	1
3.3	Embedded Figure – Complete Figure	1
3.4	Paper Cutting and Folding	1
3.5	Mirror Images and Water Images	2
4.0	**Quantitative Aptitude - Part – 5**	
4.1	Mensuration of Area, Volume	1
4.2	Mensuration of Volume	1
4.3	Surface Area In 2D And 3D Shapes	1
4.4	2D Shapes – Square, Rectangle, Triangle, Circle, Etc.	1
4.5	3D Shapes – Cube, Cuboid , Sphere , Cone , Etc.	2
5.0	**Data Interpretation and Analysis**	
5.1	Data Interpretation Based on Text	1
5.2	Data Interpretation Based on Tabulation, Pie Chart	1
5.3	Bar Graph and Line Graph	1
5.4	Venn Diagram	1
5.5	Data Sufficiency	2

Course Designer(s)

1. R. Poovarasan - poovarasan@ksrct.ac.in

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

SIXTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 EC 601	Embedded systems	2	40	60	100	45	100
2.	60 EC 602	Digital Communication	2	40	60	100	45	100
3.	60 EC 603	Mobile Communication and Networks	2	40	60	100	45	100
4.	60 EC E2*	Professional Elective II	2	40	60	100	45	100
5.	60 OE L3*	Open Elective III	2	40	60	100	45	100
THEORY CUM PRACTICAL								
6.	60 EC 604	Machine Learning Techniques	2	50	50	100	45	100
PRACTICAL								
7.	60 EC 6P1	Innovation Engineering Laboratory	3	60	40	100	45	100
8.	60 EC 6P2	Embedded systems Laboratory	3	60	40	100	45	100
9.	60 EC 6P3	Digital Communication Laboratory	2	60	40	100	45	100
10.	60 CG 0P5	Comprehension Test	2	100	00	100	00	100
11.	60 CG 0P6	Internship	-	100	-	100	-	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

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Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

60 EC 601	Embedded Systems	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To impart the knowledge of the Embedded design
- To learn the architecture and features of ARM Cortex
- To learn the functionality and its features of ARM Cortex Peripherals
- To program the CORTEX M3
- To impart the working of Embedded operating system

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the overall landscape and characteristics of embedded systems	Understand
CO2	Discuss the architecture and features of ARM CORTEX	Understand
CO3	Analyse the functionalities of ARM CORTEX-M3/M4 peripherals and develop programs	Apply
CO4	Develop programs to access the features of ARM CORTEX M3/M4	Apply
CO5	Discuss the architecture of the real time operating system and its operations	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	20
Understand	40	20	20
Apply	-	30	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 601 - Embedded Systems								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Structure of Embedded Systems * Embedded Computing: Characteristics of Embedding Computing Applications, Embedded System Architecture: Instruction Set Architecture, CISC and RISC, Embedded C Data types and variables, Storage classes, Register data assignment, Bitwise operation, GPIO: Overview, Interfacing	[9]
ARM CORTEX-M3 Architecture * ARM Architecture – Versions, CORTEX-M3/M4 Microcontroller: Block diagram, Bus architecture, Reset value of a register, Register bit positions**,** UART: Protocol, Port accessing, Error management	[9]
Peripherals in CORTEX M3 Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence, ADC: SAR ADC, HAL_ADC module, Conversion modes, Resolution, DAC: HAL_DAC module, Pin assignments, I2C Interfacing.	[9]
CORTEX M3 Programming * Development Flow, Volatile and effect of optimization, Interrupt handling, Timer Interrupt, SysTick Timer, Watchdog Timer, SPI Peripherals and testing, EEPROM Interface	[9]
Real Time Operating Systems ** OS: Principles, Architecture, System calls, Threads, tasks and process, Kernel and its function, Scheduling: static, dynamic, priority, Interrupt APIs, Task Creation API, Low Power Management with RTOS, RTOS vs Embedded Linux	[9]
Total Hours:	**45**

Text Book(s):

1.	Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", 2nd Edition, Elsevier, 2008.
2.	Joseph Yiu, "The Definitive Guide to the ARM CORTEX M3/M4", 2nd Edition, Elsevier,2010.
3.	Carmine Noviello, "Mastering STM32", 2018.
4.	Shibu K.V.Tata, "Introduction to Embedded Systems", Tata Mcgraw Hill Education (India) Private Limited, 2009.

Reference(s):

1.	Israel Gbati, "Embedded Systems Bare-Metal Programming Ground Up™ (STM32)", BHM Engineering Academy, Udemy Course.
2.	Kiran Navak, "Mastering RTOS: Hands on Free RTOS and STM32Fx with Debugging", FastBit Embedded Brain Academy, Udemy Course.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

Assignment Activity:

Assignment 1
Report on various real-life examples of embedded system

Assignment 2
Report on applications of ARM Cortex

Assignment 3
Case study - RTOS

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Structure of Embedded Systems**	
1.1	Embedded Computing: Characteristics of Embedding Computing Applications	1
1.2	Embedded System Architecture: Instruction Set Architecture, CISC and RISC	1
1.3	Embedded C Data types and variables	1
1.4	Storage classes	1
1.5	Register data assignment	1
1.6	Bitwise operation – AND, OR, NOT	1
1.7	Bitwise operation – Bit shifting	1
1.8	GPIO: Overview,	1
1.9	Interfacing	1
2.0	**ARM CORTEX-M3 Architecture**	
2.1	ARM Architecture – Versions	1
2.2	CORTEX-M3/M4 Microcontroller: Block diagram	1
2.3	Bus architecture	1
2.4	Reset value of a register, Register bit positions	1
2.5	UART: Protocol – Data frame	1
2.6	UART: Protocol – Handshaking	1
2.7	Port accessing – GPIO as Input / output	1
2.8	Port accessing – BSRR	1
2.9	Error management	1
3.0	**Peripherals in CORTEX M3**	
3.1	Operation Mode, Exceptions and Interrupts	1
3.2	Vector Tables	1
3.3	Stack Memory Operations	1
3.4	Reset Sequence	1
3.5	CORTEX M3 Instruction Sets: Assembly Basics	1
3.6	SAR ADC, HAL_ADC module	1
3.7	Conversion modes, Resolution	1
3.8	HAL_DAC module, Pin assignments	1
3.9	I2C Interfacing	1
4.0	**CORTEX M3 Programming**	
4.1	Development Flow, Volatile and effect of optimization	1
4.2	Interrupt handling	1
4.3	Timer Interrupt	1
4.4	SysTick Timer	1
4.5	Watchdog Timer	1
4.6	SPI Peripherals	1
4.7	SPI testing	1
4.8	EEPROM Interface – Write Data	1
4.9	EEPROM Interface – Read Data	1
5.0	**Real Time Operating Systems**	
5.1	OS: Basic principles, Architecture	1
5.2	System calls	1
5.3	Threads, tasks and process	1
5.4	Kernel and its function	1

5.5	Scheduling: static, dynamic, priority	1
5.6	Interrupt APIs	1
5.7	Task Creation API	1
5.8	Low Power Management with RTOS	1
5.9	RTOS vs Embedded Linux	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

60 EC 602	Digital Communication	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To study signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy charnels.
- To understand baseband signal transmission and reception techniques.
- To understand passband signal transmission and reception techniques.
- To discuss fundament concepts and limits in information theory in the context of digital communication systems.

Pre-requisites

- Analog Communication

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the sampling process and various waveform coding techniques.	Understand
CO2	Describe the different channel coding techniques used to provide reliable transmission of digital information over the channel.	Apply
CO3	Examine the transmission of a signal at high modulation rate through a band-limited channel and discuss the baseband data transmission systems.	Apply
CO4	Design of optimum receivers and explain the transmission of digital data over a band pass channel.	Analyze
CO5	Discuss the fundamental concepts and limits of information theory in the context of a digital communication system.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	3	2	3	-	-	-	-	-	-	-	3	3	-
CO2	3	2	3	3	3	-	-	3	3	3	-	3	3	3	3
CO3	3	2	3	3	3	-	-	3	3	3	-	3	3	3	3
CO4	3	3	3	2	3	-	-	-	-	-	-	-	3	3	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-	3	3	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	20	10	10
Apply	30	20	60
Analyse	-	20	20
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

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Department of ECE
K.S.Rangasamy College of Technology,
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Syllabus

<table>
<tr><td colspan="9">K.S.Rangasamy College of Technology – Autonomous R2022</td></tr>
<tr><td colspan="9">B.E - Electronics and Communication Engineering</td></tr>
<tr><td colspan="9">60 EC 602 – Digital Communication</td></tr>
<tr><td rowspan="2">Semester</td><td colspan="3">Hours / Week</td><td rowspan="2">Total Hours</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>VI</td><td>3</td><td>1</td><td>0</td><td>60</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="8">Pulse Digital Modulation Techniques*
Pulse Code Modulation - Sampling, Quantizing, Encoding - Quantization Noise - Robust Quantization - Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation - Delta Modulation - Adaptive Delta Modulation.</td><td>[9]</td></tr>
<tr><td colspan="8">Error Control Coding*
Linear Block Codes - Encoding and Decoding - Cyclic Codes – Encoder - Syndrome Calculator - Convolutional Codes - Encoding - Viterbi Decoding.</td><td>[9]</td></tr>
<tr><td colspan="8">Baseband Pulse Transmission*
Line Codes - PSD’s - ISI - Nyquist Criterion for Zero ISI - Optimum Transmit and Receive Filters - Correlative Coding - M - Array PAM.</td><td>[9]</td></tr>
<tr><td colspan="8">Baseband Modulation*
Matched Filter Receiver - BASK, BFSK, BPSK - Transmitter, Receiver, Signal Space Diagram, Error Probabilities - Coherent Quadrature Modulation Schemes: QPSK, MSK - Non Coherent Binary Modulation Schemes: BFSK - Comparison of Binary and Quaternary Modulation Schemes - M - Ary Modulation Schemes.</td><td>[9]</td></tr>
<tr><td colspan="8">Fundamentals of Information Theory*
Measure of Information - Entropy - Source Coding Theorem - Discrete Memoryless Channels - Lossless, Deterministic, Noiseless - BEC - BSC - Mutual Information - Channel Capacity - Shannon-Hartley Law - Shannon - Fano Coding - Huffman Coding - Run Length Coding - LZW Algorithm.</td><td>[9]</td></tr>
<tr><td colspan="8">Total Hours: (Lecture - 45; Tutorial -15)</td><td>60</td></tr>
<tr><td colspan="9">Text Book(s):</td></tr>
<tr><td>1.</td><td colspan="8">Simon Haykin, “Digital Communication”, 6th Edition, Wiley Publishers, 2014.</td></tr>
<tr><td>2.</td><td colspan="8">John G. Proakis, “Digital Communication”, 5th Edition, Tata McGraw Hill, 2014.</td></tr>
<tr><td colspan="9">Reference(s):</td></tr>
<tr><td>1.</td><td colspan="8">B.P Lathi & Zhi Ding, “Modern Digital and Analog Communication Systems”, 5th Edition, Oxford University Press, 2018.</td></tr>
<tr><td>2.</td><td colspan="8">Taub & Schilling, “Principles of Digital Communication”, 4th Edition, Mc-Graw Hill, 2015.</td></tr>
<tr><td>3.</td><td colspan="8">Simon Haykin, “Communication Systems”, 4th Edition, Wiley Publishers, 2013.</td></tr>
<tr><td>4.</td><td colspan="8">Bernaud Sklar & Ray, “Digital Communications- Fundamentals and Applications”, 2nd Edition, Pearson Education, 2012.</td></tr>
</table>

* SDG 4 – Quality Education

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1	**Pulse Digital Modulation Techniques**	
1.1	Sampling, Quantizing	1
1.2	Encoding	1
1.3	Quantization Noise	1
1.4	robust Quantization	1
1.5	Differential Pulse Code Modulation	1
1.6	Adaptive Differential Pulse Code Modulation	1
1.7	Delta Modulation Concept	1
1.8	Delta Modulation Problems	1
1.9	Adaptive delta modulation	1
1.10	Tutorial	3
2	**Error Control Coding**	
2.1	Linear Block Codes - Encoding	1
2.2	Linear Block Codes - Decoding	1
2.3	Cyclic Codes	1
2.4	Cyclic Codes- Encoder	1
2.5	Syndrome Calculator	1
2.6	Convolutional Codes	1
2.7	Encoding	1
2.8	Different Structures	1
2.9	Viterbi Decoding	1
2.10	Tutorial	3
3	**Baseband Pulse Transmission**	
3.1	Line codes	1
3.2	PSD's- ISI	1
3.3	Nyquist criterion for zero ISI	1
3.4	optimum transmit and receive filters	1
3.5	Correlative Coding	1
3.6	Duo Binary Signalling	1
3.7	Modified Duo Binary	1
3.8	M-Array	1
3.9	Pulse Amplitude Modulation	1
3.10	Tutorial	3
4	**Baseband Modulation**	
4.1	Matched Filter Receiver	1
4.2	BASK – Transmitter, Receiver, Signal Space Diagram, Error Probabilities	1
4.3	BFSK - Transmitter, Receiver, Signal Space Diagram, Error Probabilities	1
4.4	BPSK- Transmitter, Receiver, Signal Space Diagram, Error Probabilities	1
4.5	Coherent Quadrature Modulation Schemes: QPSK	1
4.6	Coherent Quadrature Modulation Schemes: MSK	1
4.7	Non Coherent Binary Modulation Schemes: BFSK	1
4.8	Comparison of Binary and Quaternary Modulation Schemes	1
4.9	M-ary Modulation Schemes	1
4.10	Tutorial	3
5	**Fundamentals of Information Theory**	
5.1	Measure of Information - Entropy	1

5.2	Source Coding Theorem	1
5.3	Discrete Memoryless Channels, Lossless, Deterministic, Noiseless, BEC, BSC	1
5.4	Mutual information -Channel Capacity	1
5.5	Shannon-Hartley Law	1
5.6	Shannon-Fano Coding	1
5.7	Huffman Coding	1
5.8	Run Length Coding	1
5.9	LZW Algorithm	1
5.10	Tutorial	3

Course Designer(s)

1. Dr P Kumar - pkumar@ksrct.ac.in
2. Mr P Balamurugan - pbalamurugan@ksrct.ac.in

60 EC 603	Mobile Communication and Networks	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To describe the mobile radio communication principles and the recent trends adopted in cellular systems
- To investigate different radio propagation models
- To explore various modulation techniques and its performances
- To design the different wireless standards and networks
- To understand the basics of Next generation wireless networks

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the cellular system design and technical challenges	Understand
CO2	Identify the different radio wave propagation models and fading effects	Apply
CO3	Compare the performance of modulation and diversity techniques	Apply
CO4	Discuss the principles and applications of wireless systems and standards	Understand
CO5	Investigate the next generation wireless networks	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	3	3	3	3	3	-	-	3	3	3
CO2	3	3	3	3	-	-	-	3	3	3	-	-	3	3	3
CO3	3	3	3	3	3	-	-	3	3	3	-	-	3	3	3
CO4	3	3	3	-	-	3	3	3	3	3	-	3	3	3	3
CO5	3	3	3	-	-	-	-	3	3	3	-	-	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	12	12	20
Understand	28	28	40
Apply	20	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 603 - Mobile Communication and Networks								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Wireless Communication Systems Wireless Communication Systems - 2G/3G/4G Cellular Networks - Cellular Concept: Frequency Reuse - Channel Assignment Strategies - Hand Off - Interference & System Capacity - Coverage and Capacity Improvement.	[9]
Mobile Radio Propagation Free Space Propagation Model - Reflection - Two-Ray Model - Diffraction - Knife-Edge Diffraction Model - Scattering - Log-Normal Shadowing - Okumara Model - Hata Model - Log-Distance Path Loss Model - Small-Scale Multipath Propagation - Parameters of Mobile Multipath Channels - Types of Small-Scale Fading.	[9]
Modulation Techniques and Signal Processing Principles of Offset - QPSK - Π/4-DQPSK - GMSK - Error Performance in Fading Channels - Spread Spectrum Modulation - Multi Carrier System - OFDM - Diversity Reception Techniques - MIMO Systems – Spatial Multiplexing - System Model.	[9]
Wireless Standards and Networks GSM System - GSM Network and System Architecture, GSM Channel Concepts, CDMA Architecture - Power Control, System Capacity, 60-Ghz Millimeter Wave Radios - Millimeter Wave Characteristics - Channel Performance At 60 GHz, Gigabit Wireless Communication, Standards - Wi-Gig, IEEE 802.11ad, IEEE 802.15.3c - Millimeter Wave Applications.	[9]
5G and Beyond Networks** Network Architecture Of 5G-And-Beyond Systems - Spectrum Management and Sharing - Small Cell Networks - Heterogeneous Networks - Network Densification - Cloud Radio Access Network (C-RAN) - Software Defined Network (SDN) - Network Function Virtualization (NFV) - Unmanned Aerial Vehicles (UAVs) - Unmanned Aerial Base Stations (UABSs) - Emerging Services and Applications.	[9]
Total Hours:	**45**

Text Book(s):

1.	T.S.Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education/Prentice Hall of India, 2009.
2.	Erik Dahlman, Stefan Parkvall and Johan Skold, "4G, LTE-Advanced Pro and The Road to 5G", 3rd Edition, Elsevier, 2016.

Reference(s):

1.	Lee W.C.Y, "Mobile Communications Engineering: Theory and applications", 2nd Edition, McGraw-Hill International, 2009.
2.	Martin Sauter, "From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell, 2016.
3.	Erik Dahlman, Stefan Parkvall and Johan Skold, "5G NR: The Next Generation Wireless Access Technology", 1st Edition, Elsevier, 2018.
4.	Eldad Perahia and Robert Stacey, "Next Generation Wireless LANs: 802.11n and 802.11ac", 2nd Edition, Cambridge University Press, 2013.
5.	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", 1st Edition, CRC Press, 2019.

**SDG 9 – Industry Innovation and Infrastructure

<u>Assignment Activity:</u>

Assignment 1

1. Implementation of Two-ray ground-reflection model using MATLAB.
2. Chart preparation of types of Fading.

Assignment 2

1. Implementation of MIMO/OFDM system using MATLAB.

Assignment 3

1. Report and presentation on 5G and Beyond Networks

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Wireless communication systems**	
1.1	Wireless Communication Systems - 2G/3G/4G	1
1.2	Wireless Communication Systems - 2G/3G/4G	1
1.3	Cellular Networks	1
1.4	Cellular Concept: Frequency Reuse	1
1.5	Channel Assignment	1
1.6	Hand Off	1
1.7	Interference	1
1.8	System Capacity	1
1.9	Coverage and Capacity Improvement	1
2.0	**Mobile Radio Propagation**	
2.1	Free space propagation model	1
2.2	Reflection	1
2.3	Two-Ray model, Diffraction, Knife-edge diffraction model	1
2.4	Scattering - Log-normal shadowing	1
2.5	Okumara model - Hata model	1
2.6	Log-distance path loss model	1
2.7	Small-scale multipath propagation	1
2.8	Parameters of mobile multipath channels	1
2.9	Types of small-scale fading	1
3.0	**Modulation Techniques and Signal Processing**	
3.1	Principles of Offset	1
3.2	QPSK	1
3.3	π/4-DQPSK	1
3.4	GMSK - Error performance in fading channels	1
3.5	Spread Spectrum Modulation	1
3.6	Multi carrier system-OFDM	1
3.7	Diversity reception techniques	1
3.8	MIMO systems	1
3.9	spatial multiplexing - System model.	1
4.0	**Wireless Standards and Networks**	
4.1	GSM system	1
4.2	GSM network	1
4.3	GSM system architecture & channel concepts	1
4.4	CDMA architecture –power control, system capacity	1
4.5	60-GHz Millimeter wave radios	1
4.6	Millimeter wave characteristics - Channel performance at 60 GHz	1
4.7	Gigabit wireless communication	1
4.8	Standards - Wi-Gig, IEEE 802.11ad	1
4.9	IEEE 802.15.3c - Millimeter wave applications	1
5.0	**5G and Beyond Networks**	
5.1	Network architecture of 5G-and-beyond. systems	1
5.2	Spectrum management and sharing	1
5.3	Small cell networks - Heterogeneous Networks - Network densification	1
5.5	Cloud Radio Access Network (C-RAN) - Software Defined Network (SDN)	1

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5.6	Network Function Virtualization (NFV)	1
5.7	Unmanned Aerial Vehicles (UAVs)	1
5.8	Unmanned Aerial Base Stations (UABSs)	1
5.9	Emerging services and applications	1

Course Designer(s)

1. Dr.P.Kumar - kumar@ksrct.ac.in
2. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

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60 EC 604	Machine Learning Techniques	Category	L	T	P	Credit
		PC	3	0	2	4

Objectives

- To understand different techniques related to machine learning.
- To understand machine learning techniques for linear models.
- To study various unsupervised learning techniques and dimensionality reduction techniques.
- To learn the theoretical aspects of graphical models.
- To explain the reinforcement learning techniques and its applications.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the concepts of machine learning.	Understand
CO2	Identify and apply the appropriate machine learning technique for classification, regression and decision making.	Apply
CO3	Solve the clustering and dimensionality problems.	Apply
CO4	Apply the inference and learning algorithms for the graphical model.	Apply
CO5	Apply reinforcement learning techniques for real life problems.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	3	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	3	3	3	-	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	10	-	-	30	-
Understand	30	10	30	10	10	60	10
Apply	10	90	20	90	90	10	90
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

<table>
<tr><td colspan="9">K.S.Rangasamy College of Technology – Autonomous R2022</td></tr>
<tr><td colspan="9">B.E - Electronics and Communication Engineering</td></tr>
<tr><td colspan="9">60 EC 604 - Machine Learning Techniques</td></tr>
<tr><td rowspan="2">Semester</td><td colspan="3">Hours / Week</td><td rowspan="2">Total Hours</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>VI</td><td>3</td><td>0</td><td>2</td><td>75</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="8">Neural Networks*
Neural Networks - Training a Perceptron - Learning Boolean Functions, Activation - ReLu, Hyper Parameter Tuning, Batch Normalization, Regularization, Multilayer Perceptrons - Back Propagation Algorithm - Training Procedures - Types of Machine Learning - Generalization Trade-off - Bias and Variance - Machine Learning Model Deployment Techniques.</td><td>[9]</td></tr>
<tr><td colspan="8">Linear Models
Linear Regression - Ridge Regression - Lasso, Bayesian Regression - Regression with Basis Functions - Logistic Regression - Large Margin Classification - Kernel Methods - Support Vector Machines - Decision Tree.</td><td>[9]</td></tr>
<tr><td colspan="8">Unsupervised Learning and Dimensionality Reduction
Nearest Neighbour Models - K Means - Clustering Around Medoids - Silhouettes - Hierarchical Clustering - Dimensionality Reduction - Principal Component Analysis - Factor Analysis - Independent Component Analysis.</td><td>[9]</td></tr>
<tr><td colspan="8">Graphical Model and Ensemble Methods
Markov Chain Monte Carlo Methods - Sampling - Proposal Distribution - Bayesian Belief Networks - Markov Random Fields - Hidden Markov Models - Boosting - Bagging - Simple Methods - Stacking Technique.</td><td>[9]</td></tr>
<tr><td colspan="8">Reinforcement Learning**
Passive Reinforcement Learning - Direct Utility Estimation - Adaptive Dynamic Programming - Temporal Difference Learning - Active Reinforcement Learning - Exploration - Generalization in Reinforcement Learning - Policy Search - Inverse and Transfer Learning Reinforcement - Applications in Health Care and Robot Control.</td><td>[9]</td></tr>
<tr><td colspan="8">Practical:
1. Simulate the data extraction from the database and various data pre-processing techniques for a given dataset.
2. Simulate the ANN using back-propagation algorithm.
3. Simulate a regression model for a given dataset.
4. Simulate SVM classification for a dataset.
5. Simulate a decision tree classification model for a given dataset.
6. Simulate dimensionality reduction using PCA method on a given dataset.
7. Simulate dimensionality reduction using ICA method on a given dataset.
8. Simulate K Means clustering method.
9. Simulate boosting ensemble method for any dataset.
10. Simulate reinforcement learning algorithm for medical applications.

Tools used: MATLAB / Open Source</td><td>[30]</td></tr>
<tr><td colspan="8">Total Hours: (Lecture - 45; Practical - 30)</td><td>75</td></tr>
<tr><td colspan="8">Text Book(s):</td><td></td></tr>
<tr><td>1.</td><td colspan="8">Ethem Alpaydin, “Introduction to Machine Learning”, 4th Edition, MIT Press, 2020.</td></tr>
<tr><td>2.</td><td colspan="8">Tom M Mitchell, “Machine Learning”, 1st Edition, McGraw Hill Education, 2017.</td></tr>
<tr><td colspan="9">Reference(s):</td></tr>
<tr><td>1.</td><td colspan="8">Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.</td></tr>
<tr><td>2.</td><td colspan="8">Murphy K.P, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.</td></tr>
<tr><td>3.</td><td colspan="8">Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2014.</td></tr>
<tr><td>4.</td><td colspan="8">Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, 2nd Edition, 2014.</td></tr>
</table>

* SDG 3 – Good Health and Well Being
**SDG 9 - Sustainable industrialization and foster innovation

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1	**Neural Networks**	
1.1	Neural Networks - Training a Perceptron	1
1.2	Learning Boolean Functions - ReLu, Hyper Parameter Tuning	1
1.3	Batch Normalization, Regularization, Dropout	1
1.4	Multilayer Perceptron's	1
1.5	Back Propagation Algorithm -Training Procedures	1
1.6	Types of Machine Learning - Supervised and Unsupervised Learning	1
1.7	Theory of Generalization, Generalization Bound - Approximation	1
1.8	Generalization Trade-off - Bias and Variance	1
1.9	Machine Learning Model Deployment Techniques	1
2	**Linear Models**	
2.1	Linear Regression	1
2.2	Ridge Regression	1
2.3	Lasso, Bayesian Regression	1
2.4	Regression with Basis Functions	1
2.5	Logistic Regression	1
2.6	Large Margin Classification- Kernel Methods	1
2.7	Support Vector Machines	1
2.8	Hard SVM, Soft SVM	1
2.9	Decision Tree	1
3	**Unsupervised Learning and Dimensionality Reduction**	
3.1	Nearest Neighbour Models	1
3.2	K Means	1
3.3	Clustering Around Medoids	1
3.4	Silhouettes	1
3.5	Hierarchical Clustering	1
3.6	Dimensionality Reduction	1
3.7	Principle Component Analysis	1
3.8	Factor Analysis	1
3.9	Independent Component Analysis	1
4	**Graphical Model and Ensemble Methods**	
4.1	Markov Chain Monte Carlo Methods	1
4.2	Sampling - Proposal Distribution	1
4.3	Bayesian Belief Networks	1
4.4	Markov Random Fields	1
4.5	Hidden Markov Models	1
4.6	Boosting - Gradient Boosting	1
4.7	Adaboost,	1
4.8	Bagging - Simple Methods	1
4.9	Stacking Technique	1
5	**Reinforcement Learning**	
5.1	Passive Reinforcement Learning – Direct Utility Estimation	1
5.2	Adaptive Dynamic Programming	1
5.3	Temporal Difference Learning	1

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5.4	Active Reinforcement Learning – Exploration	1
5.5	Learning an Action-Utility Function	1
5.6	Generalization in Reinforcement Learning	1
5.7	Policy Search –Inverse and Transfer Learning Reinforcement	1
5.8	Applications in Health Care	1
5.9	Applications in Robot Control	1
Practical:		
1.	Simulate the data extraction from the database and various data pre-processing techniques for a given dataset.	2
2.	Simulate the ANN using back-propagation algorithm.	2
3.	Simulate a regression model for a given dataset.	2
4.	Simulate SVM classification for a dataset.	2
5.	Simulate a decision tree classification model for a given dataset.	2
6.	Simulate dimensionality reduction using PCA method on a given dataset.	4
7.	Simulate dimensionality reduction using ICA method on a given dataset.	4
8.	Simulate K Means clustering method.	4
9.	Simulate boosting ensemble method for any dataset.	4
10.	Simulate reinforcement learning algorithm for medical applications	4

Course Designer(s)

1. Dr.K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Ms.R.Ramya - rramya@ksrct.ac.in

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60 EC 6P1	Innovation Engineering Laboratory	Category	L	T	P	Credit
		CG	0	0	3	1.5

Objectives

- To disassemble and reassemble circuits
- To diagnose faults in a circuit
- To deconstruct a product and extract design information
- To learn connections and power requirements
- To develop a prototype

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Sketch the design information of a product	Apply
CO2	Execute efficient assembly and disassembly design in an electronic product	Apply
CO3	Test and troubleshoot an electronic circuit	Analyse
CO4	Design an electronic product efficiently	Analyse
CO5	Develop prototype for a product already available in the market with enhanced features	Evaluate

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	25	-	50	50
Analyse	25	-	50	50
Evaluate	-	25	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 6P1 - Innovation Engineering Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	1.5	60	40	100

1. Diagnose and troubleshoot the given PCB
2. Extract the circuit drawing from the given PCB
3. Tear down a product
   i. Find the design information
   ii. Draw the circuit
   iii. Find the connections and power requirements
   iv. Report on feature enhancement of the product in terms of design, power requirement, packaging or any other feature of interest
4. Design and develop a prototype for the product already available in the market

The product for experiment 3 can be chosen from the below list or the student can bring his/her own electronic product

- Pulse oximeter*
- Stabiliser**
- Audio amplifier**
- UPS board**

*SDG 3 – Good Health and Well Being
**SDG 4 – Quality Education

Course Designer(s)

1. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in
2. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in

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60 EC 6P2	Embedded Systems Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To familiarize the operators and registers in Embedded C
- To learn about ADC and DAC
- To interface peripherals and processors associated with embedded systems
- To understand the concept of UART communication
- To familiarize with RTOS in Embedded computing

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Develop bare metal Embedded C programs to perform transmission and reception.	Apply
CO2	Develop Embedded C programs for interfacing peripherals	Apply
CO3	Develop multitasking bare metal Embedded C programs using RTOS	Apply
CO4	Implement Embedded C programs for interfacing DC motors	Apply
CO5	Create applications utilizing timers or external interrupts with PWM, and SPI interfaces	Evaluate

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO4	3	3	3	3	3	-	-	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	-	-	3	3	3	3	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	50	-	100	100
Analyse	-	-	-	-
Evaluate	-	25	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 6P2 - Embedded Systems Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Develop a bare metal Embedded C program to access GPIO ports *
2. Develop a bare metal Embedded C program to perform UART transmission and reception
3. Develop the bare metal Embedded C program for ADC and print the value in UART
4. Develop the bare metal Embedded C program for ADXL345 Accelerometer using the I2C *
5. Develop the multitasking bare metal Embedded C program using free RTOS for following task
   - Task-1: Blink LED for 1 second (using Vtask timer)
   - Task-2: Read ADXL345 print in UART
   - Task-3: Read ADC and trigger an LED once threshold meets and print the value in UART
6. Develop the bare metal Embedded C program for DC motor interface

Open ended experiments:

1. Develop an application using timer or external interrupts and PWM **
2. Develop an application using SPI interface

Lab Manual

1.	"Embedded Systems Lab Manual", Department of Electronics and Communication Engineering, KSRCT.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC 6P3	Digital Communication Laboratory	Category	L	T	P	Credit
		PC	0	0	2	1

Objectives

- To obtain the operation of line coding and decoding methods
- To analyse and test digital communication systems using simulation software as well as laboratory components
- To obtain a better understanding of the operation of digital modulation schemes
- To understand error coding and decoding in digital telecommunication system.
- To measure the spectrum of filters

Pre-requisites

- Analog Communication

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Generate waveforms with line coding and decoding techniques.	Apply
CO2	Demonstrate Delta Modulation.	Analyse
CO3	Demonstrate the various digital pulse modulation techniques	Apply
CO4	Develop programs for error control coding	Analyse
CO5	Measure the spectrum for different filters	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	2	2	3	3	3	2	3	3	2	2
CO2	3	3	3	2	3	2	2	3	3	3	2	3	3	2	2
CO3	3	3	3	-	3	2	2	3	3	3	2	3	3	2	2
CO4	3	3	3	2	3	2	2	3	3	3	2	3	3	2	2
CO5	3	3	3	-	3	2	2	3	3	3	2	3	3	2	2
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	25	25	50	50
Analyse	25	-	50	50
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 6P3 - Digital Communication Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	0	0	2	30	1	60	40	100

List of Experiments:

1. Simulation of Line Coding and Decoding Techniques
2. Generate Delta Modulation waveforms
3. Simulation of ASK, FSK and PSK Modulation and Detection
4. Simulation of Quadrature Phase Shift Keying Modulation and Detection
5. Implementation of Convolutional Codes
6. Spectrum Measurement for low pass, high pass and band pass Filters

- Mini project

Lab Manual	
1.	"Digital Communication Lab Manual", Department of Electronics and Communication Engineering, KSRCT.

*SDG 9 – Industry Innovation and Infrastructure

Course Designer(s)

1. Dr P Kumar – pkumar@ksrct.ac.in
2. Mr P Balamurugan – pbalamurugan@ksrct.ac.in

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60 CG 0P5 Semester VI	Comprehension Test*	Category	L	T	P	Credit
		CG	0	0	2	1

Objectives

- To evaluate the knowledge gained in core courses relevant to the programme of study
- To assess the technical skill in solving complex engineering problems

Pre-requisites

- Fundamental knowledge in all core subjects

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Infer knowledge in their respective programme domain.	Apply
CO2	Attend interviews for career progression.	Apply
CO3	Exhibit professional standards to solve engineering problems.	Apply
CO4	Promote holistic approach to problem solving.	Apply
CO5	Examine the competency of graduates in specific programme domain.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	-	-	-	-	1	2	2	3	3	3	3
CO2	3	3	2	2	-	-	-	-	1	2	2	3	3	3	3
CO3	3	3	2	2	-	-	-	-	1	2	2	3	3	3	3
CO4	3	3	2	2	-	-	-	-	1	2	2	3	3	3	3
CO5	3	3	2	2	-	-	-	-	1	2	2	3	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

The overall knowledge of the candidate in various courses he/she studied shall be evaluated with multiple choice questions.

*SDG 4 - Quality Education

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60 EC E11	Wearable Devices	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To explain the field of wearable devices and applications
- To identify the scope of wearable devices and the future roadmap
- To apply the sensors for wearable devices
- To apply the wearable cameras and microphones for navigation
- To solve the security issues, psychological effects and health issues related to wearable devices

Pre-requisites

- Electronic Devices

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Summarize the wearable devices and their applications	Understand
CO2	Explain the scope and future roadmap of wearable devices	Understand
CO3	Identify the different sensors used in wearable devices	Apply
CO4	Make use of the wearable cameras and microphones for navigation in wearable devices	Apply
CO5	Solve the security issues, psychological effects and health concerns related to wearable devices	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	-	3	3	-	3	3	2	3
CO2	3	3	3	-	-	-	-	-	3	3	-	3	3	2	3
CO3	3	3	3	-	2	2	2	-	3	3	-	3	3	2	3
CO4	3	3	3	-	3	2	2	-	3	3	-	3	3	2	3
CO5	3	3	3	-	2	2	2	-	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	20	20	-	-	34	-
Understand	40	80	20	20	20	33	20
Apply	-	-	20	80	80	33	80
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E11 - Wearable Devices								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	2	0	2	60	3	50	50	100

Wearable Devices *,,***** Motivation for Development of Wearable Devices - The Emergence of Wearable Computing and Wearable Electronics - Intelligent Clothing, Sports, Healthcare, Fashion and Entertainment, Military, Environment Monitoring, Mining Industry, Public Sector and Safety.	[6]
Scope of Wearable Devices*,,***** Role of Wearables - Attributes of Wearables - The Meta Wearables - Textiles and Clothing, Social Aspects - Interpretation of Aesthetics - Adoption of Innovation - On-Body Interaction.	[6]
Sensors for Wearable Devices*,,***** Wearable Inertial Sensors - Accelerometers, Gyroscopic Sensors, Force and Pressure Measurement, Flexible Sensors - Flex Sensor, Pulse oximeter, Inertial sensor, Dehydration sensor, Nano Sensors - CNT Based Sensors.	[6]
Wearable Cameras and Microphones for Navigation*,,***** Cameras in Wearable Devices - Navigation - Cameras in Smart-Watches - Microphones and AI For Respiratory Diagnostics and Clinical Trials - Wearable Assistive Devices for the Blind - Hearing and Touch sensation - Wearable devices with Global Positioning System (GPS) Integration for Tracking and Navigation.	[6]
Security Issues and Psychological Effects of Wearables*,,***** Security and Privacy Issues in Wearable Technology - Psychological Effects of Wearables - Social Implications - Technology Acceptance Factors - Electromagnetic Intolerance and Other Risks.	[6]
Practical: **Mini Project *,**,***** • Design and assemble a wearable circuit incorporating sensors and necessary hardware components, along with functions of the finalized project. **Tools used: MATLAB / Arduino**	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	Toshiyo Tamura and Wenxi Chen, “Seamless Healthcare Monitoring”, Springer, 2018.
2.	Edward Sazonov and Michael R. Neuman, “Wearable Sensors -Fundamentals, Implementation and Applications”, Elsevier Inc., 2014.

Reference(s):

1.	Aime Lay-Ekuakille and Subhas Chandra Mukhopadhyay, “Wearable and Autonomous Biomedical Devices and Systems for Smart Environment”, Springer, 2010.
2.	Subhas C and Mukhopadhyay, “Wearable Electronics Sensors - For Safe and Healthy Living”, Springer International Publishing, 2015.
3.	Haider Raad, “The Wearable Technology Handbook”, United Scholars Publication, 2017.

*SDG 3 – Good Health and Well Being
**SDG 9 – Industry Innovation and Infrastructure
***SDG 11 Sustainable Cities and Communities

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1	**Wearable Devices**	
1.1	Motivation for Development of Wearable Devices	1
1.2	The Emergence of Wearable Computing and Wearable Electronics	1
1.3	Applications in Intelligent Clothing, Sports	1
1.4	Applications in Healthcare	1
1.5	Applications in Fashion and Entertainment, Military	1
1.6	Applications in Environment Monitoring, Mining Industry, Public Sector and Safety	1
2	**Scope of Wearable Devices**	
2.1	Role of Wearables	1
2.2	Attributes of Wearables	1
2.3	The Meta Wearables – Textiles and Clothing	1
2.4	Social Aspects - Interpretation of Aesthetics	1
2.5	Adoption of Innovation	1
2.6	On-Body Interaction	1
3	**Sensors for Wearable Devices**	
3.1	Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors	1
3.2	Force and Pressure Measurement	1
3.3	Flexible Sensors - Flex sensor	1
3.4	Pulse Oximeter	1
3.5	Inertial Sensor, Dehydration Sensor	1
3.6	Nano Sensors - CNT Based Sensors	1
4	**Wearable Cameras and Microphones for Navigation**	
4.1	Cameras in Wearable Devices,	1
4.2	Navigation and Cameras in Smart-Watches	1
4.3	Microphones and AI For Respiratory Diagnostics and Clinical Trials	1
4.4	Wearable Assistive Devices for The Blind	1
4.5	Hearing and Touch Sensation	1
4.6	Wearable devices with Global Positioning System (GPS) integration for tracking and navigation	1
5	**Security Issues and Psychological Effects of Wearables**	
5.1	Security and Privacy Issues in Wearable Technology	1
5.2	Psychological Effects of Wearables	1
5.3	Social Implications	1
5.4	Technology Acceptance Factors	1
5.5	Electromagnetic Intolerance and Other Risks	2
Practical: (Mini Project)		
1.	Design and assemble a wearable circuit incorporating sensors and necessary hardware components, along with functions of the finalized project.	30

Course Designer(s)

1. Dr.D. Mugilan - mugilan@ksrct.ac.in

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Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

60 EC E12	IoT Hardware	Category	L	T	P	Credit
		PE	1	0	4	3

Objectives

- To evaluate the unique requirements and challenges associated with deploying IoT
- To develop practical skills in building functional IoT devices using open-source hardware
- To develop skills in combining different sensor types
- To analyze the advantages and challenges of utilizing cloud resources for IoT applications
- To design and implement IoT applications to enhance urban services and sustainability

Pre-requisites

- Electronic devices and circuits, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the fundamental concepts of the Internet of Things	Understand
CO2	Demonstrate proficiency in utilizing open-source hardware	Apply
CO3	Configure and optimize a variety of sensors	Apply
CO4	Implement IoT physical servers and cloud infrastructure	Apply
CO5	Execute comprehensive and tailored IoT applications in diverse domains	Evaluate

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
CO2	3	2	3	-	3	-	-	3	3	3	-	3	3	3	3
CO3	3	2	3	-	3	2	-	3	3	3	-	3	3	3	3
CO4	3	2	3	-	3	3	2	3	3	3	-	3	3	3	3
CO5	3	2	3	-	3	3	3	3	3	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Assessment 1 (Presentation)		Assessment 2 (CA Test)	Assessment 3 (Model – Presentation)	
Assessment Parameters	**Marks**	**Marks**	**Assessment Parameters**	**Marks**
Problem Identification	10	Questions from CO1 to CO4 As per CA Test Pattern	Innovation	30
Innovation	30		Clarity in Presentation	10
Solution for problem	10		Demo	30
Clarity in Presentation	05		Completion of Report	20
Viva	05		Viva	10
Total	**60**	**60**	**Total**	**100**

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E12 - IoT Hardware								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	1	0	4	75	3	50	50	100

Internet of Things * Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT - IoT Protocols, IoT communication models, Domain Specific IoT Applications.	[3+12]
IoT Physical Devices and Endpoints Opensource Hardware, Controlling Hardware - LED, Buzzer, Switching High Power Devices with Transistors, Controlling AC Power Devices with Relays, Controlling Servo Motor, Speed Control of DC Motor, Stepper Motor, Wired - Wireless Protocol Interfaces.	[3+12]
Sensor Interfaces * Sensors - Light Sensor, Temperature Sensor with Thermistor, Voltage Sensor, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, RFID, Level Sensors, Distance Measurement with ultrasound sensor, ADC and DAC, PWM	[3+12]
IoT Cloud * IoT Physical Servers and Cloud - Cloud Storage Models and Communication APIs Web Server - Web Server for IoT, Cloud for IoT	[3+12]
Application development * Biomedical, Agriculture, Smart City, Wearables, Smart Grid, Smart Retail, Smart Manufacturing, Transportation, Fleet Management, Predictive Maintenance	[3+12]
Total Hours: (Lecture - 15; Practical - 60)	**75**

Text Book(s):	
1.	Arshdeep Bahga and Vijay Madisetti, VPT, "Internet of Things: A Hands-On Approach", 1st Edition, 2014.
2.	Scott Klein and Matthijs Hoekstra, "IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the Real World", 1st Edition, Wiley, 2016.
3.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",1st Edition Cisco Press, 2017.
Reference(s):	
1.	Zach Shelby and Dominique Guinard, "IoT Architecture: A Guide to Realizing Value in the Digital Enterprise", 1st Edition, O'Reilly Media, 2016.
2.	Maciej Kranz, "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry", 1st Edition, 2016.
3.	Vincent M. G. Gabaglio and Marco Mancuso, "IoT Applications for Electronics",1st Edition McGraw-Hill Education, 2017.

*SDG 9 – Industry Innovation and Infrastructure

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Internet of Things**	
1.1	Definition and Characteristics of IoT	1
1.2	Sensors, Actuators	1
1.3	IoT Protocols, IoT Communication Models	1
2	**IoT Physical Devices and Endpoints**	
2.1	Opensource Hardware	1
2.2	Controlling Hardware	1
2.3	Wired - Wireless Protocol Interfaces	1
3	**Sensor Interfaces**	
3.1	Sensors- Light sensor, temperature sensor with thermistor, voltage sensor	1
3.2	Motion Detection Sensors, RFID, Level Sensors	1
3.3	ADC and DAC, PWM	1
4	**IoT Cloud**	
4.1	IoT Physical Servers and Cloud	1
4.2	Web server for IoT	1
4.3	Cloud for IoT	1
5	**Application development**	
5.1	Biomedical, Agriculture, Smart city	1
5.2	Smart Manufacturing	1
5.3	Predictive Maintenance	1
6	**Project**	
6.1	Problem Identification	10
6.2	Solution for Problem	15
6.3	Implementation	20
6.4	Presentation	5
6.5	Report	5
6.6	Demo	5

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC E13	Radar Technologies	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To understand the basic concepts of radar system
- To understand the principles of signal detection in noise and radar waveforms
- To understand principles of radar transmitter and receiver
- To understand the principles of radar antennas
- To learn the concepts of MTI and pulse doppler radar

Pre-requisites

- Electromagnetic Waves

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the Basics of radar technologies	Understand
CO2	Apply the concepts related to detection of signals in noise and radar waveforms	Apply
CO3	Describe the concepts of radar transmitter and receiver	Understand
CO4	Explain the concepts of radar antenna and Design of phased array antennas	Apply
CO5	Describe the concept of MTI and doppler radar	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	-	3	3	-	-	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3		3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	20	-	-	40	-
Understand	30	30	40	30	20	50	20
Apply	10	70	-	70	80	10	80
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E13 - Radar Technologies								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	2	0	2	60	3	50	50	100

Radar Concepts Radar Block Diagram, Radar Frequencies, Radar Coordinates, Radar Equation for Hard Targets and the SNR-Radar Cross Section of Targets, Radar Resolution Elements, Pulse, CW and FMCW Radars – Configurations, Transmitter Power- Pulse Repetition Frequency, Duty Ratio, Pulse Compression - Applications of Radar.	[6]
Detection of Signals in Noise and Radar Waveforms Probabilities of Detection and False Alarm-M**atched Filter Receiver***- Detection Criteria - Integration of Radar Pulses - Constant - False Alarm Rate Receivers - Radar Waveforms, Ambiguity Diagram.	[6]
Radar Transmitter and Receiver **Types of Transmitters*** - Linear-Beam Power Tubes - Solid-State RF Power Sources- Magnetron - Klystron, Crossed - Filed Amplifier - Radar Receiver- Receiver Noise Figure - Digital Receivers, Duplexers and Receiver Protectors - Radar Displays - **Human Machine Interface (HMI)****.	[6]
Radar Antenna **Functions of radar antenna***- Antenna Parameters - Antenna Radiation Pattern and Aperture Illumination - Reflector Antennas- Electronically Steered Phased Array Antennas- Phase Shifters - Frequency - Scan Arrays- Architectures for Phased Arrays, Radiators for Phased Arrays - Mechanically Steered Planar Array Antennas.	[6]
MTI and Pulse Doppler Radar Doppler and MTI radar- Delay - Line cancellers- Staggered Pulse Repetition Frequencies - Doppler Filter Banks- Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance Pulse Doppler Radar - MTD, **Tracking Radar****- Monopulse Tracking - Conical Scan and Sequential Lobing - Comparison of Trackers. Tracking Accuracy - Low Angle Tracking - Atmospheric & Weather Radars.	[6]
Practical: 1. Design of Radar System Using MATLAB and Simulink 2. Implementation of Matched Filter for Signal Detector using MATLAB 3. Study the Characteristics of Microwave Sources 4. Design of Phased Array Antennas using Ansys HFSS 5. Design and Implementation of Pulse-Doppler Radar System using MATLAB	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	M.I.Skolnik, "Introduction to Radar Systems", 2nd Edition, Tata McGraw Hill, 2017.
2.	Peebles P Z, "Radar Principles", Wiley, 2016.

Reference(s):

1.	Richard J Doviak, Dusan S Zrnic , "Doppler Radar and Weather Observations", Academic Press, 2014
2.	Bringi V N, Chandrasekar V, "Polarimetric Doppler Weather Radar", Cambridge University Press, 2012.
3.	Richards M A, Scheer J A and Holm W A, "Principles of Modern Radar", Scitech Publishing, 2014.

* SDG 4 – Quality Education
**SDG 9 – Industry Innovation and Infrastructure

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Radar Concepts**	
1.1	Radar Block Diagram	1

1.2	Radar Frequencies, Radar Coordinates	1
1.3	Radar Equation for Hard Targets and the SNR-Radar Cross Section of Targets	1
1.4	Radar Resolution Elements, Pulse CW	1
1.5	FMCW Radars–Configurations	1
1.6	Transmitter Power- Pulse Repetition Frequency, Duty Ratio, Pulse Compression, Applications of Radar	1
2.0	**Detection of Signals in Noise and Radar Waveforms**	
2.1	Probabilities of Detection and False Alarm	1
2.2	Matched Filter Receiver-Detection Criteria	1
2.3	Integration of Radar Pulses	1
2.4	Constant-False Alarm Rate Receivers	1
2.5	Radar Waveforms,	1
2.6	Ambiguity Diagram.	1
3.0	**Radar Transmitter and Receiver**	
3.1	Types of Transmitters	1
3.2	Linear-Beam Power Tubes	1
3.3	Solid-State RF Power Sources	1
3.4	Magnetron- Klystron, Crossed-Filed Amplifier	1
3.5	Radar Receiver- Receiver Noise Figure- Digital Receivers	1
3.6	Duplexers and Receiver Protectors- Radar Displays-Human Machine Interface (HMI).	1
4.0	**Radar Antenna**	
4.1	Functions of Radar Antenna	1
4.2	Antenna Parameters- Antenna Radiation Pattern and Aperture Illumination	1
4.3	Reflector Antennas- Electronically Steered Phased Array Antennas- Phase Shifters	1
4.4	Frequency - Scan Arrays	1
4.5	Architectures for Phased Arrays	1
4.6	Radiators for Phased Arrays- Mechanically Steered Planar Array Antennas.	1
5.0	**MTI and Pulse Doppler Radar**	
5.1	Delay – Line Cancellers Staggered Pulse Repetition Frequencies-	1
5.2	Doppler Filter Banks	1
5.3	Digital MTI Processing - Moving Target Detector	1
5.4	limitations to MTI Performance Pulse Doppler Radar-MTD, Tracking Radar	1
5.5	Monopulse Tracking- Conical Scan and Sequential Lobing- Comparison of Trackers.	1
5.6	Tracking Accuracy-Low-Angle Tracking- Atmospheric & Weather Radars.	1
Practical:		
1.	Design of Radar System using MATLAB and Simulink	6
2.	Implementation of Matched Filter for Signal Detector using MATLAB	6
3.	Study the Characteristics of Microwave Sources	6
4.	Design of Phased Array Antennas using Ansys HFSS	6
5.	Design and Implementation of Pulse-Doppler Radar System using MATLAB	6

Course Designer(s)

1. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

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Approved in Academic Council Meeting held on 23/12/2023

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Department of ECE
K.S.Rangasamy College of Technology,
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60 EC E14	Optical Communication and Networks	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To learn the basic elements of optical fiber transmission link, fiber modes, configurations and structures
- To enhance the knowledge on signal degradation in optical fibers
- To facilitate the knowledge about fiber optic sources and coupling techniques
- To provide knowledge about the operation of fiber optic receivers and parameters measurement
- To enrich the idea of optical fiber networks such as SONET/SDH and optical components

Pre-requisites

- Electromagnetic Waves

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the basic concepts of optical communication	Understand
CO2	Identify the different kind of losses & signal degradation in optical waveguides	Apply
CO3	Explain about the optical sources and coupling techniques	Understand
CO4	Apply the concepts of fiber optic receiver operation and parametric measurement techniques	Apply
CO5	Describe the basic concepts of different optical components and optical networks.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3		3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	15	-	15	-	-	40	-
Understand	35	40	35	40	40	50	40
Apply	10	60	10	60	60	10	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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K.S.Rangasamy College of Technology,
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E14 - Optical Communication and Networks								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	2	0	2	60	3	50	50	100

Optical Fibers: Structures, Waveguiding, and Fabrication **Element of an Optical Fiber Transmission link*, Ray Optics*,** Optical Fiber Modes and Configurations - Single Mode Fibers - Graded Index Fiber Structure, Fiber Fabrication Techniques.	[6]
Signal Degradation in Optical Fibers **Attenuation*** - Absorption Losses, Scattering Losses, Bending Losses, Core and Cladding Losses, Material Dispersion, Waveguide Dispersion, Intermodal Dispersion - Pulse Broadening in GI Fibers	[6]
Fiber Optical Sources and Coupling **Optical sources*** - LEDs and LASER Diodes: Structures, Characteristics and Quantum Efficiency, Power Launching and Coupling, Fiber Alignment, Fiber Splicing.	[6]
Fiber Optical Receivers and Measurements **PIN and APD*** - Structure and Working Principles, Noise in Detectors, Optical Receiver Operation - Fiber Optic Measurements – Attenuation, Dispersion, Refractive Index Profile and Cut- off Wavelength	[6]
Optical Networks and Components **SONET and WDM Optical Networks****, Optical Couplers, Filters, Isolators, Switches and Amplifiers	[6]
Practical: 1. Analog transmission characteristics of fiber optic link 2. Attenuation and numerical aperture measurement in optical fibers 3. PI characteristics of LED and LASER diodes 4. Gain characteristics of APD and photodiode 5. Study of WDM using simulator	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	Gerd Kaiser, “Optical Fiber Communications”, 5th Edition, Tata McGraw Hill Publishers, 2013.
2.	John M. Senior, “Optical Fiber Communication”, 3rd Edition, Pearson Education, 2009.

Reference(s):

1.	Govind P. Agarval, “Fiber-Optic Communication Systems”, 4th Edition, John Wiley & Sons, 2010.
2.	Rajiv Ramasamy and Kumar. N. Sivarajan, Galen H. Sasaki, “Optical Networks-A Practical Perspective”, 3rd Edition, Morgan Kauffman, 2010.
3.	Ramaswami, Sivarajan and Sasaki “Optical Networks”, Morgan Kaufmann, 2009.
4.	Vivekanand Mishra and Sunita P.Ugate, “Fiber – Optic Communication”, Wiley India, 2013.

*SDG:4- Quality Education

**SDG:9 – Build resilient infrastructure and foster innovation

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Optical Fibers: Structures, Waveguiding, and Fabrication**	
1.1	Element of an Optical Fiber Transmission Link	1
1.2	Ray Optics	1
1.3	Optical Fiber Modes and Configurations	1
1.4	Single Mode Fibers	1
1.5	Graded Index Fiber Structure	1
1.6	Fiber Fabrication Techniques.	1
2.0	**Signal Degradation in Optical Fibers**	
2.1	Attenuation – Absorption Losses, Scattering Losses	1
2.2	Bending Losses, Core and Cladding Losses	1
2.3	Material Dispersion	1
2.4	Waveguide Dispersion	1
2.5	Intermodal Dispersion	1
2.6	Pulse Broadening in GI fibers	1
3.0	**Fiber Optical Sources and Coupling**	
3.1	Optical Sources- LEDs Structures, Characteristics	1
3.2	LED Quantum Efficiency	1
3.3	LASER Diodes: Structures	1
3.4	Characteristics and Quantum Efficiency	1
3.5	Power Launching and Coupling	1
3.6	Fiber Alignment & Fiber Splicing	1
4.0	**Fiber Optical Receivers and Measurements**	
4.1	PIN - Structure and Working Principles	1
4.2	APD - Structure and Working Principles	1
4.3	Noise in Detectors	1
4.4	Optical Receiver Operation	1
4.5	Fiber Optic Measurements – Attenuation, Dispersion	1
4.6	Refractive Index Profile and Cut- off Wavelength	1
5.0	**Optical Networks and Components**	
5.1	SONET	1
5.2	SONET Layers	1
5.3	WDM Optical Networks	1
5.4	Optical Couplers	1
5.5	Filters, Isolators	1
5.6	Switches and Amplifiers	1
Practical:		
1.	Analog Transmission Characteristics of Fiber Optic Link	6
2.	Attenuation and Numerical Aperture Measurement in Optical Fibers	6
3.	PI Characteristics of LED and LASER Diodes	6
4.	Gain Characteristics of APD and Photodiode	6
5.	Study of WDM using Simulator	6

Course Designer(s)

1. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

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60 EC E15	Data Science	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the data science process	Understand
CO2	Use the different types of data description for data science process	Apply
CO3	Illustrate the relationships between data	Apply
CO4	Use the Python Libraries for Data Wrangling	Apply
CO5	Apply visualization Libraries in Python to interpret and explore data	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	2	-	3	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	10	-	-	10	-
Understand	30	20	20	20	20	40	20
Apply	10	80	30	80	80	50	80
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Approved in Academic Council Meeting held on 23/12/2023

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.E - Electronics and Communication Engineering

60 EC E15 - Data Science

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	2	0	2	60	3	50	50	100

Data Science Process* Data Science: Benefits and Uses - Facets of Data - Data Science Process: Research Goals – Retrieving Data - Data Preparation - Exploratory Data Analysis - Build the Model - Presenting Findings and Building Applications - Data Mining - Data Warehousing - Statistical Descriptions of Data.	[6]
Describing Data* Types of Data - Types of Variables - Describing Data with Tables and Graphs - Describing Data with Averages - Describing Variability - Normal Distributions and Standard (Z) Scores.	[6]
Describing Relationships* Correlation - Scatter Plots - Correlation Coefficient for Quantitative Data - Computational Formula for Correlation Coefficient - Regression - Regression Line - Least Squares Regression Line - Standard Error of Estimate - Interpretation of R2 - Multiple Regression Equations - Regression Towards the Mean.	[6]
Python Libraries for Data Wrangling** Basics of Numpy Arrays - Aggregations - Computations on Arrays –Comparisons, Masks, Boolean Logic – Fancy Indexing - Structured Arrays - Data Manipulation with Pandas - Data Indexing and Selection - Operating on Data - Missing Data - Hierarchical Indexing - Combining Datasets - Aggregation and Grouping - Pivot Tables.	[6]
Data Visualization** Importing Matplotlib - Line Plots - Scatter Plots - Visualizing Errors – Density and Contour Plots – Histograms – Legends – Colors – Subplots - Text and Annotation - Customization - Three-Dimensional Plotting - Geographic Data with Basemap - Visualization with Seaborn.	[6]
Practical: 1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI 2. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages 3. Working with Numpy arrays 4. Working with Pandas data frames 5. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set 6. Use the Pima Indians Diabetes data set for performing the univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis 7. Perform data exploration analysis using Matplotlib and Seaborn. 8. Use the diabetes data set from UCI data set and perform the bivariate analysis: Linear and logistic regression modeling 9. Apply and explore the plotting function such as Correlation and scatter plots on UCI data sets 10. Apply and explore the plotting function histograms on UCI data sets	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2023.
2.	Robert S. Witte and John S. Witte, “Statistics”, 11th Edition, Wiley Publications, 2017.

Reference(s):

1.	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2023.
2.	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.
3.	Eric Pimpler, “Data Visualization and Exploration with R”, Geospatial Training service, 2017.
4.	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.

*SDG 4 – Quality Education , **SDG 9 – Industry Innovation and Infrastructure

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Data Science Process**	
1.1	Data Science: Benefits and Uses, Facets of Data	1
1.2	Data Science Process	1
1.3	Research Goals, Retrieving Data, Data Preparation	1
1.4	Exploratory Data Analysis, Build the Model, Presenting Findings and Building Applications	1
1.5	Data Mining, Data Warehousing	1
1.6	Basic Statistical Descriptions of Data	1
2	**Describing Data**	
2.1	Types Of Data, Types of Variables	1
2.2	Describing Data with Tables and Graphs	1
2.3	Describing Data with Averages	1
2.4	Describing Variability	1
2.5	Normal Distributions	2
2.6	Standard (Z) Scores	
3	**Describing Relationships**	
3.1	Correlation, Scatter Plots	1
3.2	Correlation Coefficient for Quantitative Data	1
3.3	Computational Formula for Correlation Coefficient	1
3.4	Regression, Regression Line, Least Squares Regression Line	1
3.5	Standard Error Of Estimate, Interpretation Of R2	1
3.6	Multiple Regression Equations, Regression Towards the Mean	1
4	**Python Libraries for Data Wrangling**	
4.1	Basics Of Numpy Arrays, Aggregations	1
4.2	Computations On Arrays, Comparisons	1
4.3	Masks, Boolean Logic, Fancy Indexing	1
4.4	Structured Arrays, Data Manipulation with Pandas	1
4.5	Data Indexing and Selection, Operating On Data, Missing Data	1
4.6	Hierarchical Indexing, Combining Datasets, Aggregation and Grouping, Pivot Tables	1
5	**Data Visualization**	
5.1	Importing Matplotlib, Line Plots, Scatter Plots	1
5.2	Visualizing Errors, Density and Contour Plots	1
5.3	Histograms, Legends, Colors	1
5.4	Subplots, Text and Annotation	1
5.5	Customization, Three-Dimensional Plotting	1
5.6	Geographic Data with Basemap, Visualization With Seaborn	1
Practical:		
1.	Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI	2
2.	Apply and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages	2
3.	Demonstrate the working with Numpy arrays	2
4.	Demonstrate the working with Pandas data frames	3
5.	Illustrate the reading of data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set	3

6.	Use the Pima Indians Diabetes data set for performing the univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis	3
7.	Demonstrate the data exploration analysis using Matplotlib and Seaborn.	3
8.	Use the diabetes data set from UCI data set and perform the bivariate analysis: Linear and logistic regression modeling	4
9.	Apply and explore the plotting function such as Correlation and scatter plots on UCI data sets	4
10.	Apply and explore the plotting function histograms on UCI data sets	4

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.K.Vanitha – vanitha@ksrct.ac.in

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60 EC E16	Consumer Electronics	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To learn the working principles of audio television systems.
- To study the principle of pervasive devices.
- To study the working principle of home and office system
- To become familiar with power supply and wireless device
- To become familiar with product safety and liability issues

Pre-requisites

- Basic knowledge of Electrical and Electronics Engineering

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the working principles of basic audio and television system	Understand
CO2	Explain the functions of mobile phone	Apply
CO3	Explain the operating principles of home Appliances	Apply
CO4	Describe the working principles of wireless devices	Understand
CO5	Discuss the safety issues and safety standards of electronic systems	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	-	3	3	-	-	3	2	3
CO2	3	3	3	-	-	-	-	-	3	3	-	-	3	2	3
CO3	3	3	3	-	-	3	3	-	3	3	-	-	3	3	3
CO4	3	3	3	-	-	-	-	3	3	3		3	3	3	3
CO5	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	20	-	-	34	-
Understand	40	40	40	40	40	66	40
Apply	-	60	-	60	60	-	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E16 - Consumer Electronics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	2	0	2	60	3	50	50	100

Audio And Television System* Microphones, Loud Speaker - Digital Sound Recording on Disc-Dolby Systems, Stereo Amplifiers Principles of Television, Types of TV Camera And Picture Tube, **Principle and Working of HD TV, LCD TV, LED TV, cable TV, DTH and Set top box***	[6]
Pervasive Devices* Mobile Phone: Elements, Design - Mobile Information Architecture - Types of Mobile Operating System - Android - Preferences, The File System, The Options Menu and Intents.	[6]
Home and Office Systems* Alexa Device, Digital Camera System, Microwave Oven, Washing Machine, Air Conditioners, Refrigerators, Construction and Working Principles of Inkjet Printer, Laser Printer	[6]
Power Supply and Wireless Devices* Power Supplies SMPS/UPS - RFID, Ultrasonic remote transmitter, IR remote-control transmitter - Consumer IoT Devices-smart watches, smart glasses, and smart home technologies like text-controlled home appliances.	[6]
Compliance** Product safety and liability issues- standards related to electrical safety and standards related to fire hazards, e.g., UL and VDE - EMI/EMC requirements and design techniques for compliance - ESD, RF interference and immunity.	[6]
Practical: 1. Exploring the Frequency Response of Microphones in Different Environments 2. Identifying and replacing Speakers, Microphone and Vibration motor in mobile phones 3. Test the working function of the printer 4. Investigating the Range and Signal Strength of an IR Remote Transmitter 5. EMI Debugging using Oscilloscopes for consumer electronics.	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	Bali S.P, “Consumer Electronics”, Pearson Education, 2018.
2.	Gupta R.G. “Audio Video Systems”, 2nd Edition, McGraw-Hill, 2017

Reference(s):

1.	Gulati R.R, “Monochrome & Color Television”, 2nd Edition, New Age international, 2017.
2.	Gulati R.R, “Complete Satellite & Cable Television”, Revised Edition, New Age international, 2017.
3.	Blair K, Benson, “Audio Engineering Hand book”, McGraw-Hill, 2017.
4.	Brian Fling, “Mobile Design & Development”, 1st Edition, O’Reilly, 2016.

*SDG 4 - Quality Education
**SDG 11 - Sustainable cities and communities
***SDG 15 - Life on Land

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1	**Audio And Television System**	
1.1	Microphones, Loud Speaker, - Digital Sound Recording on Disc	1
1.2	Dolby Systems, Stereo Amplifiers Principles of Television	1
1.3	Types Of TV Camera And Picture Tube	1
1.4	Principle and working of HD TV, LCD TV, LED TV	2
1.5	Cable TV DTH and Set top box	1
2	**Pervasive Devices**	
2.1	Mobile Phone: Elements, Design	1
2.2	Mobile Information Architecture	1
2.3	Types Of Mobile Operating System	1
2.4	Android Overview	1
2.5	Preferences, The File System	1
2.6	Options Menu and Intents	1
3	**Home And Office Systems**	
3.1	Alexa	1
3.2	Digital Camera System	1
3.3	Microwave Oven	1
3.4	Washing Machine	1
3.5	Air Conditioners, Refrigerators	1
3.6	Construction And Working Principles Of Inkjet Printer, Laser Printer	1
4	**Power Supply and Wireless Devices**	
4.1	Power Supplies SMPS/UPS	1
4.2	RFID, Ultrasonic Remote Transmitter	1
4.3	IR Remote, Control Transmitter	1
4.4	Consumer IoT Devices-Smart Watches, Smart Glasses	1
4.5	Smart Home Technologies Like Text-Controlled Home Appliances	2
5	**Compliance**	
5.1	Product Safety and Liability Issues	1
5.2	Standards Related To Electrical Safety And Standards Related To Fire Hazards e.g.,UL and VDE	2
5.3	EMI/EMC Requirements and Design Techniques for Compliance	1
5.4	ESD, RF Interference and Immunity.	2
Practical:		
1.	**Exploring the Frequency Response of Microphones in Different Environments** i) Discuss the significance of frequency response in capturing accurate audio and how it can vary between different microphone types and models.Record the audio using the microphone and the recording device	4
	ii) Explore how microphone placement affects frequency response by experimenting with different placement configurations during recordings.	2
2.	**Identifying and replacing Speakers, Microphone and Vibration motor in mobile phones.** i) Explain their functions and importance in the overall functionality of mobile devices. Begin with an overview of the internal components of mobile phones, focusing on speakers, microphones, and vibration motors. Discuss common issues that may arise with these components, such as malfunctioning or damaged parts.	4

	ii) Demonstrate proper safety procedures for handling electronic devices and components. Show examples of these components and explain their functions in a mobile device.	2
3.	**Test the working function of the printer.** i) Discuss common printing problems and their troubleshooting methods. Instruct students to set up the printer, connect it to a computer, and install the necessary drivers. Assign printing tasks to each group, such as printing text documents, images, or graphics	4
	ii) Encourage students to experiment with different settings (quality, paper type, color options, etc.) and to troubleshoot common printing issues they encounter (paper jams, poor print quality, connectivity problems, etc.).	2
4.	**Investigating the Range and Signal Strength of an IR Remote Transmitter.** i) Explain the concept of signal strength and how it affects the range of an IR transmitter	4
	ii) Discuss the importance of understanding the range and signal strength for practical applications.	2
5.	**EMI Debugging using Oscilloscopes for consumer electronics**. i) Explaining the concept of EMI and its significance in consumer electronics. Discuss common sources of EMI, such as switching power supplies, digital circuits, and wireless communication.	4
	ii) Demonstrate how to use various controls and settings on the oscilloscope, such as vertical and horizontal scales, triggering, and waveform analysis features.	2

Course Designer(s)

1. Dr.S.Malarkhodi - malarkhodi@ksrct.ac.in

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60 EC E17	Speech and Audio Processing	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To study basic concepts of processing speech and audio signals
- To study and analyse various M-band filter-banks for audio coding
- To understand audio coding based on transform coders
- To study time and frequency domain speech processing methods
- To understand the predictive analysis of speech

Prerequisite

- Digital Signal Processing

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe and Analyse the modeling of speech signal and audio signal	Understand
CO2	Explain the concepts and transform techniques of filter banks in speech and audioprocessing	Apply
CO3	Describe various audio coding and transform coders	Apply
CO4	Analyse the time domain and frequency domain methods for speech processing	Apply
CO5	Explain the predicitive analysis of speech using various methods.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	3		-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	3	-	-	-	3	3	3		3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	10	-	10	-	-	20	-
Understand	40	30	40	30	30	60	30
Apply	10	70	10	70	70	20	70
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E17 - Speech and Audio Processing								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	2	0	2	60	3	50	50	100

Mechanics of Speech and Audio* Review of Signal Processing Theory-Speech Production Mechanism – Nature of Speech Signal – Discrete Time Modelling of Speech Production – Classification of Speech Sounds – Phones – Phonemes – Phonetic and Phonemic Alphabets – Articulatory Features. Absolute Threshold of Hearing – Critical Bands – Simultaneous Masking, Masking – Asymmetry, and Spread of Masking Non – simultaneous Masking – Perceptual Entropy – Basic Measuring Philosophy – Subjective versus Objective Perceptual Testing – The Perceptual Audio Quality Measure (PAQM) - Cognitive Effects in Judging Audio Quality.	[6]
Time-Frequency Analysis: Filter Banks and Transforms* Analysis-Synthesis Framework for M-band Filter Banks – Filter Banks for Audio Coding: Design Considerations – Quadrature Mirror and Conjugate Quadrature Filters – Tree-Structured QMF and CQF M-band Banks – Cosine Modulated ‘Pseudo QMF’ M-band Banks – Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) – Discrete Fourier and Discrete Cosine Transform – Pre-echo Distortion – Pre-echo Control Strategies.	[6]
Audio Coding and Transform Coders* Lossless Audio Coding – Lossy Audio Coding – ISO-MPEG-1A, 2A, 2A-Advaned, 4A Audio Coding – Optimum Coding in the Frequency Domain – Perceptual Transform Coder – Brandenburg – Johnston Hybrid Coder – CNET Coders – Adaptive Spectral Entropy Coding – Differential Perceptual Audio Coder – DFT Noise Substitution – DCT with Vector Quantization – MDCT with Vector Quantization.	[6]
Time and Frequency Domain Methods for Speech Processing* Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.	[6]
Predictive Analysis of Speech* Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method– Covariance method – Solution of LPC equations – Cholesky method – Durbin‟s Recursive algorithm– Lattice formation and solutions–Comparison of different methods–Application of LPC parameters– Pitch detection using LPC parameters – Formant analysis – VELP – CELP.	[6]
Practical: 1. Design a 16-level quantizer with uniform quantization (μ-law with μ=255),FA (α=0.5, N=5) 2. Design a 16-level quantizer with Non uniform quantization (μ-law with μ=255),FA (α=0.5, N=5) 3. Use a Levinson Durbin recursion to computer LP coefficients and filter the speech signals with the resulting LP filter to form the LP residual 4. Explore the consequences on the residual (error signal) in terms of the frame size and predictor order. 5. Compute the LP residual and ensure that you can perfectly reconstruct a speech signal from it through the LP synthesis filter. 6. Explore transforming the coefficients to other forms such as reflection coefficients, Log Area Ratios, Line Spectral Frequencies 7. Explore the use of a lattice structure as opposed to a direct form structure for the analysis and synthesis filters. 8. Implement a Long Term Predictor to operate on the residual – examine the effects on the residual of different sub-frame lengths and the ranges of delays searched. 9. Implement an Inverse LTP – ensure that your system is perfect reconstruction from LTP input to Inverse LTP output.	[30]

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	10. Construct a complete system that incorporates LP analysis filter, LTP, Inverse LTP and LP synthesis filter.	
	Total Hours: (Lecture - 30; Practical - 30)	**60**
Text Book(s):		
1.	B.Gold and N.Morgan, "Speech and Audio Signal: Processing: Processing and Perception of Speech and Music", 2nd Edition, Wiley and Sons, 2011.	
2.	Rabiner L.R and Schafer R.W, "Digital Processing of Speech Signals", Pearson Education, Delhi, India, 2004.	
1.	Mark Kahrs, Karlheinz Brandenburg, Kluwer, "Applications of Digital Signal Processing to Audio and Acoustics", Auris Reference, 2017.	
2.	Udo Zölzer, "Digital Audio Signal Processing", 2nd Edition, John Wiley & sons Ltd, 2008.	
3.	Vijay K. Madisetti, "The Digital Signal Processing Handbook: Video, Speech and Audio Signal Processing", CRC Press, 2009.	
4.	Paul Hill, "Audio and Speech Processing with MATLAB", 1st Edition, CRC Press, 2020.	

*SDG 4 - Quality Education

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Mechanics of Speech and Audio***	
1.1	Review of Signal Processing Theory, Speech Production Mechanism	1
1.2	Nature of Speech Signal &Discrete Time Modelling of Speech Production	1
1.3	Classification of Speech Sound	1
1.4	Threshold of Hearing	1
1.5	Simultaneous Masking & Non Simultaneous Masking	1
1.6	Perceptual Entropy	1
2	**Time-Frequency Analysis: Filter Banks and Transforms***	
2.1	Analysis & Synthesis Framework for M-band Filter Banks	1
2.2	Filter Banks for Audio Coding	1
2.3	Structured QMF and CQF M-band Banks	1
2.4	Cosine Modulated 'Pseudo QMF' M-band Banks and its reconstruction	1
2.5	Discrete Fourier and Discrete Cosine Transform	1
2.6	Pre-echo Distortion & Pre-echo Control Strategies	1
3	**Audio Coding and Transform Coders***	
3.1	Lossless Audio Coding & Lossy Audio Coding	1
3.2	ISO-MPEG	1
3.3	Optimum Coding in the Frequency Domain & Perceptual Transform Coder	1
3.4	Brandenburg & Johnston Hybrid Coder, CNET Coders & Adaptive Spectral Entropy Coding	1
3.5	Differential Perceptual Audio Coder DFT Noise Substitution	1
3.6	DCT & MDCT with Vector Quantization.	1
4	**Time and Frequency Domain Methods for Speech Processing***	
4.1	Time domain parameters of Speech signal & Methods for extracting the parameters	1
4.2	Zero crossing Rate & Silence Discrimination using ZCR and energy Short Time Fourier analysis	1
4.3	Pitch Extraction using time domain methods	1
4.4	Pitch Extraction using frequency domain methods	1
4.5	Formant and Pitch Estimation	1
4.6	Homomorphic Vocoders	1

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5	**Predictive Analysis of Speech***	
5.1	Formulation of Linear Prediction problem in Time Domain	1
5.2	Auto correlation method & Covariance method	1
5.3	Cholesky method & Durbin‟s Recursive algorithm	1
5.4	Lattice formation and solutions, Comparison & Application of LPC parameters	1
5.5	Pitch detection using LPC parameters – Formant analysis	1
5.6	VELP – CELP	1
Practical:		
1.	Design a 16-level quantizer with uniform quantization (μ-law with μ=255),FA (α=0.5, N=5)	2
2.	Design a 16-level quantizer with Non uniform quantization (μ-law with μ=255),FA (α=0.5, N=5)	2
3.	Use a Levinson Durbin recursion to computer LP coefficients and filter the speech signals with the resulting LP filter to form the LP residual	2
4.	Explore the consequences on the residual (error signal) in terms of the frame size and predictor order.	2
5.	Compute the LP residual and ensure that you can perfectly reconstruct a speech signal from it through the LP synthesis filter.	4
6.	Explore transforming the coefficients to other forms such as reflection coefficients, Log Area Ratios, Line Spectral Frequencies	4
7.	Explore the use of a lattice structure as opposed to a direct form structure for the analysis and synthesis filters.	4
8.	Implement a Long Term Predictor to operate on the residual – examine the effects on the residual of different sub-frame lengths and the ranges of delays searched.	2
9.	Implement an Inverse LTP – ensure that your system is perfect reconstruction from LTP input to Inverse LTP output.	4
10.	Construct a complete system that incorporates LP analysis filter, LTP, Inverse LTP and LP synthesis filter.	4

Course Designer(s)

1. Dr.P.Babu - pbabu@ksrct.ac.in

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60 EC E21	Human Assist Devices	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the basic principles of assistive technology.
- To learn technology and sensory Impairments.
- To explore assist devices for vital organs and advancements in technology.
- To identify medical assist devices for disabled persons.
- To study about recent techniques used in clinical applications.

Pre-requisites

- Electronic Devices

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Comprehend the Assistive Technology (AT) used for mobility.	Remember
CO2	Summarize the AT for sensory impairment of vision and hearing.	Understand
CO3	Uncover the assist devices for vital organs and advancements in AT.	Understand
CO4	Describe the principles of medical assist devices.	Apply
CO5	Discuss about recent techniques used in clinical applications.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	2	-	-	3	3	3	-	3	2	3
CO2	3	3	3	-	3	2	-	-	3	3	3	-	3	2	3
CO3	3	3	3	-	3	2	-	-	3	3	3	-	3	2	3
CO4	3	3	3	-	3	2	-	-	3	3	3	-	3	2	3
CO5	3	3	3	-	3	2	-	-	3	3	3	-	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	30	50
Apply	-	10	10
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E21 – Human Assist Devices								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Assistive Technology for Mobility* Basic Assessment and Devices for Mobility: Walking Canes, Wheelchairs, Mobility Scooters - Wheel Chair Seating and Positioning - Fuzzy Logic Expert System for Automatic Tuning of Myoelectric Prostheses - Intelligent Prosthesis.	[9]
Assistive Technology and Sensory Impairments* Visual and Auditory Impairment, Artificial visual Implants: Lens Implant, Corneal Implant, Artificial cornea - Electronic Travel Aids - Augmentative Methods for Dual Sensory Hearing Impairment - Hearing Aids - Cochlear Implants - Haptic as a Substitute for Vision.	[9]
Assist Devices for Vital Organs and Advancements in Technology* Cardiac Assist Devices, Intra - Aortic Balloon Pump (IABP), Auxiliary Ventricles - Dialysis for Kidneys, Intermittent Positive Pressure Breathing (IPPB) Type Assistance for Lungs-Latest Use of Assistive Technology for Chronic Heart Diseases - New Media in Assisting Healthcare- Future Trends in Assistive Technology, Virtual Reality Based Training System for Disabled Children.	[9]
Medical assist devices* Functioning and Different Types of Artificial Heart - Types of Haemodialysis - Wearable Artificial Kidney and its Implantation - Operating Principle of Ventilator -Types of Deafness and its Hearing Aids.	[9]
Recent Trends* Transcutaneous Electric Nerve Simulator, Bio-feedback, Diagnostic and Point-of-care devices - Rehabilitation devices.	[9]
Total Hours:	**45**

Text Book(s):

1.	Oliver Wendt, Raymond W. Quist, Lyle L. Lloyd, "Assistive Technology: Principles and Applications for Communication Disorders and Special Education", 2011.
2.	Kenneth J. Turner, "Advances in Home Care Technologies: Results of the match Project", Springer,1st Edition, 2011.

Reference(s):

1.	Gerr. M. Craddock "Assistive Technology-Shaping the future", IOS Press, 1st Edition, 2003
2.	Marion. A. Hersh, Michael A. Johnson, "Assistive Technology for visually impaired and blind", Springer Science & Business Media, 1st Edition, 2010.
3.	Donald R. Peterson, Joseph D. Bronzino," Medical Devices and Human Engineering",3rd Edition Three volume set, CRC press, 2014.
4.	Kenneth J. Turner, "Advances in Home Care Technologies: Results of the match Project", Springer, 1st Edition, 2011.

*SDG 3 – Good Health and Well Being

Assignment Activity:

Assignment 1:
1. Questions related to the advancements in assistive technologies for mobility and resolve sensory impairments.
2. Case study on assistive devices for learning.

Assignment 2:
1. Questions related to the common and personal assistive devices & rehabilitation devices.
2. Poster presentation on Latest technologies in assistive devices for chronic heart diseases.

Assignment 3:
1. Case study on rehabilitation devices in daily life to serve disabilities.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Assistive Technology for Mobility***	
1.1	Basic Assessment	1
1.2	Devices for Mobility: Walking Canes	1
1.3	Wheelchairs	1
1.4	Power Wheelchairs	1
1.5	Mobility Scooters	1
1.6	Wheel Chair Seating and Positioning	1
1.7	Measurement of seating variables	1
1.8	Fuzzy Logic Expert System for Automatic Tuning of Myoelectric Prostheses	1
1.9	Intelligent Prosthesis	1
2.0	**Assistive Technology and Sensory Impairments***	
2.1	Visual and Auditory Impairment	1
2.2	Artificial visual Implants: Lens Implants	1
2.3	Corneal Implant	1
2.4	Artificial cornea	1
2.5	Electronic Travel Aids: High Tech Navigation Devices	1
2.6	Talking street signs and Elevators	1
2.7	Augmentative Methods for Dual Sensory Hearing Impairment: Hearing Aids	1
2.8	Cochlear Implants	1
2.9	Haptic as a Substitute for Vision	1
3.0	**Assist Devices for Vital Organs and Advancements in Technology***	
3.1	Cardiac Assist Devices	1
3.2	Intra - Aortic Balloon Pump (IABP)	1
3.3	Auxiliary Ventricles	1
3.4	Dialysis for Kidneys	1
3.5	Intermittent Positive Pressure Breathing (IPPB) Type Assistance for Lungs	1
3.6	Latest Use of Assistive Technology for Chronic Heart Diseases	1
3.7	New Media in Assisting Healthcare	1
3.8	Future Trends in Assistive Technology	1
3.9	Virtual Reality Based Training System for Disabled Children	1
4.0	**Medical assist devices***	
4.1	Functioning of Artificial Heart	1
4.2	Different Types of Artificial Heart	1
4.3	Types of Haemodialysis	1
4.4	Wearable Artificial Kidney	1
4.5	Implantation of Wearable Artificial Kidney	1
4.6	Operating Principle of Ventilator	1
4.7	Types of Deafness	1
4.8	Types of Hearing Aids	2
5.0	**Recent Trends***	
5.1	Transcutaneous Electric Nerve Simulator	1
5.2	Bio-feedback Network	1
5.3	Diagnostic Devices	2
5.4	Point-of-care Devices	2

5.5	Rehabilitation Devices: Assistive technology in daily life	1
5.6	Technology in Home	1
5.7	Technology for Recreation	1

Course Designer(s)

1. Mrs.K.Gogila Devi - gogiladevi@ksrct.ac.in

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60 EC E22	IoT Product Development	Category	L	T	P	Credit
		PE	1	0	4	3

Objectives

- To Identifying and Gathering comprehensive requirements for IoT products
- To Acquire skills in Schematic Block Designing
- To gain proficiency in designing PCB layouts
- To develop proficiency in "3D Modelling" and "Designing" of enclosures
- To develop skills in debugging and functional verification of IoT products

Pre-requisites

- Electronic devices and circuits, Basics of C Programming, IoT Hardware

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Demonstrate comprehensive skill to analysis IoT product requirement	Understand
CO2	Execute the entire schematic design process	Apply
CO3	Demonstrate proficiency in PCB Designing and prototyping	Apply
CO4	Apply skills in 3D modelling and 3D printing to create enclosers	Apply
CO5	Demonstrate competence in IoT hardware Programming	Analyse

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	-	3	3	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	3	3	-	3	3	3	-	3	3	2	3
CO4	3	3	3	-	3	3	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	3	-	3	3	3	-	3	3	2	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Assessment 1 (Presentation)		Assessment 2 (CA Test)	Assessment 3 (Model – Presentation)	
Assessment Parameters	**Marks**	**Marks**	**Assessment Parameters**	**Marks**
Problem Identification	10	Questions from CO1 to CO4 As per CA Test Pattern	Innovation	30
Innovation	30		Clarity in Presentation	10
Solution for problem	10		Demo	30
Clarity in Presentation	05		Completion of Report	20
Viva	05		Viva	10
Total	**60**	**60**	**Total**	**100**

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.E - Electronics and Communication Engineering

60 EC E22 - IoT Product Development

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	1	0	4	75	3	50	50	100

IoT Product Requirement Analysis * Identifying and Gathering Requirements, Requirements Specification and Documentation, Validation and Verification of Requirements, Managing Requirement Changes, Requirements for IoT Security and Privacy.	[3+12]
Schematic Design for IoT Product * Schematic Block Designing, Components Selection, Datasheet Analysis, Schematic Designing, Simulation and Verification, Schematic Validation.	[3+12]
PCB Design for IoT Product * PCB Design Requirements, PCB Grade and Fabrication Capability Settings, IPC Standards, PCB Designing, EMI and EMC Compliance, PCB Prototyping, Assembling of Components, Testing of Prototype PCB.	[3+12]
Encloser Designing * Encloser Design Requirements, 3D Modelling and Designing, Encloser Design Validation, 3D Printing - Assembling of Prototype with Encloser.	[3+12]
Programming and Testing * Choosing of Compiler, Programming Standards, Functional Embedded C Programming and Debugging, Functional Verification.	[3+12]
Total Hours: (Lecture - 15; Practical - 60)	**75**

Text Book(s):

1.	Dave Shackleford, "IoT Security: A Guide for IT and Security Professionals", 1st Edition O'Reilly Media, 2015.
2.	Paul Scherz, Simon Monk, "Practical Electronics for Inventors", 4th Edition, McGraw-Hill Education, 2016.
3.	C. P. Wong, "Printed Circuit Board Basics for Non-Engineers", 3rd Edition, Wiley-IEEE Press, 2018.

Reference(s):

1.	Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann, "Internet of Things: Principles and Paradigms", 1st Edition, 2016.
2.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Cisco Press, 2017.

*SDG 9 – Industry Innovation and Infrastructure

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**IoT Product Requirement Analysis**	
1.1	Identifying and Gathering Requirements	1
1.2	Requirements Specification and documentation	1
1.3	Managing Requirement Changes	1
2	**Schematic Design for IoT Product**	
2.1	Schematic Block Designing	1
2.2	Components Selection, Datasheet Analysis	1
2.3	Schematic Validation	1
3	**PCB Design for IoT Product**	
3.1	PCB Design Requirements	1
3.2	PCB Grade and Fabrication Capability Settings	1
3.3	IPC Standards	1
4	**Encloser Designing**	
4.1	Encloser Design Requirements	1
4.2	3D Modelling and Designing	1
4.3	Encloser Design Validation	1
5	**Programming and Testing**	
5.1	Choosing Of Compiler, Programming Standards	1
5.2	Functional Embedded C Programming	1
5.3	Functional Verification	1
6	**Project**	
6.1	Problem Identification	10
6.2	Solution for Problem	15
6.3	Implementation	20
6.4	Presentation	5
6.5	Report	5
6.6	Demo	5

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC E23	Avionics Systems	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To impart knowledge on fundamentals of avionics and power systems.
- To impart knowledge on radio navigation systems.
- To impart knowledge, understand the flight instruments.
- To impart knowledge on the concepts of power plant systems, recorders.
- To impart knowledge on different advanced radar systems.

Pre-requisites

- Radar Technologies

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the power supply systems, sources, generation, distribution systems and navigation systems	Understand
CO2	Articulate the position, speed, direction of the object, warning and collision avoidance systems	Understand
CO3	State the various flight instruments and their working	Understand
CO4	Describe the different communication systems, control systems, recorders.	Understand
CO5	Explain the advanced radar systems used in avionics	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	2	-	3	3	3	-	3	3	3	3
CO2	3	3	2	-	3	2	-	3	3	3	-	3	3	2	3
CO3	3	3	2	-	-	2	-	3	3	3	-	3	2	2	3
CO4	2	3	3	-	-	1	-	3	3	3	-	2	2	2	3
CO5	3	3	3	-	3	1	-	3	3	3	-	2	2	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	12	12	20
Understand	48	48	80
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E23 - Avionics Systems								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Introduction to Flight-Theory of Flight and Control Surfaces Brief about Avionics - Evolution of Avionics - Brief about Various Avionic Systems on board an Aircraft - Power supply systems-Electrical Power Sources - Power Generation and Distribution Systems - Navigation Systems-Electrical Navigation Systems - Compasses, Inertial Navigation Systems (INS)	[9]
Radio Navigation Systems Automatic Direction Finder (ADF) - Global Positioning System (GPS) - Very High Frequency Omni-Range (VOR)-Instrument Landing System (ILS) - Air Traffic Control System (ATC) - Distance Measuring Equipment (DME) - Ground Proximity Warning System (GPWS) -Traffic Collision Avoidance System (TCAS) - Weather Radar **Hands - on:** Simulation of GPS Receiver Model	[9]
Flight Instruments * Air Data Systems/ Computers (ADS/ADC), Pitot Static Systems - Air Speed Indicator (ASI) - Vertical Speed Indicator (VSI) - Barometric Altimeters - Radio Altimeters - Artificial Horizon or Attitude Indicator-Flight Directors (FD)	[9]
Power Plant Systems* Communication Systems - VHF, HF, Data-Link, Voice Scramblers - Automatic Flight Control Systems (AFCS) - Automatic Flight Guidance Systems (AFGS) - Autopilot - Miscellaneous Systems - Collision Avoidance Systems (CAS), Flight Data Recorders (FDR), Cockpit Voice Recorders (CVR) - Space Avionics - Challenges in Design Model-Based Design of Safety - Critical Avionics Systems	[9]
Advanced Radar Systems* Helmet Mounted Target Designation System (HMTDS) - Full Authority Digital Engine (or Electronics) Control (FADEC) - Avionics of Unmanned Aerial Vehicles (UAV) - All Electric Aircraft-Design of In-flight Entertainment Systems **Hands - on: Verification of Avionics Systems Using Simulink Test and Simulink Real-Time**	[9]
Total Hours:	**45**

Text Book(s):	
1.	Dr Albert Helfrick, "Principles of Avionics", 8th Edition, Avionics Communications, 2015
Reference(s):	
1.	Ian Moir and Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", 3rd Edition, Wiley, 2011.
2.	Collinson RPG, "Introduction to Avionics Systems", 3rd Edition, Springer, Jun 2011
3.	Pallett E H J, "Aircraft Instruments and Integrated Systems", 1st Edition, Avionics Communications, 1992.

*SDG 4 – Quality Education

Assignment activity:

Assignment 1 – Covers Module 1 & 2

1. Power generation and distribution systems, Navigation Systems, Electrical Navigation Systems.
2. Instrument Landing System (ILS), Air Traffic Control System (ATC).

Assignment 2 – Covers Module 3, 4 & 5

1. Barometric Altimeters, Radio Altimeters.
2. Flight Data Recorders (FDR), Cockpit Voice Recorders (CVR).

Assignment 3 – Covers Module 5

1. Full Authority Digital Engine (or electronics) Control (FADEC), Avionics of Unmanned Aerial Vehicles (UAV)

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Introduction to Flight-Theory of Flight and Control Surfaces**	

1.1	Brief about Avionics - Evolution of Avionics	1
1.2	Brief about various Avionic systems on board an aircraft	1
1.3	Power supply systems	1
1.4	Electrical Power Sources	1
1.5	Power generation and distribution systems	1
1.6	Navigation Systems	1
1.7	Electrical Navigation Systems	1
1.8	Inertial Navigation Systems	2
2.0	**Radio Navigation Systems**	
2.1	Automatic Direction Finder (ADF)	1
2.2	Global Positioning System (GPS)	1
2.3	Very High Frequency Omni-Range (VOR)	1
2.4	Instrument Landing System (ILS)	1
2.5	Air Traffic Control System (ATC)	1
2.6	Distance Measuring Equipment (DME)	1
2.7	Ground Proximity Warning System (GPWS)	1
2.8	Traffic Collision Avoidance System (TCAS)	1
2.9	Weather Radar	1
3.0	**Flight Instruments** *	
3.1	Air Data Systems/ Computers (ADS/ADC)	2
3.2	Pitot Static Systems	1
3.3	Air Speed Indicator (ASI)	1
3.4	Vertical Speed Indicator (VSI)	1
3.5	Barometric Altimeters-Radio	1
3.6	Altimeters	1
3.7	Artificial Horizon or Attitude Indicator	1
3.8	Flight Directors (FD)	1
4.0	**Power Plant Systems***	
4.1	Communication systems-VHF, HF, Data-link, Voice scramblers	1
4.2	Automatic Flight Control Systems (AFCS)	1
4.3	Automatic Flight Guidance Systems (AFGS)	1
4.4	Autopilot	1
4.5	Miscellaneous Systems-Collision Avoidance Systems (CAS)	1
4.6	Flight Data Recorders (FDR)	1
4.7	Cockpit Voice Recorders (CVR)	1
4.8	Space avionics	1
4.9	Challenges in design	1
5.0	**Advanced Radar Systems***	
5.1	Helmet Mounted Target Designation System (HMTDS)	2
5.2	Full Authority Digital Engine (or electronics) Control (FADEC)	2
5.3	Avionics of Unmanned Aerial Vehicles (UAV)	2
5.4	All Electric Aircraft	1
5.5	Design of In-flight Entertainment Systems	2

Course Designer(s)

1. Mr S.Pradeep - pradeeps@ksrct.ac.in

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CHAIRMAN BOARD OF STUDIES
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60 EC E24	Wireless Sensor Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the fundamentals of wireless sensor network
- To gain knowledge on routing protocols of WSN
- To get exposed to 6LoWPAN technology
- To gain knowledge about operating system related to WSN
- To expand knowledge about operating system related to 6LoWPAN

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Examine the wireless sensor networks architecture and design principles	Understand
CO2	Identify the functionality of various routing protocols.	Understand
CO3	Outline the 6LoWPAN architecture with header compression techniques	Understand
CO4	Infer the different protocols and sensor networks	Apply
CO5	Build modules and be familiar with the OS used in wireless sensor networks	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	2	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	2	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	-	20
Understand	40	40	40
Apply	-	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E24 – Wireless Sensor Networks								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Wireless Sensor Network Architecture Challenges - Comparison with Ad hoc Network - Node Architecture and Network Architecture - Design Principles - Service Interfaces - Gateway - Short Range Radio Communication Standards - IEEE 802.15.4 - Zigbee and Bluetooth.	[9]
Routing Protocols* Fundamentals - Low duty cycle and Wakeup Concepts - Contention and Schedule Based Protocols - SMAC - BMAC - Routing protocols – Requirements - Classification - SPIN - Directed Diffusion – LEACH - PEGASIS.	[9]
6LoWPAN* 6LoWPAN Architecture - Protocol Stack - Adaptation Layer - Link layers – Routing - Mesh - Under - Route - Over - Header Compression - Stateless Header Compression - Context - Based Header Compression - Fragmentation and Reassembly - Mobility - Mobile IPv6, Proxy Home Agent - Proxy MIPv6 - NEMO.	[9]
Application* Design Issues - Real-time Streaming and Sessions - Publish/Subscribe - Web Service Paradigms - Common Protocols - Web Service Protocols, MQ Telemetry Transport for Sensor Networks (MQTT-S) - ZigBee compact application protocol (CAP) - Service discovery - Simple network management protocol (SNMP).	[9]
Sensor Network Platforms TinyOS - NesC - Interfaces - modules - configuration - Programming in TinyOS using NesC. TOSSIM - Simulation environment - Cooja simulator, Programming. Case Study: Underground Tunnel Mobile Target Tracking, Zigbee Smart Home Automation System	[9]
Total Hours:	**45**

Text Book(s):

1.	Holger Karl, Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley & Sons 2007.
2.	Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017.

Reference(s):

1.	Hongmei Deng, Wei Li and Dharma P. Agrawal, "Routing security in Wireless Ad hoc Networks", IEEE Communication Magazine, 2002.
2	Zach Shelby Sensinode and Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, 2009.
3	Philip Levis, "TinyOS Programming", 2006 –www.tinyos.net.
4.	The Contiki Operating System.http://www.sics.se/Contiki

*SDG4 Quality Education

Assignment activity:

Assignment 1:
1. Poster Presentation on Routing Protocol

Assignment 2:
1. Video Presentation on Application on WSN

Assignment 3:
1. Case Study Presentation on Wireless Sensor Architecture

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Wireless Sensor Network Architecture**	
1.1	Challenges	1
1.2	Comparison with Ad hoc Network	1
1.3	Node Architecture	1
1.4	Network Architecture	1
1.5	Design Principles,	1
1.6	Service Interfaces, Gateway	1
1.7	Short Range Radio Communication standards	1
1.8	Zigbee	1
1.9	Bluetooth	1
2.0	**Routing Protocols**	
2.1	Fundamentals, Low Duty Cycle Protocols	1
2.2	Wakeup Concepts	1
2.3	Contention and Schedule Based Protocols – SMAC	1
2.4	BMAC	1
2.5	Routing Protocols – Requirements	1
2.6	SPIN	1
2.7	Directed Diffusion	1
2.8	LEACH	1
2.9	PEGASIS	1
3.0	**6LoWPAN**	
3.1	6LoWPAN Architecture, Protocol Stack	1
3.2	Adaptation Layer	1
3.3	Link layers, Addressing	1
3.4	Routing - Mesh-Under- Route-Over	1
3.5	Header Compression - Stateless Header Compression	1
3.6	Context- Based Header Compression	1
3.7	Fragmentation and Reassembly	1
3.8	Mobile Ipv6, Proxy Home Agent	1
3.9	Proxy Mipv6, NEMO Routing	1
4.0	**Application**	
4.1	Design Issues, Real-Time Streaming	1
4.2	Sessions Publish/Subscribe	1
4.3	Web Service Paradigms,	1
4.4	Common Protocols	1
4.5	Web Service Protocols	1
4.6	MQ Telemetry Transport for Sensor Networks (MQTT-S)	1
4.7	Zigbee Compact Application Protocol (CAP)	1
4.8	Service Discovery	1
4.9	Simple Network Management Protocol (SNMP)	1
5.0	**Sensor Network Platforms**	
5.1	TinyOS	1
5.2	NesC Interfaces,	1
5.3	Modules, Configuration	1
5.4	Programming in TinyOS Using NesC	1

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5.5	TOSSIM	1
5.6	Simulation Environment - Cooja Simulator	1
5.7	Simulation Environment - Programming	1
5.8	Underground Tunnel Mobile Target Tracking	1
5.9	Zigbee Smart Home Automation System	1

Course Designer(s)

1. Mr S Jayamani - jayamani@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

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60 EC E25	Digital Image Processing	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To study the concept of digital image fundamentals
- To learn about simple image enhancement techniques in Spatial and Frequency domain.
- To explain the concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To learn the concept of image compression and recognition methods

Pre-requisites

- Signals and Systems

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the fundamentals of image.	Remember
CO2	Discuss image enhancement techniques in spatial domain and perform histogram equalization	Apply
CO3	Analyse image restoration through various filters	Apply
CO4	Explain the concepts of segmentation.	Apply
CO5	Discuss the algorithms for lossy and lossless compression.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO2	3	3	3	-	3	-	-	-	3	3		3	3	2	3
CO3	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO4	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	20	-	-	34	-
Understand	40	30	20	30	30	51	30
Apply	-	70	20	70	70	15	70
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

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Department of ECE
K.S.Rangasamy College of Technology,
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Syllabus

<table>
<tr><td colspan="9">K.S.Rangasamy College of Technology – Autonomous R2022</td></tr>
<tr><td colspan="9">B.E – Electronics and Communication Engineering</td></tr>
<tr><td colspan="9">60 EC E25 - Digital Image Processing</td></tr>
<tr><td rowspan="2">Semester</td><td colspan="3">Hours/Week</td><td rowspan="2">Total Hours</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>VI</td><td>2</td><td>0</td><td>2</td><td>60</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="8">Digital Image Fundamentals and Transforms*
Steps in Digital Image Processing – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships Between Pixels - Color Image Fundamentals - RGB, HSI Models, Two Dimensional Mathematical Preliminaries, 2D transforms: DFT, DCT.</td><td>[6]</td></tr>
<tr><td colspan="8">Image Enhancement**
Basic Gray Level Transformations – Histogram Processing – Histogram Matching – Spatial Filtering – Smoothing Spatial Filters – Sharpening Spatial Filters- Ideal, Butterworth and Gaussian Filters, Homomorphic Filtering, Color Image Enhancement.</td><td>[6]</td></tr>
<tr><td colspan="8">Restoration*
Model of the Image Degradation / Restoration Process- Mean Filters – Order – Statistics Filters- Adaptive Filters – Inverse Filtering** – Minimum Mean Square Error Filtering – Constrained Least Squares Filtering** – Geometric Mean Filter.</td><td>[6]</td></tr>
<tr><td colspan="8">Image Segmentation*
Edge Detection – Thresholding – Region Based Segmentation Region Based Segmentation – Region Growing – Region Splitting and Merging – Morphological Processing- Erosion and Dilation, Segmentation By Morphological Watersheds.***</td><td>[6]</td></tr>
<tr><td colspan="8">Image Compression and Recognition*
Need For Data Compression, Huffman, Run Length Encoding Codes, JPEG Standard, Boundary Representation, Fourier Descriptor, Regional Descriptors Texture - Patterns and Pattern Classes** - Recognition Based on Matching.</td><td>[6]</td></tr>
<tr><td colspan="8">Practical:
1.Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)
2. Implementation of Relationships between Pixels
3. Contrast stretching of a low contrast image and finding Histogram, Histogram Equalization.
4. Implementation of Transformations of an Image.
5. Implementation of image restoring techniques.
6. Display of bit planes of an Image.
7.Implementation of image sharpening filters and Edge Detection using Gradient Filters
8.Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)
9 Image Compression by DCT, DPCM, HUFFMAN coding.
10. Implementation of image sharpening filters and Edge Detection using Gradient Filters
Tools used: MATLAB</td><td>[30]</td></tr>
<tr><td colspan="8">Total Hours: (Lecture - 30; Practical - 30)</td><td>60</td></tr>
<tr><td colspan="8">Text Book(s):</td><td></td></tr>
<tr><td>1.</td><td colspan="8">Rafael C Gonzalez, Richard E. Woods, ‘Digital Image Processing’, 4th Edition, Pearson Education, 2018.</td></tr>
<tr><td>2.</td><td colspan="8">Jain A.K, ‘Fundamentals of Digital Image Processing’, New Edition, Prentice Hall of India, 2016.</td></tr>
<tr><td colspan="9">Reference(s):</td></tr>
<tr><td>1.</td><td colspan="8">Rafael C Gonzalez, Richard E. Woods, ‘Digital Image Processing’, Prentice Hall, 3rd Edition, 2016.</td></tr>
<tr><td>2.</td><td colspan="8">William K. Pratt, ‘Digital Image Processing‘, John Wiley, New York, 2016</td></tr>
<tr><td>3.</td><td colspan="8">Dudgeon D.E and Mersereau RM, ‘Multidimensional Digital Signal Processing‘, Prentice Hall Professional Technical Reference, 2016.</td></tr>
<tr><td>4.</td><td colspan="8">Yao Wang, JoernOstermann, and Ya-Qin Zhang ,’ Video Processing and Communications’, Prentice Hall, 2016.</td></tr>
</table>

*SDG 4- Quality Education
**SDG 8-Decent work and economic growth
***SDG 11- Sustainable cities and communities

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CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
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Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Digital Image Fundamentals and Transforms**	
1.1	Steps in Digital Image Processing, Elements of Visual Perception	1
1.2	Image Sensing and Acquisition, Image Sampling and Quantization	2
1.3	Relationships Between Pixels, Color Image Fundamentals, RGB, HIS Models	2
1.4	Two-Dimensional Mathematical Preliminaries, 2D Transforms – DFT, DCT	1
2	**Electrical and Emission Control System**	
2.1	Basic gray level transformations	2
2.2	Histogram Processing, Histogram Matching, Spatial Filtering, Smoothing Spatial Filters	2
2.3	Sharpening Spatial Filters, Homomorphic Filtering, Smoothing Spatial Filters	2
3	**Restoration**	
3.1	Model of the Image Degradation / Restoration Process	1
3.2	Mean Filters, Order Statistics Filters, Adaptive Filters	2
3.3	Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering	2
3.4	Geometric Mean Filter	1
4	**Image Segmentation**	
4.1	Edge Detection, Thresholding, Region Based Segmentation	2
4.2	Region Based Segmentation, Region Growing, Region Splitting and Merging	2
4.3	Morphological Processing, Erosion and Dilation, Segmentation by Morphological Watersheds	2
5	**Image Compression and Recognition**	
5.1	Need For Data Compression, Huffman, Run Length Encoding Codes	2
5.2	JPEG Standard, Boundary Representation, Fourier Descriptor, Regional Descriptors	2
5.3	Topological Feature, Texture, Patterns and Pattern Classes, Recognition Based on Matching	2
Practical:		
1.	Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)	4
2.	Implementation of Relationships between Pixels	2
3.	Contrast stretching of a low contrast image and finding Histogram, Histogram Equalization	4
4.	Implementation of Transformations of an Image	2
5.	Implementation of image restoring techniques	4
6.	Display of bit planes of an Image	2
7.	Implementation of image sharpening filters and Edge Detection using Gradient Filters	4
8.	Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)	2
9.	Image Compression by DCT, DPCM, HUFFMAN coding	4
10.	Implementation of image sharpening filters and Edge Detection using Gradient Filters	2

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Dr.S.Malarkhodi - malarkhodi@ksrct.ac.in

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60 EC E26	Optoelectronic Devices	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To know the basics of solid state physics and understand the nature and characteristics of light.
- To understand the operation of different display devices and their applications.
- To learn the principle of optical detection mechanism in different detection devices.
- To understand different light modulation techniques and optical switching.
- To study the opto electronic integrated circuits in transmitters and receivers.

Pre-requisites

- Electron devices

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Illustrate the concept of light wave theory and solid state physics	Understand
CO2	Describe the operation of various display devices	Understand
CO3	Discuss the working principle of optical detection devices	Understand
CO4	Describe the construction and properties of optical modulator and Optoelectronic Devices and Identify their applications	Understand
CO5	Describe the optoelectronic applications and guided wave devices	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	40	40
Apply	-	-	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E26 - Optoelectronic Devices								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Elements of Light and Solid State Physics* Wave Nature of Light - Polarization, Interference - Diffraction, Quantum Mechanical Concept - Band Structure and Carrier Effective Masses - Scattering and Carrier Mobilities Semiconductors Statistics - Carrier Recombination.	[9]
Display Devices and Lasers* Photo Luminescence - Cathode Luminescence - Electro Luminescence - Injection Luminescence – LED - Plasma Display - Liquid Crystal Displays - Numeric Displays - Laser Emission – Absorption – Radiation - Population Inversion - Optical Feedback - Threshold Condition - Laser Modes - Classes of Lasers - Laser Applications.	[9]
Optical Detection Devices* Photo Detector - Thermal Detector - Photo Devices - Photo Conductors - Detector Performance.	[9]
Optoelectronic Modulators and Switches* Analog and Digital Modulation - Electro-Optic modulators - Magneto Optic Devices - Acoustic Devices Optical - Switching and Logic Devices.	[9]
Optoelectronic Integrated Circuits* Hybrid and Monolithic Integration - Application of Opto Electronic Integrated Circuits - Integrated Transmitters and Receivers - Guided wave devices.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Pallab Bhattacharya, “Semiconductor Opto Electronic Devices”, 2nd Edition, Prentice Hall of India Pvt., Ltd. New Delhi, 2017.
2.	Jasprit Singh, “Opto Electronics: As Introduction to Materials and Devices”, 2nd Edition, Mc Graw -Hill International, 1998.
Reference(s):	
1.	Gupta S.C, “Opto Electronic Devices and Systems”, 2nd Edition, Prentice Hall of India, 2015.
2.	Wilson J and Hawkes J, “Opto Electronics: An Introduction”, 3rd Edition, Prentice Hall, 1998.
3.	Aamir T. Grifel and Henry L. Bertoni, “Guided wave opto-electronics: Device characterization, analysis and design”, 1st Edition, Plenium Press, 1995.
4.	Richard Osgood Jr. and Xiang Meng ,"Principles of Photonic Integrated Circuits: Materials, Device Physics, Guided Wave Design",1st Edition, Springer, 2021.

*SDG 7 - Ensure access to affordable, reliable, sustainable and modern energy for all

<u>Assignment Activity</u> :

Assignment 1:
1. Seminar in Scattering and Carrier Mobilities Semiconductors Statistics
2. Group discussion on Luminescence Techniques

Assignment 2:
1. Demo on Optical Detection Devices.

Assignment 3:
1. Seminar on Modulator techniques.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Elements of Light and Solid State Physics**	
1.1	Wave nature of light	1
1.2	Polarization	1
1.3	Interference	1
1.4	Diffraction	1
1.5	Quantum Mechanical Concept	1
1.6	Band Structure and Carrier Effective Masses	1
1.7	Scattering and Carrier Motilities	1
1.8	Semiconductors Statistics	1
1.9	Carrier Recombination	1
2	**Display Devices and Lasers**	
2.1	Photo Luminescence	1
2.2	Cathode Luminescence	1
2.3	Electro Luminescence, Injection Luminescence	1
2.4	LED, Plasma Display	1
2.5	Liquid Crystal Displays, Numeric Displays	1
2.6	Laser Emission, Absorption, Radiation, Population Inversion	1
2.7	Optical Feedback, Threshold Condition	1
2.8	Laser Modes, Classes of Lasers	1
2.9	Laser Applications	1
3	**Optical Detection Devices**	
3.1	Photo detector	1
3.2	Quantum mechanics of photon interaction	1
3.3	Thermal detector	1
3.4	Fundamental Principles of Thermal Detection	1
3.5	Photo Devices	1
3.6	Types of Photo Devices	1
3.7	Photo Conductors	1
3.8	Photoconductivity Mechanism	1
3.9	Detector performance	1
4	**Optoelectronic Modulators and Switches**	
4.1	Analog Modulation	1
4.2	Digital Modulation	1
4.3	Electro-optic modulators	1
4.4	Key Parameters and Characteristics	1
4.5	Magneto optic Devices	1
4.6	Types of Magneto-Optic Devices	1
4.7	Acoustic devices	1
4.8	Optical Switching Devices	1
4.9	Optical Logic Devices	1
5	**Optoelectronic Integrated Circuits**	
5.1	hybrid Integration	1
5.2	Monolithic Integration	1
5.3	Opto Electronic Integrated Circuits	1
5.4	Application of Opto Electronic Integrated Circuits	1

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5.5	Integrated transmitters	1
5.6	Directly Modulated and External Modulated	1
5.7	Integrated Receivers	1
5.8	Performance Metrics	1
5.9	Guided wave devices	1

Course Designer(s)

1. M.Devaki - devaki@ksrct.ac.in

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K.S.Rangasamy College of Technology,
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60 EC E27	Therapeutic Equipment	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To study the fundamentals of bioelectric signals and methods of recording various bio- potentials
- To evaluate the measurement of bio-chemical and non-electrical parameters
- To explore the various functional blocks present is cardiac care units and various assist devices
- To develop an understanding of the physiotherapy and diathermy equipment
- To study the electrical safety in the hospital environment

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss and analyze bioamplifiers	Understand
CO2	Describe vital and non-electrical parameters	Understand
CO3	Explain about the pacemaker and defibrillator	Apply
CO4	Demonstrate the function of assist devices.	Apply
CO5	Describe about electrical safety of medical equipment in the hospital environment	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	2	
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	2	
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	2	
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	30
Understand	50	20	30
Apply	-	30	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Tiruchengode - 637 215.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E27 - Therapeutic Equipment								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Content	Hours
Bio Potential Recording* Cell Potential-Half-cell Potential, Electrodes -Types of Electrodes, Signal Conditioning circuits Characteristics of Amplifiers, Differential Amplifiers, Filters, Isolation Amplifier, Design concepts. ECG, EEG, EMG, PCG, EOG, Lead System and Recording Methods, Typical Waveform, Frequency Spectrum, Abnormal Waveforms. Evoked Response.	[9]
Measurement of Non Electrical Parameter * Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements - Direct, Indirect. Blood flow Measurements – In vitro, In vivo, Gas Flow Measurements. Lung Volume Measurement – Spirometer.	[9]
Cardiac Care Units *** Pace Makers - Different Types, Batteries for Pace Makers, Design Concept. DC Defibrillators, Asynchronous and Synchronous Types, Patient Monitoring System, Principles of Bio Telemetry.	[9]
Assist Devices ** Heart Lung Machine-Condition to be satisfied by the H/L System. Different Types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process. Hemodialyser Indication and Principle of Hemodialysis, Membrane, Dialysate, Different types of Hemodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. Respiratory aids- Types of Ventilators – Pressure, Volume, and Time controlled.	[9]
Diathermy, Stimulator and Patient Safety *** Diathermy-Physiological Effects of HF radiation, Depth of Penetration, Short Wave, Ultrasonic and Microwave Diathermy, Surgical Diathermy, Hazards and Safety Procedures. Medical Stimulators – Intensity Duration Curve, Current Waveforms - Galvanic, Faradic, Surged Faradic, Exponential, Biphasic, TENS, Interferential Therapy. Electrical Safety-Leakage Current, Micro and Macro Electric Shock, GFI Units, Earthing Scheme, Electrical Safety Analyser.	[9]
Total Hours:	**45**

Text Book(s):

1.	Geddes L.A and Baker L.E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley and Sons, Reprint 2008
2.	John G.Webster, "Medical Instrumentation Application and Design", 4th Edition, John Wiley and Sons, New York, 2009.

Reference(s):

1.	Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2014.
2.	Richard S.Cobbold, "Transducers for Biomedical Measurements; Principle and applications", John Wiley and sons, 1992.
3.	Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4.	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

* SDG 4 - Quality Education
**SDG 9 - Industry Innovation and Infrastructure
***SDG 15 - Life on land

Assignment Activity:

Assignment 1 - Group Discussion on Amplifiers
Assignment 2 - Seminar on Defibrillators
Assignment 3 - Case Study on Diathermy

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. Of Hours**
1.0	**Bio Potential Recording**	
1.1	Cell Potential-Half-cell potential	**1**
1.2	Electrodes-types of electrodes	**1**
1.3	Signal Conditioning circuits	**1**
1.4	Characteristics of Amplifiers, Differential Amplifiers	**1**
1.5	Filters, Isolation Amplifier	**1**
1.6	Design concepts. ECG, EEG, EMG, PCG, EOG	**1**
1.7	lead system and recording methods	**1**
1.8	typical waveform, frequency spectrum, abnormal waveforms	**1**
1.9	Evoked Response	**1**
2.0	**Measurement of Non Electrical Parameter**	
2.1	Measurements of Respiration Rate	**1**
2.2	Temperature, Pulse rate, Blood pressure Measurements	**2**
2.3	Direct, Indirect. Blood flow Measurements	**2**
2.4	in vitro, In vivo, Gas flow measurements	**2**
2.5	Lung volume measurement – Spirometer	**2**
3.0	**Cardiac Care Units**	
3.1	Pace makers - different types	**1**
3.2	batteries for pace makers	**2**
3.3	Design Concept. DC defibrillators	**1**
3.4	asynchronous and synchronous types	**2**
3.5	patient monitoring system	**2**
3.6	principles of bio telemetry	**1**
4.0	**Assist Devices**	
4.1	Heart Lung Machine	**1**
4.2	Condition to be satisfied by the H/L System	**1**
4.3	Different types of Oxygenators	**1**
4.4	Pumps, Pulsatile and Continuous Types	**1**
4.5	Monitoring Process. Hemodialyser Indication and Principle of Hemodialysis	**1**
4.6	Membrane, Dialysate, Different types of Hemodialysers	**1**
4.7	Monitoring Systems, Wearable Artificial Kidney	**1**
4.8	Implanting Type. Respiratory aids	**1**
4.9	Types of Ventilators – Pressure, Volume, and Time controlled	**1**
5.0	**Diathermy, Stimulator and Patient Safety**	
5.1	Diathermy-Physiological effects of HF radiation	**1**
5.2	Depth of Penetration, short wave	**1**
5.3	Ultrasonic and microwave diathermy	**1**
5.4	Surgical diathermy, Hazards and safety procedures	**1**
5.5	Medical Stimulators – Intensity Duration Curve	**1**
5.6	Current waveforms - Galvanic, Faradic, surged faradic, exponential, biphasic, TENS, Interferential therapy	**2**
5.7	Electrical Safety-Leakage current, Micro and macro electric shock	**1**
5.8	GFI units, Earthing Scheme, Electrical safety Analyser.	**1**

Course Designer(s)

1. Dr.S.Malarkhodi – malarkhodi@ksrct.ac.in

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K.S.Rangasamy College of Technology
(Autonomous)

Curriculum & Syllabi

for

Minor Degree

Electronics and Communication Engineering

(Internet of Things)

(For batch admitted in 2022-2023)

R 2022

Accredited by NAAC with 'A++' grade,

Approved by AICTE, Affiliated to Anna University, Chennai.

KSR Kalvi Nagar, Tiruchengode – 637 215.

Namakkal District, Tamil Nadu, India.

K.S.RANGASAMY COLLEGEOF TECHNOLOGY, TIRUCHENGODE – 637215

(Autonomous)

DEPARTMENT OF ECE

MINOR DEGREE PROGRAMME - INTERNET OF THINGS

LIST OF COURSES

S.No.	Course Code	Course Name	Category	Contact Periods	L	T	P	C
1.	60 EC M01	Internet of Things and its Application	PE	3	3	0	0	3
2.	60 EC M02	Security of Cyber Physical Systems	PE	3	3	0	0	3
3.	60 EC M03	Embedded Systems for IoT	PE	3	3	0	0	3
4.	60 EC M04	IoT Processors	PE	3	3	0	0	3
5.	60 EC M05	IoT Device Development and Integration	PE	3	3	0	0	3
6.	60 EC M06	Industrial IoT and Industry 4.0	PE	3	3	0	0	3
				Total	18	0	0	18

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60 EC M01	Internet of Things and its Application	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To make students know the IoT ecosystem.
- To explore the structural components of IoT systems.
- To provide an understanding of the technologies and the standards relating to the internet of things.
- To explore a wide array of IoT applications across various industries.
- To develop skills on IoT technical planning.

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Analyze the evolution and convergence of web technologies leading to the IoT universe.	Understand
CO2	Explain the value chains associated with M2M and IoT technologies.	Understand
CO3	Construct an outline of an IoT architecture using appropriate architectural principles.	Understand
CO4	Assess the potential benefits and challenges of implementing IoT in specific industries like retail, oil and gas, and healthcare.	Apply
CO5	Analyze the privacy and security challenges associated with data aggregation and sharing in smart cities.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	3	-	-	3	3	3	-	2	-	-	-
CO2	3	3	3	-	2	-	-	3	3	3	-	2	-	-	-
CO3	3	3	3	-	2	-	-	3	3	3	-	2	-	-	-
CO4	3	3	2	-	3	-	-	3	3	3	-	2	-	-	-
CO5	3	3	3	-	3	-	-	3	3	3	-	2	-	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	10
Understand	40	20	30
Apply	-	30	60
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC M01 - Internet of Things and its Application								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Understanding IoT* IoT & Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization	[9]
M2M to IoT * M2M to IoT – M2M Value Chains, IoT Value Chains, An Emerging Industrial Structure for IoT, Building an Architecture, Main Design Principles and Needed Capabilities, An IoT Architecture Outline, Standards Considerations.	[9]
IoT Architecture* IoT Architecture – State of the Art, Architecture Reference Model – Introduction, Reference Model and Architecture, IoT Reference Model, IoT Reference Architecture – Functional View, Information View, Deployment and Operational View, Other Relevant Architectural Views.	[9]
IoT Applications* IoT Applications for Value Creations, IoT Applications for Industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	[9]
Privacy, Security, and Governance in IoT** Internet of Things Privacy, Security and Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT – Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.	[9]
Total Hours:	**45**

Text Book(s):	
1.	RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, "Internet of Things", 2nd Edition, John Wiley & Sons, 2020.
2.	Nitesh Dhanjani, "Abusing the Internet of Things", 1st Edition, Shroff Publisher/O'Reilly Publisher, 2015.
Reference(s):	
1.	Cuno Pfister, "Getting Started with the Internet of Things", 6th Edition, Shroff Publisher/Maker Media, 2018.
2.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3.	Massimo Banzi, Michael Shiloh "Make: Getting Started with the Arduino", 4th Edition, Shroff Publisher/Maker Media Publishers, 2022.

* SDG 9 - Industry, innovation and infrastructure
** SDG 16 - Peace, justice, and strong institutions

Assignment Activity

Assignment 1: Design a simple IoT weather station using an embedded system
Assignment 2: Transmit the data from the weather station to the Cloud server for further analysis and visualization
Assignment 3: Mini Project

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K.S.Rangasamy College of Technology
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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Understanding IoT**	
1.1	IoT & Web Technology: The Internet of Things Today	1
1.2	Time for Convergence	1
1.3	Towards the IoT Universe, Internet of Things Vision	1
1.4	IoT Applications, Future Internet Technologies	1
1.5	Infrastructure, Networks and Communication	1
1.6	Processes, Data Management, Security,	1
1.7	Privacy & Trust	1
1.8	Device Level Energy Issues	1
1.9	IoT Related Standardization	1
2	**M2M to IoT**	
2.1	M2M to IoT – A Basic Perspective	1
2.2	M2M Value Chains	1
2.3	IoT Value Chains	1
2.4	An emerging industrial structure for IoT	1
2.5	An Architectural Overview	1
2.6	Building an architecture	1
2.7	Main design principles and needed capabilities	1
2.8	An IoT architecture outline	1
2.9	Standards considerations	1
3	**IoT Architecture**	
3.1	IoT Architecture -State of the Art	1
3.2	Architecture Reference Model	1
3.3	Reference Model and architecture	1
3.4	IoT reference Model	1
3.5	IoT Reference Architecture	1
3.6	Functional View	1
3.7	Information View	1
3.8	Deployment and Operational View	1
3.9	Other Relevant architectural views	1
4	**IoT Applications**	
4.1	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts	1
4.2	Brownfield IoT, Smart Objects, Smart Applications	1
4.3	Four Aspects in your Business to Master IoT	1
4.4	Value Creation from Big Data and Serialization	1
4.5	IoT for Retailing Industry	1
4.6	IoT for Oil and Gas Industry	1
4.7	Opinions on IoT Application and Value for Industry	1
4.8	Home Management	1
4.9	eHealth	1
5	**Privacy, Security, and Governance in IoT**	
5.1	Internet of Things Privacy,	1
5.2	Security and Governance Introduction	1

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5.3	Governance	1
5.4	Privacy and Security Issues	1
5.5	Contribution from FP7 Projects	1
5.6	Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities	1
5.7	First Steps Towards a Secure Platform	1
5.8	Smart Approach. Data Aggregation for the IoT in Smart Cities	1
5.9	Security	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

60 EC M02	Security of Cyber Physical Systems	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the basics of security and various types of security issues.
- To study different cryptography techniques available and various security attacks.
- To explore network security and how they are implemented in real world.
- To analyze potential privacy vulnerabilities within Software-Defined Networks.
- To get an insight of various issues of Web security and biometric authentication.

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the nature and scope of information system security and privacy	Understand
CO2	Evaluate the architecture of applied cryptography and its role in ensuring information integrity	Apply
CO3	Assess security challenges specific to the Internet of Things (IoT) environment	Apply
CO4	Identify security challenges unique to SDNs and understand their impact on network infrastructure	Apply
CO5	Develop strategies for secure deployment and operation of CPS in real-world scenarios	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	3	2	-	3	3	3	-	2	-	-	-
CO2	3	3	3	2	2	-	-	3	3	3	-	2	-	-	-
CO3	3	3	3	3	2	-	-	3	3	3	-	2	-	-	-
CO4	3	3	2	3	3	-	-	3	3	3	-	2	-	-	-
CO5	3	3	3	2	3	2	-	3	3	3	-	2	-	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	30
Apply	40	40	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC M02 - Security of Cyber Physical Systems								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Security and Privacy in Information Systems * Information System Security and Privacy: Nature and Scope, History of Information Security and Privacy, Information and Data Privacy, Security of Technical Systems in Organizations, Issues in Information Security Issues in Information Privacy.	[9]
Applied Cryptography and Intrusion Detection Applied Cryptography and Intrusion Detection, Architecture of Applied Cryptography, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class).	[9]
Security and Privacy in Internet of Things (IoT) * Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile Health Care.	[9]
Security and Privacy in Software-Defined Networks * Software-Defined Networks, Security for Software-Defined Networks, Privacy Leakages for Software-Defined Networks, Case Studies: How to Attack Software - Defined Networks.	[9]
Security of Cyber-Physical Systems (CPS) * Cyber - Physical Systems (CPS), CPS - Platform Components, CPS Implementation Issues, Intelligent CPS, Secure Deployment of CPS.	[9]
Total Hours:	**45**

Text Book(s):

1. Nina Godbole, “Cyber Security”, John Wiley & Sons. 2018.
2. Li Da Xu, Shancang Li, “Securing the Internet of Things”, 1st Edition, Syngress Publishing, 2017.

Reference(s):

1. Alasdair Gilchrist, “IoT Security Issues”, 1st Edition, De Gruyter, 2017.
2. Sean Smith, “The Internet of Risky Things”, Sean Smith, 1st Edition, Shroff Publisher/O’Reilly, 2017.

* SDG 9 - Industry, innovation and infrastructure

Assignment Activity

Assignment 1: Potential security threats and privacy concerns associated with IoT devices
Assignment 2: Case study about Security and Privacy in the Internet of Things (IoT)
Assignment 3: Case study - Cyber Physical Systems

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Security and Privacy in Information Systems**	
1.1	Information System Security	1
1.2	Privacy	1
1.3	Nature and Scope	1
1.4	History of Information Security and Privacy	1
1.5	Information Privacy	1
1.6	Data Privacy	1
1.7	Security of Technical Systems in Organizations	1
1.8	Issues in Information Security	1
1.9	Issues in Information Privacy	1
2	**Applied Cryptography and Intrusion Detection**	
2.1	Applied Cryptography	1

2.2	Intrusion Detection	1
2.3	Architecture of Applied Cryptography	1
2.4	One Way Hash Function and Integrity	1
2.5	Encryption Algorithms	1
2.6	Confidentiality	1
2.7	Digital Signature and Authentication - DH	1
2.8	Digital Signature and Authentication - RSA	1
2.9	Digital Signature and Authentication - 2 class)	1
3	**Security and Privacy in Internet of Things (IoT)**	
3.1	Internet of Things Security	1
3.2	Security for IoT	1
3.3	Privacy for IoT	1
3.4	Case Study: Smart Home	1
3.5	Case Study: Smart Grid Network	1
3.6	Case Study: Modern Vehicle	1
3.7	Case Study: Wearable Computing	1
3.8	Case Study: BYOD	1
3.9	Case Study: Mobile Health Care	1
4	**Security and Privacy in Software-Defined Networks**	
4.1	Software-Defined Networks	1
4.2	Attacks in SDN	1
4.3	Vulnerabilities in SDN	1
4.4	Network Security Enhancement using SDN	1
4.5	Challenge of Integrating Legacy Protocols	1
4.6	Cross Domain Connection	1
4.7	Security for Software-Defined Networks	1
4.8	Privacy Leakages for Software-Defined Networks	1
4.9	Case Studies: How to Attack Software-Defined Networks	1
5	**Security of Cyber-Physical Systems (CPS**	
5.1	Cyber - Physical Systems (CPS)	1
5.2	CPS - Platform components	1
5.3	CPS implementation issues	1
5.4	Intelligent CPS	1
5.5	Secure Deployment of CPS	1
5.6	Advanced Cyber-Physical Systems Security Concepts	1
5.7	Physical issues in security	1
5.8	Security Requirements of CPS	1
5.9	Security Goals	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC M03	Embedded Systems for IoT	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To make students know the basic concept and architecture of embedded systems.
- To explore the design principles and components of embedded systems.
- To comprehend the various types of inputs and outputs in embedded IoT systems.
- To delve into the technologies and protocols enabling IoT systems
- To have knowledge about the IoT enabled technology.

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the fundamental pillars of Embedded IoT and the concept of the internet of devices	Understand
CO2	Identify common sensors, actuators, and embedded processors used in IoT applications.	Apply
CO3	Describe the usage of digital and analog inputs and outputs, including bus communication.	Understand
CO4	Explore IoT platforms like IBM Watson IoT, Eclipse IoT, AWS IoT, Azure IoT Suite, and Google Cloud IoT.	Analyze
CO5	Examine real-world case studies of IoT integration with cloud platforms.	Analyze

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	3	-	-	3	3	3	-	2	-	-	-
CO2	3	3	2	2	3	-	-	3	3	3	-	2	-	-	-
CO3	3	3	3	2	2	-	-	3	3	3	-	2	-	-	-
CO4	3	3	3	3	2	-	-	3	3	3	-	2	-	-	-
CO5	3	3	2	3	3	-	-	3	3	3	-	2	-	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	20
Apply	40	30	60
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC M03 - Embedded Systems for IoT								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Fundamentals of Embedded IoT Systems * Purpose and Requirement Specification, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Pillars of Embedded IoT and Physical Devices: The internet of Devices.	[9]
Design of Embedded Systems and Components * Design of Embedded Systems: Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture.	[9]
Inputs and Outputs in Embedded IoT * Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, Bus In, Bus Out, and Bus in Out, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).	[9]
IoT Enabling Technologies and Protocols * IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT - Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots.	[9]
Web and Cloud Integration for IoT * Web of Things and Cloud of Things: Web of Things Versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers, Cloud Offerings and IoT Case Studies: Cloud Storage Models, Communication API.	[9]
Total Hours:	**45**

Text Book(s):

1.	RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, "Internet of Things", 2nd Edition, John Wiley and Sons, 2020.
2.	Klaus Elk, "Embedded Software for the IoT", 3rd Edition, De Gruyter, 2018.
3.	Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed", 1st Edition, Wiley, 2018.

Reference(s):

1.	Elizabeth Gootman et. al, "Designing Connected Products", 1st Edition, Shroff Publisher/O'Reilly Publisher, 2015.

* SDG 9 - Industry, innovation and infrastructure

Assignment activity

Assignment 1: Design a simple IoT weather station using an embedded system

Assignment 2: Transmit the data from the weather station to the Cloud server for further analysis and visualization

Assignment 3: Case study - Web and Cloud Integration for IoT

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K.S.Rangasamy College of Technology,
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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Fundamentals of Embedded IoT Systems**	
1.1	Purpose and requirement specification	1
1.2	IoT level specification	1
1.3	Functional view specification	1
1.4	Operational view specification	1
1.5	Device integration	1
1.6	Component integration	1
1.7	Pillars of Embedded IoT	1
1.8	Physical Devices	1
1.9	The internet of devices	1
2	**Design of Embedded Systems and Components**	
2.1	Design of Embedded Systems	1
2.2	Common Sensors	1
2.3	Actuators	1
2.4	Components	1
2.5	Embedded Processors	1
2.6	Memory Architectures	1
2.7	Software architecture	1
2.8	System Integration	1
2.9	Onboard Communication interfaces	1
3	**Inputs and Outputs in Embedded IoT**	
3.1	Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs	1
3.2	Bus In, Bus Out, and Bus in Out,	1
3.3	Analog Inputs and Outputs	1
3.4	Analog Inputs, Analog Outputs	1
3.5	Pulse Width Modulation (PWM)	1
3.6	Accelerometer	1
3.7	Magnetometer	1
3.8	SD Card	1
3.9	Local File System (LPC1768)	1
4	**IoT Enabling Technologies and Protocols**	
4.1	IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication)	1
4.2	Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee	1
4.3	Z-Wave, LoRa, Protocols, HTTP, WebSocket	1
4.4	MQTT, CoAP, XMPP	1
4.5	Node-RED, Platforms	1
4.6	IBM Watson IoT—Bluemix, Eclipse IoT	1
4.7	AWS IoT, Microsoft Azure IoT Suite	1
4.8	Google Cloud IoT	1
4.9	ThingWorx, GE Predix, Xively, macchina.io, Carriots	1
5	**Web and Cloud Integration for IoT**	
5.1	Web of Things and Cloud of Things: Web of Things versus Internet of Things	1
5.2	Two Pillars of the Web	1

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5.3	Architecture Standardization for WoT	1
5.4	Platform Middleware for WoT	1
5.5	Cloud of Things	1
5.6	IoT Physical Servers	1
5.7	Cloud Offerings	1
5.8	IoT Case Studies: Cloud Storage Models	1
5.9	Communication API	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC M04	IoT Processors	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Learn the architecture and features of ARM.
- Study the exception handling and interrupts in CORTEX M3
- Program the CORTEX M3
- Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
- Understand the concepts of System – On – Chip (SoC)

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the architecture and features of ARM	Understand
CO2	List the concepts of exception handling	Understand
CO3	Develop programs using ARM CORTEX M3/M4	Apply
CO4	Discuss the architecture of STM32L15XXX ARM CORTEX M3/M4	Understand
CO5	Design an SoC for any application	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	-	-	-	2	-	-	-
CO2	3	3	2	-	3	-	-	-	-	-	-	2	-	-	-
CO3	3	3	3	-	2	-	-	-	-	-	-	2	-	-	-
CO4	3	3	3	-	2	-	-	-	-	-	-	2	-	-	-
CO5	3	3	2	-	3	-	-	-	-	-	-	2	-	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	10
Understand	40	10	30
Apply	-	40	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Tiruchengode - 637 215.

Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022

B.E - Electronics and Communication Engineering

60 EC M04 - IoT Processors

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

ARM and CORTEX-M3 * ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence	[9]
CORTEX Exception Handling and Interrupts* Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency	[9]
CORTEX M3/M4 Programming* Cortex M3/M4 Programming: Typical Development Flow, Using C, Exception Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.	[9]
STM32L15XXX ARMCORTEX M3/M4 Microcontroller and Debugging Tools STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In – Circuit Emulator (ICE), Logic Analyser.	[9]
System - on - Chip * System Architecture: Components of the System Processors, Processor Architectures, Memory and Addressing, System Level Interconnection – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.	[9]
Total Hours:	**45**

Text Book(s):

1.	Joseph Yiu, "The Definitive Guide to the ARM CORTEX M3/M4", 2nd Edition, Elsevier, 2010.
2.	Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimizing System Software", Elsevier, 2006.
3.	Michael J Flynn and Wayne Luk, "Computer System Design, System on Chip", 1st Edition, Wiley India, 2011.

Reference(s):

1.	Steve Furber, "ARM System – on – Chip Architecture", 2nd Edition, Pearson, 2015.
2.	CORTEX M Series ARM Reference Manual, 2007
3.	CORTEX M3 Technical Reference Manual,2005
4.	STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97, 2023.

* SDG 4 - Quality education

Assignment activity

Assignment 1: Identify any notable IoT products or projects that leverage Cortex-M3? How does it enhance their functionality or performance?

Assignment 2: Develop a temperature monitoring system using a Cortex M3/M4 microcontroller for an IoT application

Assignment 3: Case study – System on Chip

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**ARM and CORTEX-M3 ***	
1.1	ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture	1
1.2	Cortex M3 Basics: Registers, Stack Pointer,	1
1.3	Link Register, Program Counter	1
1.4	Special Registers	1
1.5	Operation Mode	1
1.6	Exceptions and Interrupts	1
1.7	Vector Tables	1
1.8	Stack Memory Operations	1
1.9	Reset Sequence	1
2.0	**CORTEX Exception Handling and Interrupts ***	
2.1	Exception Types, Priority, Vector Tables	1
2.2	Interrupt Inputs and Pending behaviour	1
2.3	Fault Exceptions	1
2.4	Supervisor Call and Pendable Service Call	1
2.5	NVIC: Nested Vector Interrupt Controller	1
2.6	Basic Interrupts	1
2.7	Nested Interrupts	1
2.8	Tail – Chaining Interrupts	1
2.9	Late Arrivals and Interrupt Latency	1
3.0	**CORTEX M3/M4 Programming ***	
3.1	Cortex M3/M4 Programming: Typical Development Flow	1
3.2	Using C, Exception Programming Using Interrupts	1
3.3	Exception/Interrupt Handlers	1
3.4	Software Interrupts, Vector Table Relocation	1
3.5	Memory Protection Unit	1
3.6	Other CORTEX M3 Features	1
3.7	MPU Registers, Setting up the MPU	1
3.8	Power Management	1
3.9	Multiprocessor Configuration	1
4.0	**STM32L15XXX ARMCORTEX M3/M4 Microcontroller and Debugging Tools**	
4.1	STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture	1
4.2	Power Control, Reset and Clock Control	1
4.3	STM32L15XXX Peripherals: GPIOs	1
4.4	System Configuration Controller, NVIC	1
4.5	ADC, Comparators, GP Timers	1
4.6	USART Development and Debugging Tools: Software and Hardware tools like Cross Assembler	1
4.7	Compiler, Debugger, Simulator	1
4.8	In – Circuit Emulator(ICE)	1
4.9	Logic Analyser	1
5.0	**System - on - Chip ***	
5.1	System Architecture: Components of the System Processors	1
5.2	Processor Architectures	1

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5.3	Memory and Addressing	1
5.4	System Level Interconnection	1
5.5	SOC Design Approach	1
5.6	Application Studies – AES	1
5.7	3D Graphics Processor	1
5.8	Image Compression	1
5.9	Video Compression	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC M05	IoT Device Development and Integration	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the foundational concepts of IoT.
- To give students hands-on experience using different IoT architectures.
- To provide skills for interfacing sensors and actuators with different IoT architectures.
- To develop skills on data collection and logging in the cloud.
- To familiarize with Raspberry Pi

Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the fundamental concepts of the Internet of Things (IoT) and its components.	Understand
CO2	Develop a basic understanding of the Arduino Uno board and its features.	Apply
CO3	Discuss the ESP 8266-12E Node MCU board and its capabilities.	Understand
CO4	Configure headless operation and connect Raspberry Pi 3 remotely via SSH.	Analyze
CO5	Discuss the 'plug and play' cloud platforms for IoT device integration.	Analyze

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	2	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	2	-	-	-
CO4	3	3	3	3	2	-	-	-	-	-	-	2	-	-	-
CO5	3	3	2	3	3	-	-	-	-	-	-	2	-	-	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	20
Apply	40	30	60
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC M05 - IoT Device Development and Integration								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

IoT and Device Components * IoT – Components, IoT Building Blocks, Sensors and Actuators, IoT Devices, IoT Boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi).	[9]
IoT Development ** Arduino Uno – Getting Started with the Uno Boards, Blink Program, Connection of Sensors to the Uno Board, Reading Values of Sensors from the Uno Board, Interrupts. Interfacing Temperature/Humidity using GSM Module.	[9]
Cloud Integration * ESP 8266 -12E Node MCU – ESP Board, Micropython and Esplorer IDE, Interfacing Sensors to the ESP Board, Interfacing ESP board to WiFi, Interfacing ESP with the Cloud, Interrupts, ESP32 Vs ESP 8266 board. Case Study: Switching Light on /off Remotely. Case Study: Voice-Based Home Automation for Switching Lights on/off.	[9]
Processor for IoT Development * Raspberry Pi – Installing the Raspbian OS, Headless - Computer and Rpi Configuration to Connect through SSH via Ethernet, Headless - Connecting Rpi Remotely without Ethernet Cable via SSH, IP address, Rpi – Testing the GPIO pins through Scripts.	[9]
Processor Integration and IoT Platform ** Raspberry pi- Interfacing with Sensor DHT11, Raspberry pi Python Library Install - Cloud Platform for Integration to IOT Device – Actuator (LED) - Integration through Python. Raspberry Pi versions Comparison, LoRawan /LPWAN.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Rao M, "Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects", 1st Edition, Packt Publishing Ltd, 2018.
2.	Baichtal J, "Arduino for beginners: essential skills every maker need", 1st Edition, Pearson Education, 2013.
3.	Schwartz M, "Internet of Things with ESP8266", 1st Edition, Packt Publishing Ltd, 2016.
Reference(s):	
1.	Richardson M, & Wallace S, "Getting Started with Raspberry PI", O'Reilly Publisher Media, Inc, 1st Edition, 2012.Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015.

* SDG 9 **–** Industry, innovation and infrastructure
** SDG 12 **–** Responsible consumption and production

Assignment activity

Assignment 1: Covers Module 1 & 2 Questions related to the problems and simulation / Hands on
Assignment 2: Design an IoT based system for reading /sending values from sensors to the internet via GSM module.
Assignment 3: Mini Project

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**IoT and Device Components**	
1.1	IoT– Components	1
1.2	IoT building blocks	1
1.3	Sensors	1
1.4	Actuators	1
1.5	IoT Devices	1
1.6	IoT Boards – Arduino Uno	1
1.7	ESP 8266-12E	1
1.8	Node MCU	1
1.9	Raspberry Pi	1
2.0	**IoT Development**	
2.1	Arduino Uno – getting Started with the Uno boards,	1
2.2	Blink Program	1
2.3	Connection of Sensors to the Uno Board	1
2.4	Reading Values of Sensors from the Uno board	1
2.5	Interrupts	1
2.6	Interfacing Temperature and Humidity Sensor	1
2.7	Interfacing GSM Module	1
2.8	Interfacing GSM Module – Sending Data	1
2.9	Interfacing GSM Module – Receiving Data	1
3.0	**Cloud Integration**	
3.1	ESP 8266-12E Node MCU –ESP Board	1
3.2	Micropython and Esplorer IDE	1
3.3	Interfacing Sensors to the ESP Board	1
3.4	Interfacing ESP board to WiFi	1
3.5	Interfacing ESP with the Cloud	1
3.6	ESP Interrupts	1
3.7	ESP32 Vs ESP 8266 board	1
3.8	Case Study: Switching Light on /off Remotely	1
3.9	Case Study: Voice-Based Home Automation for Switching Lights on/off	1
4.0	**Processor for IoT Development**	
4.1	Raspberry Pi	1
4.2	Installing the Raspbian OS	1
4.3	Networks	1
4.4	Headless - Computer Configuration to connect through SSH via Ethernet	1
4.5	Headless - Rpi Configuration to connect through SSH via Ethernet	1
4.6	Headless - connecting Rpi3 Remotely without Ethernet cable via SSH	1
4.7	IP address	1
4.8	Rpi 3 - Testing the GPIO pins	1
4.9	Rpi 3 - Testing the GPIO pins through Scripts	1
5.0	**Processor Integration and IoT Platform**	
5.1	Raspberry pi- Interfacing with Sensor DHT11	1
5.2	Raspberry pi Python Library Install	1
5.3	Cloud Platform basics	1

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5.4	Cloud Platform for Integration to IOT Device	1
5.5	Actuator (LED)	1
5.6	Integration through Python	1
5.7	Raspberry Pi versions Comparison	1
5.8	LoRawan	1
5.9	LPWAN	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC M06	Industrial IoT and Industry 4.0	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Gain knowledge of key concepts of Industry 4.0
- Examine cutting-edge technologies for Industry 4.0
- Acquire skills to identify, assess, and mitigate cybersecurity risks
- Delve into the layers of Industrial IoT (IIoT) architecture
- Develop the ability to apply Industry 4.0 principles and technologies

Pre-requisites

- Internet of Things

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Assess the impact of Industry 4.0 on traditional production systems and identify opportunities for improvement.	Understand
CO2	Discuss the strategies for integrating Industry 4.0 technologies into existing production systems to enhance efficiency and productivity.	Understand
CO3	Assess the effectiveness of cybersecurity measures in protecting critical infrastructure and minimizing potential disruptions.	Analyze
CO4	Implement end-to-end IIoT solutions tailored to specific application domains, considering factors such as data security, latency, and scalability.	Analyze
CO5	Identify key application domains of Industry 4.0 technologies, including the oil, chemical, pharmaceutical, and manufacturing industries.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	3	3	-	3	3	-	-	3	-	-	-
CO4	3	2	3	2	3	3	3	3	3	3	-	-	-	-	-
CO5	3	3	2	3	-	3	3	3	3	3	-	3	-	-	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	10
Understand	40	10	20
Apply	-	30	60
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC M06 - Industrial IoT and Industry 4.0								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Industry 4.0 Essentials * Sensing & Actuation, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories	[9]
Industry 4.0 Evolution * Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis	[9]
Cybersecurity * Cybersecurity in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, Industrial IoT: Business Model and Reference Architecture	[9]
IIoT Layers * IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking, Big Data Analytics and Software Defined Networks: IIoT Analytics - Machine Learning and Data Science	[9]
Application Domains ** Oil, Chemical and Pharmaceutical Industry, Applications of UAVs in Industries, Milk Processing and Packaging Industries, Manufacturing Industries	[9]
Total Hours:	**45**

Text Book(s):	
1.	Misra S, Mukherjee A, and Roy A, “Introduction to IoT”, Cambridge University Press, 2021.
2.	Misra S, Roy C, and Mukherjee A, “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press,2020.
3.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Cisco Press, 2017.
Reference(s):	
1.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", 2021.
2.	Alexander Manu, “Digital Transformation and Industry 4.0: A Guide for Executives and Decision Makers”, 2022.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

Assignment Activity

Assignment 1- Explanatory questions in Industry 4.0 Essential, Evolution and cybersecurity.
Assignment 2 - Mini project on IIoT
Assignment 3- Case studies on Application Domains.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Industry 4.0 Essentials**	
1.1	Sensing & actuation	1
1.2	Industry 4.0: Globalization and Emerging Issues	1
1.3	Industry 4.0: Emerging Issues	1
1.4	The Fourth Revolution	1
1.5	LEAN Production Systems	1
1.6	LEAN Production Systems	1
1.7	Smart and Connected Business Perspective	1
1.8	Smart Factories	1
1.9	Smart Factories	1
2.0	**Industry 4.0 Evolution**	
2.1	Cyber Physical Systems	1
2.2	Next Generation Sensors	1
2.3	Collaborative Platform	1
2.4	Product Lifecycle Management	1
2.5	Product Lifecycle Management	1
2.6	Augmented Reality and Virtual Reality	1
2.7	Artificial Intelligence	1
2.8	Big Data	1
2.9	Advanced Analysis	1
3.0	**Cybersecurity**	
3.1	Cybersecurity in Industry 4.0 – Manufacturing	1
3.2	Cybersecurity in Industry 4.0 – Shipping and Cargo	1
3.3	Cybersecurity in Industry 4.0 – Medical	1
3.4	Industrial Processes	1
3.5	Industrial Sensing & Actuation	1
3.6	Industrial Internet Systems	1
3.7	Industrial Internet Systems	1
3.8	Business Model	1
3.9	Reference Architecture	1
4.0	**IIoT Layers**	
4.1	IIoT Sensing	1
4.2	IIoT Processing	1
4.3	IIoT Communication	1
4.4	IIoT Networking	1
4.5	Big Data Analytics	1
4.6	Software Defined Networks	1
4.7	IIoT Analytics	1
4.8	Machine Learning	1
4.9	Data Science	1
5.0	**Application Domains**	
5.1	Oil Industries	1
5.2	Chemical industry	1
5.3	Pharmaceutical industry	1
5.4	Applications of UAVs in Industries	1

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5.5	Milk Processing Industries	1
5.6	Packaging Industries	1
5.7	Manufacturing Industries	1
5.8	Smart Energy Management	1
5.9	Environmental Monitoring	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

SEVENTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 HS 002	Engineering Economics and Financial Accounting	2	40	60	100	45	100
2.	60 EC 701	Antennas and Microwave Engineering	2	40	60	100	45	100
3.	60 EC 702	Computer Networks	2	40	60	100	45	100
4.	60 EC E3*	Professional Elective III	2	40	60	100	45	100
5.	60 EC E4*	Professional Elective IV	2	40	60	100	45	100
6.	60 AC 001	Research Skill Development	2	100	00	100	00	100
THEORY CUM PRACTICAL								
7.	60 AB 00*	NCC\NSS\NSO\YRC\RRC\Yoga\Fine Arts	2	50	50	100	45	100
PRACTICAL								
8.	60 EC 7P1	RF Laboratory	2	60	40	100	45	100
9.	60 EC 7P2	Networks Laboratory	2	60	40	100	45	100
10.	60 EC 7P3	Project Work - Phase I	2	100	00	100	00	100
11.	60 CG 0P6	Internship	-	100	-	100	-	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

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60 HS 002	Engineering Economics and Financial Accounting	Category	L	T	P	Credit
		HS	3	0	0	3

Objectives

- To know about the economic principles underlying demand, supply, and market structure
- To understand the concept related to types of business organization and types of banking
- To know about concepts in financial accounting and capital budgeting
- To understand the different methods of pricing and appraisal of projects
- To know the application of break-even analysis in engineering projects

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Summarize the basic concepts of economics, demand, supply, and market structure	Understand
CO2	Interpret the forms of business organization and functions of commercial and central bank	Understand
CO3	Examine the basis of financial accounting and capital budgeting techniques	Analyse
CO4	Demonstrate the different types of pricing strategies and comprehensive project feasibility in diverse business	Apply
CO5	Demonstrate the break even analysis in engineering projects and business	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	2	3	-	3	-	-	-	3	2	3	3	3
CO2	-	-	-	-	-	2	2	-	-	-	3	3	-	3	-
CO3	-	-	2	3	-	-	-	-	-	-	3	-	2	2	-
CO4	2	-	-	3	-	2	-	-	-	-	-	3	3	3	2
CO5	3	3	3	3	-	-	2	2	-	-	2	2	3	2	2
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	25	25	35
Understand	35	25	45
Apply	-	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
Common to CIVIL, EEE, ECE, CSE, IT, AI&DS, CSE(AIML), EE (VLSI D&T), BT, FT								
60 HS 002 - Engineering Economics and Financial Accounting								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Topics	Hours
Basic Economics Definition of Economics – Nature and Scope of Economics, Basic Concepts of Economics, Factors of Production - Definition of Demand – Law of Demand, Exception to Law of Demand, Factors Affecting Demand, Elasticity of Demand, Demand Forecasting – Definition of Supply – Factors Affecting Supply, Elasticity of Supply – Market Structure – Perfect Competition, Imperfect Competition – Monopoly, Duopoly, Oligopoly, and Bilateral Monopoly.	[9]
Organization and Business Financing* Forms of Business – Sole Proprietorship, Partnership, Joint Stock Company, Cooperative Organization, State Enterprise - Mixed Economy - Money and Banking – Kinds of Banking, Functions of Commercial Banks and Central Bank – Definition of Monetary Policy and its Types – Types of financing - Short Term Borrowing, Long Term Borrowing - Internal Generation of Funds – External Commercial Borrowings.	[9]
Financial Accounting and Capital Budgeting The Balance Sheet and Related Concepts – The Profit and Loss Statement and Related Concepts – Financial Ratio Analysis – Definition of Working Capital – Types, Factors – Definition of Capital Budgeting - Techniques – Average Rate of Return, Payback Period, Net Present Value, Profitability Index Method and Internal Rate of Return.	[9]
Cost Analysis Types of Costing – Traditional Costing Approach - Activity Based Costing - Fixed Cost – Variable Cost – Marginal Cost – Cost Output Relationship in the Short Run and in Long Run – Pricing Practice – Full Cost Pricing – Marginal Cost Pricing – Going Rate Pricing – Bid Pricing – Pricing for a Rate of Return – Project Appraisal - Appraisal process, - Cost Benefit Analysis – Feasibility Reports –– Technical Feasibility, Economic Feasibility, Financial Feasibility, Managerial Feasibility, Operational Feasibility.	[9]
Break Even Analysis Basic Assumptions –Break-Even Chart – Profit Zone in Break-Even Chart, Loss Zone in Break-Even Chart, Angle of Incidence – Managerial Uses of Break-Even Analysis, Applications of Break-Even Analysis in Engineering Projects.	[9]
Total Hours:	**45**

Text Book(s):

1.	Khan M.Y., Jain P.K., "Financial Management ", 8th Edition, McGraw Hill Education, 2018.
2.	Maheshwari K.L., Varshney R.L., "Managerial Economics", 22nd Edition, S Chand and Co., New Delhi, 2018.

Reference(s):

1.	Samuelson P.A., "Economics – An Introductory", 16th Edition, New Age Publications, New Delhi, 2019.
2.	Barthwal R.R., "Industrial Economics – An Introductory", 4th Edition, New Age Publications, New Delhi, 2021.
3.	Bhattacharyya S. K., John Deardon, "Accounting for Management Text and Cases", 3rd Edition, S Chand Publication, 2018

*SDG 9 – Increase Industry Innovation and Infrastructure

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basic Economics**	
1.1	Definition of economics – Nature and Scope of Economics	1
1.2	Basic Concepts of Economics, Factors of Production	1
1.3	Definition of Demand – Law of Demand	1

1.4	Exception to Law of Demand	1
1.5	Factors Affecting Demand, Elasticity of Demand	1
1.6	Demand Forecasting	1
1.7	Definition of Supply – Factors Affecting Supply, Elasticity of Supply	1
1.8	Market Structure – Perfect Competition, Imperfect Competition	1
1.9	Monopoly, Duopoly, Oligopoly, and Bilateral Monopoly	1
2.0	**Organization and Business Financing**	
2.1	Forms of Business – Sole Proprietorship, Partnership	1
2.2	Joint Stock Company, Cooperative Organization, State Enterprise	1
2.3	Mixed Economy - Money and banking	1
2.4	Kinds of Banking	1
2.5	Functions of Commercial Banks and Central Bank	1
2.6	Definition of Monetary Policy and its Types	1
2.7	Types of Financing	1
2.8	Short Term Borrowing, Long Term Borrowing	1
2.9	Internal Generation of Funds, External Commercial Borrowings	1
3.0	**Financial Accounting and Capital Budgeting**	
3.1	The Balance Sheet and Related Concepts	1
3.2	The Profit and Loss Statement and Related Concepts	1
3.3	Financial Ratio Analysis	2
3.4	Definition of Working Capital – Types, Factors	2
3.5	Definition of Capital Budgeting - Techniques	1
3.6	Average Rate of Return, Payback Period	1
3.7	Net Present Value, Profitability Index Method and Internal Rate of Return	1
4.0	**Cost Analysis**	
4.1	Types of Costing - Traditional Costing Approach - Activity Based Costing	1
4.2	Fixed Cost – Variable Cost – Marginal Cost	1
4.3	Cost Output Relationship in the Short Run and in Long Run	1
4.4	Pricing Practice – Full Cost Pricing	1
4.5	Marginal Cost Pricing, Going Rate Pricing	1
4.6	Bid Pricing, Pricing for a Rate of Return	1
4.7	Project Appraisal - Appraisal Process - Cost Benefit Analysis	1
4.8	Feasibility Reports -— Technical Feasibility, Economic Feasibility	1
4.9	Financial Feasibility, Managerial Feasibility, Operational Feasibility.	1
5.0	**Break Even Analysis**	
5.1	Basic Assumptions – Break-Even Chart	2
5.2	Profit Zone in Break-Even Chart, Loss Zone in Break-Even Chart	2
5.3	Angle of Incidence	1
5.4	Managerial Uses of Break-Even Analysis	2
5.5	Applications of Break-Even Analysis in Engineering Projects	2

Course Designer(s)

1. Mr.V.S.Vijayachander - vijayachander@ksrct.ac.in
2. Dr.E.kalaivani - kalaivanie@ksrct.ac.in

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60 EC 701	Antennas and Microwave Engineering	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To learn radiation mechanism and fundamental parameters for antennas.
- To analyse the design concepts of linear and planer antenna arrays.
- To design and analyse various types of antenna and their performance characteristics.
- To study the microwave passive devices.
- To learn the functioning of microwave sources.

Pre-requisites

- Electromagnetic Waves

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Interpret the radiation mechanism of wired antennas and calculate the fundamental parameters for antennas.	Apply
CO2	Develop linear and planar antenna arrays and their radiation patterns.	Apply
CO3	Design VHF, UHF, Microwave antennas and antenna beamforming techniques and Illustrate techniques for antenna measurement.	Apply
CO4	Discuss the microwave passive devices such as isolator, circulator, Directional couplers etc.	Understand
CO5	Illustrate the working of the high power and low power microwave devices.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	2	-	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	2	-	3	3	-	-	3	2	3
CO3	3	3	3	3	3	-	2	-	3	3	-	-	3	2	3
CO4	3	3	3	-	-	-	2	-	3	3	-	-	3	2	3
CO5	3	3	3	-	-	-	2	-	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	30	30	50
Apply	20	20	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 701 - Antennas and Microwave Engineering								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

EM Radiation and Antenna Parameter* Radiation Mechanism - Single Wire, Two Wire and Current Distribution - Hertzian Dipole - Halfwave Dipole and Monopole - Radiation Pattern - Beamwidth - Field Regions - Radiation Power Density - Radiation Intensity - Directivity and Gain - Bandwidth - Polarization - Input Impedance - Efficiency - Antenna Effective Length and Area - Friis Transmission Equation.	[9]
Linear and Planar Arrays* Array of Two Point Sources - N-Element Linear Array - End Fire Array, Directivity, Radiation Pattern - Pattern Multiplication - Non-Uniform Excitation - Binomial Distribution - Arrays: Planar Array, Circular Array, Phased Array Antenna.	[9]
VHF, UHF and Microwave Antennas* Yagi-Uda Antenna - Aperture Antennas - Horn Antenna - Parabolic Reflector Antenna - Microstrip Antenna - Smart Antennas - Conformal Antennas - Antenna Beamforming Techniques. Antenna Measurements: Radiation Pattern, Gain and Directivity Measurement	[9]
Microwave Passive components* Microwave Networks - ABCD, 'S' Parameter and its Properties - E-Plane Tee, H-Plane Tee, Magic Tee and Multi-Hole Directional Coupler - Principle of Faraday Rotation, Isolator, Circulator and Phase Shifter.	[9]
Microwave Sources* Microwave Frequencies and Applications - Microwave Tubes: TWT, Klystron Amplifier, Reflex Klystron & Magnetron - Semiconductor Devices: Gunn Diode, Tunnel Diode, IMPATT Diode.	[9]
Total Hours:	**45**

Text Book(s):

1.	K.D.Prasad, "Antenna and Wave Propagation", Satya Prakasham, 2021.
2.	Samuel Y.Liao, "Microwave Devices and Circuits", 3rd Edition, Prentice Hall of India, 2008.

Reference(s):

1.	John D. Kraus Ronald J.Marhefka, and Ahmed S.Khan, "Antennas and Wave Propagation", 5th Edition, McGraw-Hill, 2017.
2.	Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley & Sons, 2016.
3.	David M.Pozar, "Microwave Engineering", 4th Edition, John Wiley & Sons, 2014.
4.	Robert E.Collin, "Foundations for Microwave Engineering", 2nd Edition, Wiley, Reprint 2009.

*SDG 9 – Industry Innovation and Infrastructure

Assignment Activity:

Assignment 1:

1. Group problem solving in antenna parameters and antenna arrays

Assignment 2:

1. Poster Presentation on various types of antennas and its applications.

Assignment 3:

1. Presentation on real life examples of Microwave devices and sources

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**EM Radiation and Antenna Parameter**	
1.1	Radiation Mechanism - Single wire, Two wire and Current distribution	1
1.2	Hertzian Dipole-Electric and Magnetic Field Components	1
1.3	Hertzian Dipole-Power Radiated	1
1.4	Halfwave Dipole and Monopole	1
1.5	Radiation Pattern, Beamwidth, Field Regions	1
1.6	Radiation Power Density, Radiation Intensity, Directivity and Gain	1
1.7	Bandwidth, Polarization, Input impedance	1
1.8	Efficiency, Antenna Effective Length and Area	1
1.9	Friis Transmission Equation	1
2.0	**Linear and Planar Arrays**	
2.1	Array of Two Point Sources- Case1	1
2.2	Array of Two Point Sources- Case2	1
2.3	N-Element Linear Array- End Fire Array	1
2.4	N-Element Linear Array- Directivity, Radiation Pattern	1
2.5	Pattern Multiplication	1
2.6	Non-Uniform Excitation - Binomial Distribution	1
2.7	Arrays: Planar Array,	1
2.8	Circular Array	1
2.9	Phased Array Antenna	1
3.0	**VHF, UHF and Microwave Antennas**	
3.1	Yagi-Uda Antenna	1
3.2	Aperture Antennas – Horn Antenna	1
3.3	Parabolic Reflector Antenna	1
3.4	Microstrip Antenna	1
3.5	Smart Antennas	1
3.6	Conformal Antennas	1
3.7	Antenna Beamforming Techniques	1
3.8	Antenna Measurements: Radiation Pattern	1
3.9	Gain and Directivity measurement	1
4.0	**Microwave Passive Components**	
4.1	ABCD Parameter	1
4.2	'S' Parameter and Its Properties	1
4.3	E-Plane Tee	1
4.4	H-Plane Tee	1
4.5	Magic Tee	1
4.6	Multi-Hole Directional Coupler	1
4.7	Principle of Faraday Rotation	1
4.8	Isolator, Circulator	1
4.9	Phase Shifter	1
5.0	**Microwave Sources**	
5.1	Microwave Frequencies and Applications	1
5.2	TWT	1
5.3	Klystron Amplifier	1

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5.4	Reflex Klystron	1
5.5	Magnetron	1
5.6	Gunn diode	1
5.7	Tunnel diode	1
5.8	IMPATT Diode - Construction	1
5.9	IMPATT Diode - Power and Efficiency Measurement	1

Course Designer(s)

1. Ms.C.Saraswathy - saraswathy@ksrct.ac.in
2. Mr.D.Poornakumar - poornakumard@ksrct.ac.in

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60 EC 702	Computer Networks	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To get an understanding on the fundamentals of networks and concepts of OSI, TCP/IP reference model
- To learn the datalink layer functions.
- To understand routing in the network layer
- To explore methods of communication and congestion control by the transport layer and application layer protocols.
- To study the network security mechanisms

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the Network Models, layers and functions	Understand
CO2	Deploy the error & flow control mechanisms and medium access control	Apply
CO3	Classify the network with IP address and compare the routing protocols	Apply
CO4	Describe the various transport layer and application layer protocols	Understand
CO5	Apply the network security mechanisms.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	30	30	50
Apply	20	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 702 - Computer Networks								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Unit	Hours
Data Communications and Networking Data Communications - Networks - Network Types - Protocol Layering - Networking Models: OSI Model, TCP/IP Protocol Suite, OSI Vs TCP/IP - Measurement of Network Performance - Connecting Devices - **Network Slicing principles and Software Defined Networking Architecture*.**	[9]
Data Link Layer** Nodes and Links, Services - Three Methods of Switching - Error Detection and Correction: CRC and Check Sum - Data Link Control: HDLC and PPP - Multiple Access Protocols - IEEE Standards: 802.3 and IEEE 802.11, Comparison of Wired and Wireless LAN -VLAN.	[9]
Network Layer** Network Layer Services - Packet Switching: Datagram and Virtual Circuit Approach - IPV4 - IPV6 - DHCP - ICMP - Unicast Routing Protocols: Distance Vector, Link State and Path Vector Routing.	[9]
Transport Layer and Application Layer** Transport Layer Services - UDP - TCP - Sliding Window Protocols - Congestion Control - Quality of Service - Application Layer Paradigms - Client - Server Programming - Domain Name System - World Wide Web and HTTP – FTP - Electronic Mail - SNMP.	[9]
Network Security Network security Threats - Cryptography - Security in the Internet: IP Security, Firewalls and Virtual Private Network (VPN) - RTP - **Data Privacy: Protecting Sensitive Data, Uses Cases - Cyber Security: Cyber Crime and Information Security*.**	[9]
Total Hours:	**45**

Text Book(s):

1.	Behrouz A Forouzan, “Data Communication and Networking”, 6th Edition, Tata McGraw-Hill, New Delhi, 2022.
2.	William Stallings, “Cryptography and Network Security”, 7th Edition, Pearson Education, 2017.

Reference(s):

1.	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Morgan Kauffmann Publishers Inc., 2012.
2.	Nina Godbole, Sunit Belapure, “Cyber Security”, Wiley India, New Delhi, 2012.
3.	Nataraj Venkataramanan, Ashwin Shriram, “Data Privacy: Principles and Practice”, CRC Press, 2016.
4.	Ahsan Kazmi S.M, Latif U. Khan, Choong Seon Hong, Nguyen H. Tran, “Network Slicing for 5G and Beyond Networks”, Springer International Publishing, 2020.

*SDG 9 – Industry Innovation and Infrastructure

**SDG 4 – Quality Education

Assignment Activity:

Assignment 1:

1. Group problem solving in CRC
2. Poster Presentation on connecting devices
3. Prepare a case study on wireless LAN

Assignment 2:

1. Group problem solving in subnetting
2. Configure and implementation of router within a network using Packet Tracer

Assignment 3:

1. Presentation on Network Security

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Data Communications and Networking**	
1.1	Data Communications, Networks, Network Types	1
1.2	Protocol Layering	1
1.3	Networking Models: OSI Model	1
1.4	TCP/IP Protocol Suite	1
1.5	OSI Vs TCP/IP	1
1.6	Measurement of Network Performance	1
1.7	Connecting Devices	1
1.8	Network Slicing principles	1
1.9	Software Defined Networking Architecture	1
2.0	**Data Link Layer**	
2.1	Nodes and Links, Services and Three Methods of Switching	1
2.2	Error Detection and Correction: CRC	1
2.3	Check Sum	1
2.4	Data Link Control: HDLC	1
2.5	PPP	1
2.6	Multiple Access Protocols	1
2.7	IEEE Standards: 802.3	1
2.8	IEEE 802.11, Comparison of Wired and Wireless LAN	1
2.9	VLAN	1
3.0	**Network Layer**	
3.1	Network Layer Services	1
3.2	Packet Switching: Datagram and Virtual Circuit Approach	1
3.3	IPV4	1
3.4	IPV6	1
3.5	DHCP	1
3.6	ICMP	1
3.7	Unicast Routing Protocols: Distance Vector Routing	1
3.8	Link State Routing	1
3.9	Path Vector Routing	1
4.0	**Transport Layer and Application Layer**	
4.1	Transport Layer Services	1
4.2	UDP and TCP	1
4.3	Sliding Window Protocols	1
4.4	Congestion Control and Quality of Service	1
4.5	Application Layer Paradigms and Client - Server Programming	1
4.6	Domain Name System	1
4.7	World Wide Web and HTTP	1
4.8	FTP - Electronic Mail	1
4.9	SNMP	1
5.0	**Network Security**	
5.1	Network security Threats and	1
5.2	Cryptography	1
5.3	Security in the Internet: IP Security	1
5.4	Firewalls	1
5.5	Virtual Private Network (VPN)	1

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5.6	RTP	1
5.7	Data Privacy: Protecting Sensitive Data	1
5.8	Uses Cases	1
5.9	Cyber Security: Cyber Crime and Information Security	1

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.K.Vanitha - vanitha@ksrct.ac.in

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60 AB 001	National Cadet Corps (Air wing)	Category	L	T	P	Credit
		HS	2	0	2	3

Objectives

- To designed especially for NCC Cadets to educate basic military knowledge
- To develop character, camaraderie, discipline, secular outlook
- To inculcate spirit of adventure, sportsman spirit
- To teach selfless service amongst cadets by working in teams
- To learn military subjects including weapon training and motivate them to join in tri-services

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion	Remember
CO2	Demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Remember
CO3	Illustrate various forces and moments acting on aircraft	Understand
CO4	Outline the concepts of aircraft engine and rocket propulsion	Understand
CO5	Design, build and fly chuck gliders/model airplanes and display static models	Create

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
CO2	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	3
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	-	3
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	-	3
3 - Strong; 2 - Medium; 1 - Some															

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to ALL Branches								
60 AB 001 - National Cadet Corps (Air wing)								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

NCC Organisation and National Integration* NCC Organization – History of NCC- NCC Organization – NCC Training – NCC Uniform – Promotion of NCC cadets – Aim and Advantages of NCC Training – NCC Badges of Rank – Honors‟ and Awards – Incentives for NCC Cadets by Central and State Govt. History and Organization of IAF – Indo-PakWar-1971 – Operation Safed Sagar .National Integration – Unity in diversity – Contribution of Youth in Nation Building-National Integration Council – Images and Slogans on National Integration.	[12]
Drill and Weapon Training* Basic Physical Training – Various Exercises for Fitness (with Demonstration) – Food – Hygiene and Cleanliness. Drill – Words of Commands- Position and Commands– Sizing and Forming – Saluting – Marching – Turning on the march and wheeling – Saluting on the march – Sidepace, Pace forward and to the rear – Marking time – Drill with arms – Ceremonial drill – Guard mounting.(WITH DEMONSTRATION)	[12]
Principles of Flight* Laws of Motion – Forces Acting on Aircraft - Bernoulli‟s Theorem - Staling – Primary control surfaces - Secondary control surfaces – Aircraft recognition.	[12]
Aero Engines* Introduction of Aero Engine – Types of Engines – Piston Engine – Jet Engines –Turboprop Engines – Basic Flight Instruments – Modern trends.	[12]
Aero Modeling* History of Aero modelling – Materials used in Aeromodeling – Types of Aeromodels – Static Models – Gliders – Control line models – Radio Control Models-Building and Flying of Aeromodels.	[12]
Total Hours: (Lecture - 30; Practical - 30):	60

Text Book(s):

1.	"National Cadet Corps- A Concise hand book of NCC Cadets", Ramesh Publishing House, NewDelhi,2014.

Reference(s):

1.	"Cadets Handbook–Common Subjects SD/SW", published by DGNCC, New Delhi.
2.	"Cadets Handbook-Specialized Subjects SD/SW", published by DGNCC, NewDelhi.
3.	"NCCOTA Precise", published by DGNCC, New Delhi.

*SDG 4 – Quality Education

Course Designer(s)

1. Flt Lt V.R.SADASIVAM- sadasivam@ksrct.ac.in

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60 AB 002	National Cadet Corps - Army Wing	Category	L	T	P	Credit
		HS	2	0	2	3

Objectives

- Develop character, camaraderie
- Inculcate discipline, secular outlook
- Enrich the spirit of adventure, sportsman spirit
- Ideals of selfless service amongst cadets by working in teams
- Improve qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Understand
CO2	Demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders.	Apply
CO3	Basic knowledge of weapons and their use and handling.	Understand
CO4	Aware about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Analyse
CO5	Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	1	-	3	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3
CO3	-	-	-	-	-	1	-	3	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
3 - Strong; 2 - Medium; 1 - Some															

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Syllabus

K. S. Rangasamy College of Technology – Autonomous R2022								
Common to all Branches								
60 AB 002 – National Cadet Corps (Army Wing)								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
VII	2	0	2	60	3	50	50	100

Contents	Hours
NCC Organization & National Integration* NCC Organization – History of NCC - NCC Organization- NCC Training – NCC Uniform – Promotion of NCC cadets – Aim and Advantages of NCC Training- NCC Badges of Rank - Honors' and Awards – Incentives for NCC Cadets by Central and State Govt. National Integration - Unity in Diversity - Contribution of Youth in Nation Building - National Integration Council- Images and Slogans on National Integration	[12]
Basic Physical Training & Drill* Basic Physical Training – various Exercises for Fitness (with Demonstration) – Food – Hygiene and Cleanliness. Drill – Words of Commands - Position and Commands – Sizing and Forming – saluting – Marching- Turning on the March and Wheeling – Saluting on the March - Side Pace, Pace Forward and to the Rear – Marking time – Drill with arms- Ceremonial Drill - Guard Mounting. (WITH DEMONSTRATION).	[16]
Weapon Training* Main Parts of a Rifle – Characteristics of .303 rifle - Characteristics of .22 Rifle – Loading and Unloading – Position and Holding Safety Precautions – Range Procedure- MPI and Elevation – Group and Snap Shooting – Long/Short Range Firing (WITH PRACTICE SESSION) – Characteristics of 5.56mm rifle - Characteristics of 7.62mm SLR- LMG- Carbine Machine Gun – Pistol.	[12]
Social Awareness and Community Development* Aims of Social Service – Various Means and Ways of Social Services – Family Planning – HIV and AIDS – Cancer its Causes and Preventive Measures - NGO and their Activities- Drug Trafficking- Rural Development Programmes – MGNREGA-SGSYJGSY-NSAP – PMGSY–Terrorism and Counter Terrorism – Corruption – Female Foeticide – Dowry – Child Abuse-RTI Act – RTE Act – Protection of Children from Sexual Offences Act – Civic Sense and Responsibility	[12]
Specialized Subject (ARMY)* Basic Structure of Armed Forces - Military History – War Heroes - Battles of Indo-Pak war – ParamVir Chakra – Career in the Defence Forces – Service Tests and Interviews.	[08]
Total Hours: (Lecture - 30; Practical - 30):	**60**

Text Book(s):

1.	National Cadet Corps- A Concise handbook of NCC Cadets by Ramesh Publishing House, New Delhi, 2014.
2.	Cadets Handbook- Specialized Subjects SD/SW published by DG NCC, New Delhi, 2014.

Reference(s):

1.	"Cadets Handbook – Common Subjects SD/SW" by DG NCC, New Delhi, 2019.
2.	"Cadets Handbook – Specialised Subjects SD/SW" by DG NCC, New Delhi, 2017.

* SDG 4 - Quality Education

Course Contents and Lecture Schedule

S.No.	Topic	No. of Hours
1	**NCC Organization & National Integration**	
1.1	NCC Organization	1
1.2	History of NCC and NCC Organization	1
1.3	NCC Training and NCC Uniform	1
1.4	Promotion of NCC cadet, Aim and advantages of NCC Training	1

1.5	NCC badges of Rank, Honors' and Awards, Incentives for NCC cadets by central and state govt	2
1.6	National Integration, Unity in diversity	1
1.7	Contribution of youth in nation building	2
1.8	National integration council	1
1.9	Images and Slogans on National Integration	2
2	**Basic Physical Training & Drill**	
2.1	Basic physical Training – various exercises for fitness (with Demonstration)-	3
2.2	Food – Hygiene and Cleanliness.	1
2.3	Drill- Words of commands- position and commands- sizing and forming-	3
2.4	saluting- marching- turning on the march and wheeling-	3
2.5	saluting on the march- side pace, pace forward and to the rear- marking time-	3
2.6	Drill with arms- ceremonial drill- guard mounting. (WITH DEMONSTRATION)	3
3	**Weapon Training Main Parts of a Rifle**	
3.1	Characteristics of 0.303 rifle	1
3.2	Characteristics of 0.22 rifle	2
3.3	Loading and unloading, position and holding safety precautions	2
3.4	Range procedure, MPI and Elevation-	2
3.5	Group and Snap shooting Long/Short range firing (WITH PRACTICE SESSION)	3
3.6	Characteristics of 5.56mm rifle	1
3.7	Characteristics of 7.62mm	1
4	**Social Awareness and Community Development**	
4.1	Aims of Social service, Various Means and ways of social services	1
4.2	Family planning, HIV and AIDS	1
4.3	Cancer its causes and preventive measures	1
4.4	NGO and their activities, Drug trafficking	1
4.5	Rural development programmes	1
4.6	MGNREGA, SGSY, JGSY, NSAP, PMGSY	2
4.7	Terrorism and counter terrorism, Corruption	1
4.8	female foeticide, dowry, child abuse	1
4.9	RTI Act, RTE Act	1
4.10	Protection of children from sexual offences act	1
4.11	Civic sense and responsibility	1
5	**Specialized Subject (ARMY)**	
5.1	Basic structure of Armed Forces	1
5.2	Military History, War heroes	1
5.4	battles of Indo - Pak war	1
5.3	Param Vir Chakra,	1
5.5	Career in the Defence forces	2
5.6	Service tests and interviews.	2

Course Designer(s)

1. Mr.E.Chandra Kumar - chandrakumar@ksrct.ac.in

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60 AC 001	Research Skill Development	Category	L	T	P	Credit
		AC	1	0	0	0

Objectives

- To identify research problems, formulate hypotheses, collect data and test hypotheses
- To prepare and submit quality manuscripts and understand peer review process
- To utilize software tools for effective manuscript preparation and visualization of research data
- To familiarize different journal metrics and author-level quality indicators
- To protect creative works, inventions, and branding elements using IPR

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Develop structured scientific approach to plan and execute research work	Apply
CO2	Comply with the journal requirements to publish research findings effectively	Understand
CO3	Apply various software tools during the manuscript preparation	Apply
CO4	Select suitable journals to publish the work using different publication metrics	Analyse
CO5	Apply the appropriate form of IP protection to a specific invention or creation	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	-	2	2	3	3	3	-	3	3	-	2
CO2	-	-	-	-	-	-	-	3	3	3	-	3	3	-	2
CO3	-	-	-	-	3	-	-	3	3	3	-	3	3	-	2
CO4	-	-	-	-	-	-	-	3	3	-	-	3	3	-	2
CO5	-	-	2	2	-	-	-	3	3	3	-	3	3	-	2
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

One review at end of the semester

Parameters	Weightage (Marks)
Research Problem Identification (Research gap, SDG, Objectives)	10
Literature Review preparation (Clarity, Number and quality of sources)	20
Patent Draft/ Manuscript Preparation (Structure, Content)	20
Use of software tools (Plagiarism, Reference Management, etc.,)	10
Journal Identification (Aim & scope of the journal, journal metrics)	10
Presentation & Viva voce	30
Total	**100**

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
60 AC 001 – Research Skill Development								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	1	0	0	15	0	100	-	100

Research - Scientific Approach* Types of Research - Identification and Clarification of The Problem - Formulating Hypothesis, Selection of Sample and Tools of Data Collection - Testing the Hypothesis - Conclusion	[3]
Manuscript Preparation* Structure of a Manuscript - Types of Manuscript - Graphical Abstract - Highlights - Literature Review - Citation - Reference Style - Plagiarism – Journal Selection - Peer Review Process	[3]
Research Toolkit* Software Tools for Writing Enhancement - Literature Review - Reference Management - Data Analysis and Visualization - Drawing - Plagiarism	[3]
Research Publication Metrics* Journal Index: Scopus - Web of Science - SCI - UGC Care - Q Journal; Journal Metrics: Impact Factor, Cite Score; Quality Indicators: H-Index - i-10 Index - Citations	[3]
Intellectual Property Rights* Patents - Industrial Designs - Copyright - Trademarks - Geographical Indications - Trade Secrets	[3]
Total Hours:	**15**

Reference(s):

1.	Kothari, C.R. and Gaurav Garg, “Research Methodology: Methods and Techniques”, New Age International Publishers, 2023
2.	Chawla H S., “Introduction to Intellectual Property Rights”, CBS Publishers and Distributors Private Limited, 2019

*SDG 9 – Industry Innovation and Infrastructure

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Research - Scientific Approach**	
1.1	Types of Research - Identification and Clarification of The Problem - Formulating Hypothesis	2
1.2	Selection of Sample and Tools of Data Collection - Testing the Hypothesis - Conclusion	1
2	**Manuscript Preparation**	
2.1	Structure of a Manuscript - Types of Manuscript - Graphical Abstract - Highlights	1
2.2	Literature Review	1
2.3	Citation - Reference Style – Plagiarism, Journal Selection - Peer Review Process	1
3	**Research Toolkit**	
3.1	Software Tools for Writing Enhancement	1
3.2	Literature Review, Reference Management	1
3.3	Data Analysis and Visualization – Drawing, Plagiarism	1
4	**Research Publication Metrics**	
4.1	Journal Index: Scopus - Web of Science - SCI - UGC Care - Q Journal;	1
4.2	Journal Metrics: Impact Factor, Cite Score	1
4.3	Quality Indicators: h-index - i-10 index - Citations	1
5	**Intellectual Property Rights**	
5.1	Patents	1
5.2	Industrial Designs - Copyright	1
5.3	Trademarks - Geographical Indications - Trade Secrets	1

Course Designer

1. Dr.M.Kathirselvam - mkathirselvam@ksrct.ac.in

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60 EC 7P1	RF Laboratory	Category	L	T	P	Credit
		PC	0	0	2	1

Objectives

- To demonstrate the performance of array antennas and Yagi-Uda antenna.
- To analyse the radiation pattern of horn antenna and microwave antennas.
- To analyse the performance of antenna beamforming techniques.
- To study the basic parameters of microwave devices.
- To identify the characteristics of microwave devices.

Pre-requisites

- Electromagnetic Waves

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Analyse the performance of array antennas and Yagi-Uda antenna	Apply
CO2	Analyse the radiation pattern of horn antenna and design the microstrip antenna.	Apply
CO3	Implement the antenna beamforming techniques.	Apply
CO4	Measure VSWR and Impedance for the microwave passive components	Apply
CO5	Interpret the characteristics of microwave sources.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	2	-	3	3	-	3	3	2	3
CO2	3	3	3	3	3	-	2	-	3	3	-	3	3	2	3
CO3	3	3	3	-	3	-	2	-	3	3	-	3	3	2	3
CO4	3	3	3	-	3	-	2	-	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	2	-	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	25	-	50	50
Apply	25	25	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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B.E - Electronics and Communication Engineering

60 EC 7P1 - RF Laboratory

Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	0	0	2	30	1	60	40	100

List of Experiments*:

1. Performance analysis of array antennas
2. Measurement of antenna radiation pattern of Yagi-Uda antenna.
3. Performance analysis of horn antenna.
4. Design of microstrip antenna.
5. Performance analysis of antenna beamforming techniques.
6. Frequency and wavelength measurement
7. Measurement of S-parameters, coupling factor, directivity, insertion loss and isolation of a directional coupler using X-band waveguide test bench set up.
8. VSWR and impedance measurement.
9. Study of the characteristics of a reflex klystron oscillator.
10. Study of Gunn-oscillator characteristics using X-band waveguide test bench.

Lab Manual

1. "RF Laboratory Manual", Department of Electronics and Communication Engineering, KSRCT.

*SDG 9 – Industry Innovation and Infrastructure

Course Designer(s)

1. Ms.C.Saraswathy – saraswathy@ksrct.ac.in
2. Mr.D.Poornakumar-poornakumard@ksrct.ac.in

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60 EC 7P2	Networks Laboratory	Category	L	T	P	Credit
		PC	0	0	2	1

Objectives

- To demonstrate the functioning of network topology and error detection and error correction techniques
- To study the performance of routing protocols
- To apply the sliding window protocols
- To analyse the performance of wired and wireless networks
- To develop an application based on cryptography

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Implement and realize the network topology	Apply
CO2	Implement the data link layer protocols	Apply
CO3	Implement the routing mechanisms and analyse the performance of wired/ wireless networks	Apply
CO4	Implement sliding window protocols	Apply
CO5	Develop an application based on cryptographic algorithms	Analyse

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	3	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	50	25	70	70
Analyse	-	-	30	30
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 7P2 - Networks Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	0	0	2	30	1	60	40	100

List of Experiments:

1. Implement the Data Link Layer framing methods - Bit stuffing/Character stuffing*
2. Implementation of Error Detection / Correction Techniques – LRC/CRC/Hamming code*
3. Implementation of Stop and Wait Protocol/Go back-N/Selective Repeat Protocols*
4. Implementation of IP addressing scheme for finding the class of an IP address*
5. Application based on cryptographic algorithms*
6. Implement and realize the Network Topology – Star/Bus/Ring
7. Implementation of Distance Vector Routing algorithm*
8. Implementation of Link State Routing algorithm*
9. Apply various application tools using RIP/OSPF and analyse the performance of wired/wireless network using Qualnet**
10. Configuration of FTP using CISCO Packet Tracer**

The following tools can be used – C, NS2, Qualnet, CISCO Packet Tracer

*SDG 9 – Industry Innovation and Infrastructure

**SDG 4 – Quality Education

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.K.Vanitha - vanitha@ksrct.ac.in

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60 EC 7P3	Project Work - Phase I	Category	L	T	P	Credit
		CG	0	0	4	2

Objectives

- To help the students apply their academic knowledge and technical skills in a specific domain
- To facilitate the students to identify, formulate and solve engineering problems
- To help the students design a system, component or process to meet the desired needs within realistic constraints
- To work and communicate efficiently in multidisciplinary terms
- To develop an understanding of professional and ethical responsibility in students

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Identify engineering problems in their domain of interest and carry out literature review in the chosen technical area	Understand
CO2	Analyse and identify an appropriate technique to solve the problem.	Analyse
CO3	Design engineering solution, do experimentation / simulation / programming / fabrication/ collect and interpret data utilizing a systems approach	Analyse
CO4	Communicate effectively in oral and written forms	Apply
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer as an individual and member of a team	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

(Internal Assessment: 100 Marks)

Review I (R1)			Review II (R2)		Review III (R3)			Total (R1+R2+R3)	Internal
Literature Survey	Topic Identification & Justification	Work Plan	Approach	Conclusion	Demo-Existing System	Presentation	Report	Total	
10	10	10	20	20	10	10	10	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 7P3 - Project Work - Phase I								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	0	0	4	60	2	100	00	100

1 A committee is constituted with the project coordinator, project guide and HOD/Senior professor in the department
2 Three reviews have to be conducted by the committee
3 Problem should be selected by every batch of students
4 Students must do a literature survey collecting a minimum of 1 survey paper and 2 technical papers related to their work
5 Report has to be prepared by the students as per the format
6 Preliminary implementation can be done if possible Internal evaluation has to be done based on the three reviews for 100 marks *

*SDG 4 – Quality Education

Course Designer(s)

1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2022-2023)

EIGHTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1.	60 EC E5*	Professional Elective V	2	40	60	100	45	100
THEORY CUM PRACTICAL								
PRACTICAL								
2.	60 EC 8P1	Project Work - Phase II	3	60	40	100	45	100
3.	60 CG 0P6	Internship	-	100	-	100	-	100

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination and 40 marks for project End semester Examination.

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60 EC 8P1	Project Work - Phase II	Category	L	T	P	Credit
		CG	0	0	16	8

Objectives

- To help the students apply their academic knowledge and technical skills in a specific domain
- Foster collaborative learning skills
- Habituated to critical thinking and use problem solving skills
- Develop self-directed inquiry and life-long skills
- To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Identify engineering problems in their domain of interest and carry out literature review in the chosen technical area	Understand
CO2	Analyse and identify an appropriate technique to solve the problem.	Analyse
CO3	Design engineering solution, do experimentation / simulation / programming / fabrication/ collect and interpret data utilizing a systems approach	Analyse
CO4	Communicate effectively in oral and written forms	Apply
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer as an individual and member of a team	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

(Internal Assessment: 60 Marks + End Semester Examination: 40 Marks)

Internal Assessment (60)					End Semester (40)
Items	**Review 1**	**Review 2**	**Review 3**	**Publication***	
Marks	**5**	**10**	**15**	**30**	**40**
	Total internal marks 60				

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K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC 8P1 - Project Work - Phase II								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	0	0	16	240	8	60	40	100

1. A committee is constituted with the project coordinator, project guide and HOD/Senior professor in the department.
2. Three reviews have to be conducted by the committee
3. Each review has to be evaluated for 100 marks.
4. Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or more chance may be given.
5. A senior professor from other departments may be included in the committee for final review.
6. The report should be submitted as per the format by the students.

*SDG 4 – Quality Education

Course Designer(s)

1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in

60 EC E31	Medical Imaging Systems	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To study the ultrasound and photo acoustic imaging principles and methodologies used in medical imaging.
- To observe the functioning of X ray computed tomography for image scanning.
- To comprehend the principles of MRI in image acquisition and reconstruction.
- To study radio isotopic imaging equipment and safety measures.
- To study the imaging modalities in infrared and radiation safety.

Pre-requisites

- Digital Image Processing

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the production, capture and applications of ultrasound in medicine.	Understand
CO2	Illustrate the principles and reconstruction techniques of X ray in image scanning.	Understand
CO3	Describe the MRI principles, acquisition and reconstruction in medical applications.	Apply
CO4	Discuss the techniques involved in radiation therapy and principles involved in application of radiation in medical field.	Understand
CO5	Demonstrate the concept of infrared and radio isotopic imaging in medical imaging systems.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO2	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO3	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO4	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	-	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	30	50
Apply	-	10	10
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E31- Medical Imaging Systems								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Ultrasound & Photo acoustic imaging * **Ultrasound Imaging:** Production of Ultrasound - Pulse Echo Imaging - Principles of A-mode, B-mode and M-mode Display - Steering and Focusing. **Photo acoustic imaging:** principles - Case Study on Photo Acoustic Imaging in Oncology - Imaging procedure. **Hands - on:** Develop a software based model to fit and map the moving image to the fixed image obtained from different imaging modalities	[9]
X-Ray Computed Tomography * CT instrumentation: CT Generations and CT Detectors - Image Formation Principles - Image Reconstruction Techniques: Parallel Ray and Fan Beam - Noise Quality in CT Images: Measurement Statistics, Image Statistics, Image SNR. **Hands - on:** Develop a software based model for removing noise from CT images.	[9]
Magnetic Resonance Imaging * Principles - Image Acquisition: Encoding Spatial Position, Principle of Slice Selection - Reconstruction Techniques: Rectilinear and Polar Data - Image Quality in MRI Images: Sampling, Resolution, Noise, SNR, Artifacts. **Hands - on:** Develop a software based model to load a stack of MRI images and view the same as volume slice-by-slice and as a 3D representation.	[9]
Radiation Therapy and Radiation Safety * Radiation Therapy - Linear Accelerator - Tele Gamma Machine - Recent Techniques in Radiation Therapy - IGRT and Cyber Knife - Radiation Measuring Instruments: Thermo Luminescent Dosimeters & Electronic Dosimeter - Radiation Protection in Medicine - Radiation Protection Principles. **Hands - on:** Develop a software based model for 3D dose calculation, comparing dose distributions, reconstructing treatment plans and their summations.	[9]
Infra Red & Radio Isotopic Imaging* I**nfra Red Imaging:** Physics of Thermography - Infrared Detectors - Thermographic Equipment - Pyro Electric Vidicon Camera - Thermal Camera Based on IR Sensor. **Radio Isotopic Imaging:** SPECT & PET Image Formation - Iterative Reconstruction. **Hands - on:** Create a multi modeling image with use of CT and PET images.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Jerry L.Prince and Jonathan M.Links, “Medical Imaging Signals and Systems”, Pearson Education Inc. 2014.
2.	Divyendu Sinha & Edward R.Dougherty, “Introduction to Computer Based Imaging Systems”, PHI, 2003.
Reference(s):	
1.	Jacob Beutel (Editor), M. Sonka (Editor), “Handbook of Medical Imaging”, Volume 2. Medical Image Processing and Analysis, SPIE Press, 2019.
2.	Khin Wee Lai, Dyah Ekashanti Octorina Dewi, “Medical Imaging Technology”, Springer Singapore, 2015.
3.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata Mc Graw Hill, 2003.
4.	William R. Hendee, “Medical Imaging Physics”, 4^{th} Edition, A John Wiley & Sons, inc., Publication, 2002.

*SDG 3 – Good Health and Well Being

Assignment Activity:

Assignment 1:
1. Case study on Photo Acoustic Imaging in Oncology.
2. Hands on noise removal in X ray and Ultrasound images.

Assignment 2:
1. Poster presentation on Recent Techniques in Radiation Therapy.
2. Problems on frequency encoding & slice selection in MRI images.

Assignment 3:
1. Case studies on applications of MRI images in various medical fields.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Ultrasound & Photo acoustic imaging**	
1.1	Production of Ultrasound	1
1.2	Pulse Echo Imaging	1
1.3	Principles of A-mode	1
1.4	Principles of B-mode	1
1.5	Principles of M-mode	1
1.6	Transmit Steering and Focusing	1
1.7	Beam Forming and Dynamic Focusing	1
1.8	Case Study on Photo Acoustic Imaging in Oncology	1
2.0	Imaging Procedure	
2.1	**X-Ray Computed Tomography**	
2.2	CT Instrumentation	1
2.3	CT Generations	1
2.4	CT Detectors	1
2.5	Image Formation Principles: Line Integrals	1
2.6	CT Numbers	1
2.7	Image Reconstruction Techniques :Parallel Ray	1
2.8	Image Reconstruction Techniques : Fan Beam	1
2.9	Noise Quality in CT images: Measurement Statistics	1
3.0	Image Statistics, Image SNR.	
3.1	**Magnetic Resonance Imaging**	
3.2	Principles of MRI Pulse Sequence	1
3.3	Image Acquisition: Encoding Spatial Position	1
3.4	Principle of Slice Selection	1
3.5	Reconstruction Techniques: Rectilinear Data	1
3.6	Polar Data	1
3.7	Image Quality in MRI Images: Sampling	1
3.8	Resolution	1
4.0	Noise	
4.1	SNR, Artifacts	1
4.2	**Radiation Therapy And Radiation Safety**	
4.3	Radiation Therapy	1
4.4	Linear Accelerator	1
4.5	Tele Gamma Machine	1
4.6	Recent Techniques in Radiation Therapy	1
4.7	IGRT and Cyber Knife	1
4.8	Radiation Measuring Instruments: Thermo Luminescent Dosimeters	1
4.9	Electronic Dosimeter	1
5.0	Radiation Protection in Medicine	
5.1	Radiation Protection Principles	1
5.2	**Infra Red & Radio Isotopic Imaging***	
5.3	Physics of Thermography	1

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5.4	Infrared Detectors	1
5.5	Thermographic Equipment	1

Course Designer(s)

1. Dr. K.B.Jayanthi -jayanthikb@ksrct.ac.in
2. Mrs.K.Gogila Devi - gogiladevi@ksrct.ac.in

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60 EC E32	Wireless Broadband Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To familiarize High Speed Networks
- To learn different wireless LAN network technologies and its application
- To study the various protocols in broadband networks
- To learn the basics of 5G and Beyond Wireless communication
- To understand about the layer level functionalities in interconnecting networks

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the concept of ISDN and frame relay in high speed networks.	Understand
CO2	Describe the architecture of high-speed WLAN technologies.	Understand
CO3	Illustrate the concepts of various protocols in wireless networks.	Understand
CO4	Explore the current generation (5G and beyond) network architecture.	Understand
CO5	Explain the interconnecting network functionalities by layer level functions.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	50	50	80
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E32 – Wireless Broadband Networks								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

High Speed Networks ISDN: Conceptual View - Standards - Transmission Structure - B-ISDN Standards and Services, Protocol Architecture - Frame Relay Networks, Call Control - LAPF - Frame Relay Congestion Control - Asynchronous Transfer Mode - ATM Protocol Architecture, ATM Logical Connection, ATM Cell - ATM Service Categories – AAL.	[9]
Wireless Broadband* Local Broad Band and Ad hoc Networks - Different Versions of IEEE 802.11 Standard, Protocol Architecture of WLAN - WLAN Technologies: Applications, Requirements - Hiper LAN: WATM, BRAN, HiperLAN2 - WiMAX Technology Protocol and Application of Technology - 6LoWPAN, Wireless HART.	[9]
Wireless Protocols Mobile Network Layer - Fundamentals of Mobile IP, Data Forwarding Procedures in Mobile IP, IP Mobility Management - Mobile Transport Layer - TCP Congestion Control, Slow Start, Fast Recovery / Fast Retransmission, Classical TCP improvements - Indirect TCP, snooping TCP, Mobile TCP - Congestion Control in ATM, Mobile Ad-Hoc Network: Routing: Destination Sequence Distance Vector, IoT: CoAP.	[9]
5G and Beyond* 5G Roadmap - 5G Architecture - IoT and Context Awareness - Networking Reconfiguration and Virtualization Support - Mobility QoS Control - Emerging Approach for Resource Over Provisioning, Small Cells for 5G Mobile Networks - Capacity Limits and Achievable Gains with Densification - Mobile Data Demand, Demand Vs Capacity, and 5G Future Directions with AI - 6G Key Enablers.	[9]
Layer-Level Function and QoS Characteristics of Wireless Channels - Downlink Physical Layer, Uplink Physical Layer, MAC Scheme - Frame Structure, Resource Structure, Mapping, Synchronization, Reference Signals and Channel Estimation, Interference Cancellation - Comp, Carrier Aggregation, Services - Multimedia Broadcast/Multicast, Location-Based Services. QoS Issues in Broadband Communication - A Case Study of Broadband Service Regulations for Maintaining QoS by Telecom Regulatory Bodies Such as TRAI.	[9]
Total Hours:	**45**

Text Book(s):

1.	Vannithamby R and Talwar S, “Towards 5G: Applications, Requirements and Candidate Technologies”, John Willey & Sons, West Sussex, 2017.
2.	Jonathan Rodriguez, “Fundamentals of 5G Mobile networks”, John Wiley, 2015.

Reference(s):

1.	Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.
2.	William Stallings, “ISDN and Broadband ISDN with Frame Relay and ATM’, 4th Edition, PHI, 2004.
3.	Vaei M, Ding Z, and Poor H.V, “Multiple Access techniques for 5G Wireless Networks and Beyond”, Springer Nature, Switzerland, 2019.
4.	Erik Dahlman, Stefan Parkvall, Johan Sko˙ld, “5G NR: The Next Generation Wireless Access Technology”, 1st Edition, Elsevier, 2016.

*SDG 9 - Sustainable industrialization and foster innovation

Assignment Activity:

Assignment 1:
1. Prepare a case study on wireless LAN
2. Poster Presentation on ATM

Assignment 2:
1. Group discussion in wireless protocols

Assignment 3:
1. Video presentation on 5G

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Course Contents and Lecture Schedule

S.No.	Topic	No. of Hours
1	**High Speed Networks**	
1.1	ISDN: Conceptual View – Standards – Transmission Structure	1
1.2	B-ISDN Standards and Services, Protocol Architecture	1
1.3	Frame Relay Networks	1
1.4	Call Control – LAPF	1
1.5	Frame Relay Congestion Control	1
1.6	Asynchronous Transfer Mode	1
1.7	ATM Protocol Architecture	1
1.8	ATM Logical Connection, ATM Cell	1
1.9	ATM Service Categories – AAL	1
2	**Wireless Broadband**	
2.1	Local Broad Band and Ad hoc Networks	1
2.2	Different Versions of IEEE 802.11 Standard	1
2.3	Protocol Architecture of WLAN	1
2.4	WLAN Technologies: Applications, Requirements	1
2.5	Hiper LAN: WATM, BRAN	1
2.6	WiMAX Technology Protocol	1
2.7	WiMAX Application of Technology	1
2.8	6LoWPAN	1
2.9	Wireless HART	1
3	**Wireless Protocols**	
3.1	Mobile Network Layer- Fundamentals of Mobile IP	1
3.2	Data Forwarding Procedures in Mobile IP	1
3.3	IPv6	1
3.4	IP Mobility Management, IP Addressing	1
3.5	DHCP, Mobile Transport Layer	1
3.6	TCP Congestion Control, Slow Start, Fast Recovery/Fast Retransmission	1
3.7	Classical TCP Improvements-Indirect TCP, Snooping TCP	1
3.8	Mobile TCP. Mobile ad-hoc Network	1
3.9	Routing: Destination Sequence Distance Vector, IoT: CoAP	1
4	**5G and Beyond**	
4.1	5G Roadmap – 5G Architecture	1
4.2	IoT and Context Awareness - Networking Reconfiguration and Virtualization Support	1
4.3	Mobility QoS control – Emerging Approach for Resource Over Provisioning	1
4.4	Small Cells for 5G Mobile Networks	1
4.5	Capacity Limits and Achievable Gains with Densification	1
4.6	Mobile Data Demand	1
4.7	Demand Vs Capacity	1
4.8	Small Cell Challenges	1
4.9	5G Future Directions with AI	1
5	**Layer-Level Function and QoS**	
5.1	Characteristics of Wireless Channels - Downlink Physical Layer	1
5.2	Uplink Physical Layer, MAC Scheme - Frame Structure	1
5.3	Resource Structure, Mapping	1

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5.4	Synchronization	1
5.5	Reference Signals and Channel Estimation	1
5.6	CoMP, Carrier Aggregation	1
5.7	Services - Multimedia Broadcast/Multicast	1
5.8	Location-Based Services	1
5.9	QoS	1

Course Designers

1. Ms.R.Ramya – rramya@ksrct.ac.in

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60 EC E33	Satellite Communication	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the basic orbital mechanism in satellite communication
- To study the uplink/downlink link design
- To learn about the basic earth and space segments
- To study about the basic satellite access techniques
- To learn about the broadcast and their services

Pre-requisites

- Digital Communication

Course Outcomes

On the Successful Completion of the Course, Students will be able to

CO1	Recognize the different orbital constellation mechanism in satellite communication.	Understand
CO2	Build the uplink and downlink design in satellite communication.	Apply
CO3	Construct the elements of earth and space segments.	Apply
CO4	Summarize the basic CDMA, TDMA and FDMA access techniques	Understand
CO5	Discuss the benefits of satellite broadcast and their services	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	2	2	-	2	3	2	-	-	3	2	3
CO2	3	3	3	-	2	2	-	2	3	2	-	-	3	2	3
CO3	3	3	3	-	2	2	-	2	3	2	-	-	3	2	3
CO4	3	3	3	-	2	2	-	2	3	2	-	-	3	2	3
CO5	3	3	3	-	2	2	-	2	3	2	-	-	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	20	20	32
Apply	20	20	34
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E33 – Satellite Communication								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Satellite Orbit Satellite Orbits: Kepler's Laws - Earth Satellite Orbiting Satellite Terms - Orbital Elements - Orbital Perturbations - Inclined Orbits - Sun Synchronous Orbit - Constellation: Geo Stationary Satellites - NonGeostationary Constellation - Launching of Geostationary Satellites - Chandrayan - 3.	[9]
Link Design EIRP - Transmission Losses - Power Budget Equation - System Noise Carrier to Noise Ratio - Uplink - Downlink - Effects of Rain - Inter Modulation Noise.	[9]
Space and Earth Segment Space Segment: Power Supply - Altitude Control - Station Keeping - Thermal Control - TT& C Subsystems - Antenna Subsystem - Transponders - Wideband Receiver - Earth segment: Receive only Home TV System - Community Antenna TV system.	[9]
Satellite Access Single Access - Pre assigned FDMA - Demand assigned FDMA - Spade System - TWT Amplifier Operation - Downlink Analysis - TDMA - Reference Bursts - Preamble - Postamble - Carrier Recovery - Network Synchronization - Preassigned TDMA assigned - CDMA.	[9]
Broadcast and Services Broadcast: DBS - Orbital Spacings - Power Ratings - Frequency and Polarization - Transponder Capacity - Bit Rate - MPEG - Forward Error Correction - ODU - IDU - Downlink Analysis - Uplink - Satellite Mobile Services: VSAT - GPS.	[9]
Total Hours:	**45**

Text Book(s):

1.	Timothy Pratt, Charles Bostian & Jeremy Allmuti, "Satellite Communications", 3^{rd} Edition, John Willy & Sons (Asia) Pvt. Ltd, 2019.
2.	Dennis Roddy, "Satellite Communication", 4^{th} Edition, McGraw Hill Publications, 2006.

Reference(s):

1.	M.Richharia, "Satellite Communication Systems (Design Principles)", 2^{nd} Edition, Macmillan Press Ltd., 2017.
2.	Agarwal D.C, "Satellite Communication", 5^{th} Edition, Khanna Publications, Mc.Graw Hill, 2008.
3.	Raja Rao K.N, "Fundamentals of Satellite Communications", PHI, 2004.
4.	Wilbur L. Pritchars Henri G. SuyderHond Robert A.Nelson, "Satellite Communication Systems Engineering", 2^{nd} Edition, Pearson Education Ltd., 2003.

*SDG 3 – Good Health and Well Being
**SDG 7 – Affordable and Clean Energy

Assignment Activity:

Assignment 1:
1. Poster Presentation: Orbital Elements & Effects of Rain
2. Group Problem Solving: Power Budget Equation & Constellation: Geo Stationary Satellites
3. Case Studies: Chandrayan-3 & Latest launching Satellites

Assignment 2:
1. Poster Presentation: Transponders & TWT
2. Group Problem Solving: FDMA & TDMA

Assignment 3:
1. Seminar Presentation: Thermal Control & Network Synchronization
2. Case Studies: Community Antenna TV system

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Satellite Orbit**	
1.1	Satellite Orbits: Kepler's laws	1
1.2	Earth Satellite Orbiting Satellite Terms	1
1.3	Orbital Elements	1
1.4	Orbital Perturbations	1
1.5	Inclined Orbits	1
1.6	Sun Synchronous Orbit	1
1.7	Constellation: Geo Stationary Satellites	1
1.8	Non Geostationary Constellation	1
1.9	Launching of Geostationary Satellites.	1
2.0	**Link Design**	
2.1	EIRP	1
2.2	Transmission Losses	1
2.3	Power Budget equation	1
2.4	System Noise Carrier to Noise	1
2.5	Uplink	1
2.6	Downlink	1
2.7	Effects of Rain	1
2.8	Inter Modulation Noise	2
3.0	**Space and Earth Segment**	
3.1	Space Segment: Power Supply	1
3.2	Altitude control- Station keeping	1
3.3	Thermal Control	1
3.4	TT& C Subsystems	1
3.5	Antenna Subsystem	1
3.6	Transponders	1
3.7	Wideband Receiver	1
3.8	Earth Segment: Receive only Home TV System	1
3.9	Community Antenna TV System	1
4.0	**Satellite Access**	
4.1	Single Access - Pre assigned FDMA	1
4.2	Demand Assigned FDMA	1
4.3	SPADE System	1
4.4	TWT Amplifier Operation Downlink Analysis	1
4.5	TDMA	1
4.6	Reference Bursts-Preamble	1
4.7	Postamble - Carrier Recovery	1
4.8	Network Synchronization Pre assigned TDMA assigned	1
4.9	CDMA	1
5.0	**Broadcast and Services**	
5.1	Broadcast: DBS	1
5.2	Orbital Spacings- Power Ratings	1
5.3	Frequency and Polarization	1
5.4	Bit Rate	1
5.5	MPEG	1
5.6	Forward Error Correction	1

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5.7	ODU, IDU	1
5.8	Downlink Analysis- Uplink	1
5.9	Satellite Mobile Services: VSAT, GPS	1

Course Designer(s)

1. Dr P Babu- pbabu@ksrct.ac.in
2. Mr P Balamurugan - pbalamurugan@ksrct.ac.in

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60 EC E34	5G Communication Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the evolution of wireless networks
- To understand the concepts of 5G networks
- To study the basics of network slicing and edge computing
- To understand the concepts of MM-wave communication
- To understand the security in 5G networks

Pre-requisites

- Mobile communication and Networks

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Illustrate the principles of 2G,3G,4G and 5G networks	Remember
CO2	Explain the 5G concepts and challenges	Understand
CO3	Describe about network slicing and edge computing	Understand
CO4	Apply the concepts of mm-wave communication	Apply
CO5	Apply the security concepts in 5G networks	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	30	20	30
Understand	30	20	50
Apply	-	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E34 - 5G Communication Networks								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Evolution of Wireless Networks* Networks Evolution: 2G, 3G, 4G, Evolution of Radio Access Networks, Need for 5G, 4G versus 5G, Next Generation Core (NG-core), Visualized Evolved Packet Core (vEPC) **Hands - on:** Multiband OFDM Demodulation	[9]
5G Concepts and Challenges** Fundamentals of 5G Technologies, Overview of 5G Core Network Architecture, New Radio and Cloud Technologies, Radio Access Technologies (RATs), EPC for 5G, Front haul and Backhaul in 5G. **Hands - on:** Modelling of 5G Synchronization Signal Blocks and Bursts	[9]
Network Slicing and Edge computing **, Network Slicing Architecture, Multi Access Edge Computing (MEC), Visualization of 5G Components, End-to-end System Architecture, Service Continuity, Relation to EPC and Edge Computing. **Hands - on:** Perfect Channel Estimation	[9]
Dynamic Spectrum Management and Mm-Waves Mobility Management, Command and Control, Spectrum Sharing and Spectrum Trading, Cognitive Radio based on 5G, Millimetre Waves, **Carrier Aggression****. **Hands - on:** 5G-Compliant Waveform Generation and Testing	[9]
Security in 5G Networks** Security Features in 5G networks, Network Domain security, User Domain Security, Flow Based QoS Framework, Mitigating the Threats in 5G. **Hands - on:** Demonstration of Cryptographic Algorithms in 5G Applications	[9]
Total Hours:	**45**

Text Book(s):

1.	Stephen Rommer, “5G Core Networks: Powering Digitalization”, 1st Edition, Academic Press, 2019.
2.	Saro Velrajan, “An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases”, 1st Edition, Notion Press, 2020.

Reference(s):

1.	Afif osseiran, Jose .F. Monserrat, Patrick marsch, “5G Mobile and Wireless Communications Technology “, 1st Edition, Cambridge university, 2016.
2.	Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, 1st Edition, CRC Press, 2019.
3.	Guy Pujolle, “Software Networks: Virtualization, SDN, 5G and Security”, 2nd Edition, John Wiley & Sons, 2015.
4.	Dr. William Stallings, “5G Wireless A Comprehensive Introduction”, Addison-wesley, 2021.
5.	Ulrich Trick, “An Introduction to the 5th Generation Mobile Networks”, Walter de Gruyter, 2021.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 4 – Quality Education

Assignment Activity

Assignment 1:
1. Chartwork and presentation on electromagnetic spectrum
2. Flipped class on 1G to 5G communication.

Assignment 2:
1. Case study on Millimetre waves

Assignment 3:
1. Flipped class on types of cryptography

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Evolution of Wireless Networks**	
1.1	Networks Evolution: 2G, 3G	1
1.2	Networks Evolution:4G	1
1.3	Evolution of Radio Access Networks	1
1.4	Need for 5G	1
1.5	4G versus 5G	1
1.6	Next Generation Core (NG-core)	1
1.7	NG-core	1
1.8	EPC	1
1.9	Visualized Evolved Packet core (vEPC)	1
2.0	**5G Concepts and Challenges**	
2.1	Fundamentals of 5G Technologies	1
2.2	Features of 5G Technologies	1
2.3	Overview of 5G Core Network Architecture	1
2.4	5G Core Network Architecture	1
2.5	New Radio	1
2.6	Cloud Technologies	1
2.7	Radio Access Technologies (RATs)	1
2.8	EPC for 5G	1
2.9	Fronthaul and Backhaul in 5G	1
3.0	**Network Slicing and Edge computing**	
3.1	Network Slicing Architecture	1
3.2	Network Slicing Architecture-Functions	1
3.3	Multi Access Edge Computing (MEC)	1
3.4	Visualization of 5G Components	1
3.5	End-to-end System Architecture	1
3.6	Service Continuity	1
3.7	Relation to EPC and Edge Computing	1
3.8	5G protocols: 5G NAS, NGAP	1
3.9	GTP-U, IPSec and GRE	1
4.0	**Dynamic Spectrum Management and Mm-Waves**	
4.1	Mobility Management	1
4.2	Command and Control	1
4.3	Spectrum Sharing	1
4.4	Spectrum Trading	1
4.5	Cognitive Radio Based on 5G	1
4.6	Cognitive Radio Based on 5G-Functions	1
4.7	Millimetre Waves	1
4.8	Carrier Aggression	1
4.9	Carrier Aggression-Functions	1
5.0	**Security in 5G Networks**	
5.1	Security Features in 5G networks	1
5.2	Security Features in 5G networks	1
5.3	Network Domain Security	1
5.4	Network Domain Security	1
5.5	User Domain Security	1

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5.6	Flow Based QoS Framework	1
5.7	Flow Based QoS Framework	1
5.8	Mitigating the Threats in 5G	1
5.9	Mitigating the Threats in 5G	1

Course Designer(s)

1. Mr.R.Satheesh kumar - satheeshkumar@ksrct.ac.in

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60 EC E35	Artificial Intelligence	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To learn the concepts of the agents and environments in AI.
- To study the fundamentals of problem-solving.
- To explore the knowledge and reasoning in propositional logic and first-order logic.
- To understand the uncertain knowledge in solving AI problems.
- To discuss the different forms of learning.

Pre-requisites

- Machine Learning Techniques

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the agents and environments in AI.	Understand
CO2	Explain the concepts of intelligent agents and problem-solving aspects.	Apply
CO3	Apply the knowledge of propositional logic and first order logic.	Apply
CO4	Solve the uncertainty and probabilistic reasoning.	Apply
CO5	Develop the types of learning methods and AI applications.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	2	3	-	3	-	-	-	-	-	-	-	3	3	-
CO4	3	2	3	-	3	-	-	3	3	3	-	3	3	3	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	3	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	15	-	-	30	-
Understand	40	20	30	10	10	50	10
Apply	-	80	15	90	90	20	90
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E35 - Artificial Intelligence								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Agents and Environments in AI The Ethics and Risks of Developing Artificial Intelligence, AI: The Present and Future, Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	[6]
Search Algorithms Solving Problems by Searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Adversarial Search: Optimal Decisions in Game.	[6]
Knowledge and Reasoning Logical Agents: Knowledge-based Agents, The Wumpus World, Agents based on Propositional Logic. First-Order Logic: Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.	[6]
Uncertain Knowledge and Reasoning Quantifying Uncertainty: Acting Under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Bayes' Rule and Its Use, Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Inference in Temporal Models, Hidden Markov Models.	[6]
Learning and Applications* Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, A Logical Formulation of Learning, Statistical Learning - Applications of Artificial Intelligence	[6]
Practical: 1. Simulate intelligent agents and analyze their behavior. 2. Simulate uninformed and informed search strategies. 3. Simulate the local search algorithms. 4. Simulate the behavior of local search algorithms and analyze its performance. 5. Write a program to generate the output for A* algorithm. 6. Write a program to show the tic tac toe game for 0 and X. 7. Simulate the various bayesian parameters 8. Simulate hidden markov models. 9. Simulate supervised learning for the selected problems-based regression. 10. Simulate supervised learning for the selected problems-based classification. **Tools used: MATLAB / Open Source**	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, MIT Press, 2020.
2.	Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2017.

Reference(s):

1.	Peter Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
2.	Murphy K.P, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
3.	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2014.
4.	Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, 2014.

*SDG 9 - Sustainable industrialization and foster innovation

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Agents and Environments in AI**	
1.1	The Ethics and Risks of Developing Artificial Intelligence	1
1.2	AI: The Present and Future, Intelligent Agents	1

1.3	Agents and Environments	1
1.4	Good Behaviour: The Concept of Rationality	1
1.5	The Nature of Environments	1
1.6	The Structure of Agents	1
2	**Search Algorithms**	
2.1	Solving Problems by Searching: Problem-Solving Agents	1
2.2	Uninformed Search Strategies, Informed (Heuristic) Search Strategies	1
2.3	Beyond Classical Search: Local Search Algorithms	1
2.4	Optimization Problems	1
2.5	Local Search in Continuous Spaces	1
2.6	Adversarial Search: Optimal Decisions in Game	1
3	**Knowledge, Reasoning**	
3.1	Logical Agents: Knowledge-Based Agents	1
3.2	The Wumpus World	1
3.3	Agents Based on Propositional Logic	1
3.4	First-Order Logic: Syntax and Semantics of First-Order Logic	1
3.5	Using First-Order Logic	1
3.6	Knowledge Engineering in First-Order Logic.	1
4	**Uncertain Knowledge and Reasoning**	
4.1	Quantifying Uncertainty: Acting Under Uncertainty	1
4.2	Basic Probability Notation, Inference Using Full Joint Distributions	1
4.3	Bayes’ Rule and Its Use. Probabilistic Reasoning	1
4.4	Representing Knowledge in an Uncertain Domain,	1
4.5	The Semantics of Bayesian Networks, Inference in Temporal Models	1
4.6	Hidden Markov Models	1
5	**Learning and Applications**	
5.1	Forms of Learning, Supervised Learning	1
5.2	Learning Decision Trees, Evaluating and Choosing the Best Hypothesis	1
5.3	Regression and Classification with Linear Models	1
5.4	Artificial Neural Networks, Nonparametric Models	1
5.5	Ensemble Learning, A Logical Formulation of Learning	1
5.6	Statistical Learning - Applications of Artificial Intelligence	1
Practical:		
1.	Implement intelligent agents and analyze their behavior.	2
2.	Implement uninformed and informed search strategies.	2
3.	Simulate the local search algorithms.	2
4.	Analyze the performance and behavior of local search algorithms.	2
5.	Write a program to generate the output for A* algorithm.	2
6.	Write a program to show the Tic Tac Toe game for 0 and X.	4
7.	Simulate the various bayesian parameters.	4
8.	Implementation of hidden markov models.	4
9.	Simulate supervised learning for the selected problems-based regression.	4
10.	Simulate supervised learning for the selected problems-based classification.	4

Course Designer(s)

1. Dr. K.B.Jayanthi -jayanthikb@ksrct.ac.in
2. Ms.R.Ramya - rramya@ksrct.ac.in

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60 EC E36	Ad hoc and Sensor Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To analyse the various design issues and challenges in the layered architecture of Ad hoc wireless networks
- To teach the students about various MAC and Routing protocols of Ad hoc and WSN.
- To compute the power consumption and Euclidean distance of a sensor network
- To identify appropriate layer protocols with the suitable routing algorithm
- To educate the students on introduction and application of LoWPAN

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Identify the necessity of Ad hoc and sensor networks	Understand
CO2	Describe the operation of the routing and localization	Understand
CO3	Compute the power consumption and Euclidean distance of a sensor network	Apply
CO4	Identify appropriate layer protocols with the suitable routing algorithm based on the network and user requirement	Apply
CO5	Illustrate the LoWPAN architecture with different protocols	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	2	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	-	-	-	3	3	3	-	3	2	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	20
Understand	40	30	40
Apply	-	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K. S. Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E36 – Ad hoc and Sensor Networks								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Ad hoc Networks Characteristic - Features - Need for Ubiquitous Computing Network - Applications of Ad hoc, Mobility Models: Brownian Model - Column model - Random Walk Model - Random Waypoint model - Random Gauss Markov.	[9]
Routing Protocols* Need for Different routing Protocols - Proactive Vs Reactive Routing. Unicasting: Dynamic Source Routing – Ad hoc On-Demand Distance Vector Routing - Temporally Ordered Routing Algorithm - Signal Stability Based Routing - Associativity Based Routing - Zone Routing Protocol.	[9]
Wireless Sensor Networks* Challenges for Wireless Sensor Networks - Characteristics Requirements - Required mechanisms - Difference between Mobile Ad hoc and Sensor networks, Applications of Sensor Networks – Single - Node Architecture - Hardware Components - Energy Consumption of Sensor Nodes	[9]
Networking of Sensors* Physical Layer and Transceiver Design Considerations - MAC Protocols for Wireless Sensor Networks. The Mediation Device Protocol - Wakeup Radio Concepts - Address and Name Management - Assignment of MAC Addresses - Routing Protocols - Energy-Efficient Routing, Geographic Routing.	[9]
LOWPAN Architecture, Protocol stack - Link layers - Addressing - Header format - Bootstrapping - Mesh topologies - Internet integration - Routing - Mesh-Under - Route-Over – ROLL, Common Protocols –WSP, MQTTS, CAP.	[9]
Total Hours:	**45**

Text Book(s):

1.	C. Siva Ram Murthy, and B. S. Manoj, “Ad hoc Wireless Networks: Architectures and Protocols”, Prentice Hall Professional Technical Reference, 2008.
2.	Tracy Camp, Jeff Boleng, Vanessa Davies, "A survey on Mobility Models for Ad hoc Network Research Wireless Communications and Mobile Computing", Special Issue on Mobile Ad hoc Networking: Research, Trends and Applications, Vol.2. No. 5. pp.483 502,2002.

Reference(s):

1	Carlos De Morais Cordeiro, Dharma Prakash Agrawal, “Ad hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.
2	Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks, An Information Processing Approach", Elsevier, 2016.
3	Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley,2007.
4	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks - Technology, Protocols, and Applications”, John Wiley, 2015.
5	Hongmei Deng, Wei Li and Dharma P. Agrawal, “Routing security in Wireless Ad hoc Networks”, IEEE Communication Magazine, 2002.

*SDG 4 - Quality Education

Assignment Activity

Assignment 1:

1. Applications on Ad hoc network models - Video Presentation

Assignment 2:

1. Poster Presentation on Routing Protocol

Assignment 3:

1. Group Activity on Wireless Sensor Network

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Course Contents and Lecture Schedule		
S.No.	**Topics**	**No. of hours**
1.0	**Ad hoc Networks**	
1.1	Characteristic	1
1.2	Features	1
1.3	Need for Ubiquitous Computing Network	1
1.4	Applications of Ad hoc	1
1.5	Brownian Model	1
1.6	Column Model	1
1.7	Random Walk Model	1
1.8	Random Waypoint Model	1
1.9	Random Gauss Markov Model	1
2.0	**Routing Protocols**	
2.1	Need for Different Routing Protocols	1
2.2	Proactive Routing	1
2.3	Reactive Routing	1
2.4	Unicasting: Dynamic Source Routing	1
2.5	Ad hoc On-Demand Distance Vector Routing	1
2.6	Temporally Ordered Routing Algorithm	1
2.7	Signal Stability Based Routing	1
2.8	Associativity Based Routing	1
2.9	Zone Routing Protocol	1
3.0	**Wireless Sensor Networks**	
3.1	Challenges for Wireless Sensor Networks	1
3.2	Characteristics	1
3.3	Requirements	1
3.4	Required Mechanisms	1
3.5	Difference Between Mobile Ad hoc and Sensor Networks	1
3.6	Applications of Sensor Networks	1
3.7	Single-Node Architecture	1
3.8	Hardware Components	1
3.9	Energy Consumption of Sensor Nodes	1
4.0	**Networking of Sensors**	
4.1	Physical Layer and Transceiver Design Considerations	1
4.2	MAC Protocols for Wireless Sensor Networks	1
4.3	The Mediation Device Protocol	1
4.4	Wakeup Radio Concepts	1
4.5	Address and Name Management	1
4.6	Assignment of MAC Addresses	1
4.7	Routing Protocols	1
4.8	Energy-Efficient Routing	1
4.9	Geographic Routing.	1
5.0	**LoWPAN**	
5.1	Architecture, Protocol Stack, Link Layers,	1
5.2	Addressing - Header Format	1
5.3	Bootstrapping	1
5.4	Mesh Topologies	1

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5.5	Internet Integration	1
5.6	Routing - Mesh-Under -Route-Over –Roll	1
5.7	Common Protocols –WSP	1
5.8	MQTTS, CAP	1
5.9	CAP	1

Course Designer(s)

1. Mr S Jayamani - jayamani@ksrct.ac.in

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60 EC E37	Fundamentals of Nanoelectronics	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To make students know the basic concept of nanoelectronics.
- To have knowledge about the quantum electronic devices.
- To understand the concepts of Nano electronic transistors, Semiconductor nanowire and memory cell.
- To understand the concepts of Nano electronic tunneling devices and superconducting devices
- To have knowledge about the Nanotubes and Nanostructure Devices.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss the basics of nano electronics including quantum wires, dots and wells	Understand
CO2	Use the mechanism behind quantum electronic devices.	Understand
CO3	Understand the basics of Nano Electronic Transistors	Understand
CO4	Analyze the key performance aspects of tunneling and superconducting nano electronic devices	Analyze
CO5	Apply the knowledge in the development of nanotubes and nanostructure devices	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	10
Understand	40	10	20
Apply	-	30	60
Analyze	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E37 - Fundamentals of Nanoelectronics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Fundamentals of Nano Electronics Scaling to nano - Light as a wave and particle- Electrons as waves and particles- Origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation - Electron confinement - Quantum dots, wires and well -Spin and angular momentum.	[9]
Quantum Electronics* Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata - Quantum dot array, Quantum memory.	[9]
Nano Electronic Transistors Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.	[9]
Nano Electronic Tunneling and Super Conducting Devices* Tunnel effect -Tunneling element -Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices - Superconducting switching devices - Cryotron-Josephson tunneling device.	[9]
Nanotubes and Nanostructure Devices* Carbon Nanotube - Fullerenes - Types of nanotubes - Formation of nanotubes - Assemblies - Purification of carbon nanotubes - Electronic properties - Synthesis of carbon nanotubes - Carbon nanotube interconnects - Carbon nanotube FETs and SETs - Nanotube for memory applications - Nano structures and nano structured devices.	[9]
Total Hours:	**45**

Text Book(s):	
1.	George W.Hanson, “Fundamentals of Nanoelectronics”, 1st Edition, Pearson Education, 2009.
2.	Jan Dienstuhl, Karl Goser, and Peter Glösekötter, “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Springer-Verlag, 2004.
Reference(s):	
1.	Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, “Nanoelectronics: Materials, Devices, Applications”, Wiley, 2017.
2.	Brajesh Kumar Kaushik, “Nanoelectronics: Devices, Circuits and Systems”, Elsevier science, 2018.

* SDG 9 - Industry, Innovation and Infrastructure

Assignment Activity:

Assignment 1: Explanatory questions in Fundamentals of Nano Electronics & Quantum Electronics.

Assignment 2: Seminar presentation

Assignment 3: Explanatory questions in Module 5.

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Fundamentals of Nano Electronics**	
1.1	Scaling to nano	1
1.2	Light as a wave and particle	1
1.3	Electrons as waves and particles	1
1.4	origin of quantum mechanics	1
1.5	General postulates of quantum mechanics	1
1.6	Time independent Schrodinger wave equation	1
1.7	Electron confinement	1
1.8	Quantum dots, wires and well	1
1.9	Spin and angular momentum	1
2	**Quantum Electronics**	
2.1	Quantum electronic devices	1
2.2	MOS transistor	1
2.3	Short channel MOS transistor	1
2.4	Split gate transistor	1
2.5	Electron wave transistor	1
2.6	Electron spin transistor	1
2.7	Quantum cellular automata	1
2.8	Quantum dot array	1
2.9	Quantum memory	1
3	**Nano Electronic Transistors**	
3.1	Coulomb blockade	1
3.2	Coulomb blockade in Nano capacitors	1
3.3	Coulomb blockade in tunnel junctions	1
3.4	Single electron transistors	1
3.5	Semiconductor nanowire FETs	1
3.6	Semiconductor nanowire SETs	1
3.7	Molecular SETs	1
3.8	Molecular electronics	1
3.9	Memory cell	1
4	**Nano Electronic Tunneling and Super Conducting Devices**	
4.1	Tunnel effect	1
4.2	Tunneling element	1
4.3	Tunneling diode	1
4.4	Resonant tunneling diode	1
4.5	Three terminal resonant tunneling devices	1
4.6	Superconducting switching devices	1
4.7	Cryotron	1
4.8	Tunneling device	1
4.9	Josephson tunneling device	1
5	**Nanotubes and Nanostructure Devices**	
5.1	Carbon Nanotube	1
5.2	Fullerenes- Types of nanotubes	1
5.3	Formation of nanotubes	1
5.4	Assemblies - Purification of carbon nanotubes	1

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5.5	Electronic properties	1
5.6	Synthesis of carbon nanotubes - Carbon nanotube interconnects	1
5.7	Carbon nanotube FETs and SETs	1
5.8	Nanotube for memory applications	1
5.9	Nano structures and nano structured devices.	1

Course Designer(s)

1. Dr.T.Baranidharan – baranidharan@ksrct.ac.in

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60 EC E41	Brain Computer Interface and Applications	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To impart knowledge on types and structure of brain control interfaces.
- To impart knowledge on various potentials related to brain activation function.
- To impart knowledge on different methods of feature extraction from the signals.
- To impart knowledge on the machine learning methods for the brain control interface.
- To impart knowledge on various applications of BCI.

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the types and structure of brain control interfaces.	Understand
CO2	Articulate the various potentials related to brain activation function.	Understand
CO3	Discuss the different methods of feature extraction from the signals	Understand
CO4	Describe the various machine learning methods for the brain control interface.	Understand
CO5	Discuss the applications of the brain control interface.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	2	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	2	2	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	-	2	-	3	3	3	-	3	2	2	3
CO4	2	3	3	-	2	1	-	3	3	3	-	2	2	2	3
CO5	3	3	2	-	2	1	-	3	3	3	-	2	2	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	12	12	20
Understand	48	48	80
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.E - Electronics and Communication Engineering

60 EC E41 - Brain Computer Interface and Applications

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

BCI Brain Structure and Function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI. **Hands - on: Simulation of EEG Waveform**	[9]
Brain Activation Brain Activation Patterns - Spikes, Oscillatory Potential and ERD, Slow Cortical Potentials, Movement Related Potentials-Mu Rhythms, Motor Imagery, Stimulus Related Potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials Related to Cognitive Tasks.	[9]
Feature Extraction Methods Data Processing – Spike Sorting, Frequency Domain Analysis, Wavelet Analysis, Time Domain Analysis, Spatial Filtering – Principal Component Analysis (PCA) and Independent Component Analysis (ICA), Artifacts Reduction, Feature Extraction - Phase Synchronization and Coherence. **Hands - on: EEG Signal Feature Extraction using Principal Component Analysis.**	[9]
Machine Learning Methods for BCI Classification Techniques –Binary Classification, Ensemble Classification, Multiclass Classification. Regression - Linear, Polynomial - RBF's - Perceptron's - Multilayer Neural Networks -Support Vector Machine - Graph Theoretical Functional Connectivity Analysis. **Hands - on: EEG Signal Classification using Support Vector Machine.**	[9]
Applications of BCI Invasive BCIs: Decoding and Tracking Arm (hand) Position, Controlling Prosthetic Devices such as Orthotic Hands, Cursor and Robotic Control using Multi-Electrode Array Implant, Visual Cognitive BCI, Emotion Detection.	[9]
Total Hours:	**45**

Text Book(s):

1.	Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", 1st Edition, Cambridge University Press, 2013.
2.	Jonathan Wolpaw, Elizabeth Winter Wolpaw, "Brain Computer Interfaces: Principles and Practice", 1st Edition, Oxford University Press, USA, January 2012.

Reference(s):

1.	Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", 2015, Springer.
2.	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.
3.	Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch, "A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals", Journal of Neural Engineering, Vol.4, PP.32-57, 2007
4.	Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.

*SDG 4 - Quality Education

<u>Assignment Activity:</u>

Assignment 1 – Covers Module 1 & 2

1. Brain-Computer Interface Types.
2. Stimulus-related potentials, Visual Evoked Potentials, Auditory Evoked Potentials.

Assignment 2 – Covers Modules 3, 4 & 5

1. Principal Component Analysis (PCA), Independent Component Analysis (ICA).
2. Binary classification, Ensemble classification, Multiclass Classification.

Assignment 3 – Covers Modules 5

1. Controlling prosthetic devices such as orthotic hands, Cursor, and robotic control using multi-electrode array implant.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**BCI**	
1.1	Brain Structure and Function	1
1.2	Brain Computer Interface Types	1
1.3	Synchronous and Asynchronous Types	1
1.4	Invasive BCI	1
1.5	Partially Invasive BCI	1
1.6	Non Invasive BCI	1
1.7	Structure of BCI System	1
1.8	BCI Monitoring Hardware	1
1.9	EEG, ECoG, MEG, fMRI.	1
2.0	**Brain Activation**	
2.1	Brain Activation Patterns	1
2.2	Spikes, Oscillatory Potential and ERD	1
2.3	Slow Cortical Potentials	1
2.4	Movement Related Potentials	1
2.5	Mu Rhythms, Motor Imagery	1
2.6	Stimulus Related Potentials	1
2.7	Visual Evoked Potentials – P300	1
2.8	Auditory Evoked Potentials	1
2.9	Potentials Related to Cognitive Tasks	1
3.0	**Feature Extraction Methods**	
3.1	Data Processing – Spike Sorting	1
3.2	Frequency Domain Analysis	1
3.3	Wavelet Analysis	1
3.4	Time Domain Analysis	1
3.5	Spatial Filtering	1
3.6	Principal Component Analysis (PCA)	1
3.7	Independent Component Analysis (ICA)	1
3.8	Artifacts Reduction	1
3.9	Feature Extraction - Phase Synchronization and Coherence	1
4.0	**Machine Learning Methods for BCI**	
4.1	Binary, Ensemble Classification	2
4.2	Multiclass Classification	1
4.3	Regression - Linear, Polynomial	1
4.4	RBF's, Perceptron's	1
4.5	Multilayer Neural Networks	1
4.6	Support Vector Machine	1
4.7	Graph Theoretical Functional Connectivity Analysis	2
5.0	**Applications of BCI**	
5.1	Invasive BCIs: Decoding and Tracking Arm (Hand) Position	2
5.2	Controlling Prosthetic Devices such as Orthotic Hands	2
5.3	Cursor and Robotic Control using Multi Electrode Array Implant	2
5.4	Visual Cognitive BCI	1
5.5	Emotion Detection	2

Course Designer(s)

1. Mr S.Pradeep – pradeeps@ksrct.ac.in

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60 EC E42	Industrial IoT and Industry 4.0	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Gain knowledge of key concepts of Industry 4.0
- Examine cutting-edge technologies for Industry 4.0
- Acquire skills to identify, assess, and mitigate cybersecurity risks
- Delve into the layers of Industrial IoT (IIoT) architecture
- Develop the ability to apply Industry 4.0 principles and technologies

Pre-requisites

- Internet of Things

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Assess the impact of Industry 4.0 on traditional production systems and identify opportunities for improvement.	Understand
CO2	Discuss the strategies for integrating Industry 4.0 technologies into existing production systems to enhance efficiency and productivity.	Understand
CO3	Assess the effectiveness of cybersecurity measures in protecting critical infrastructure and minimizing potential disruptions.	Analyze
CO4	Implement end-to-end IIoT solutions tailored to specific application domains, considering factors such as data security, latency, and scalability.	Analyze
CO5	Identify key application domains of Industry 4.0 technologies, including the oil, chemical, pharmaceutical, and manufacturing industries.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	2	-	3	3		3	3	-	-	3	3	2	3
CO4	3	2	3	-	3	3	3	3	3	3	-	-	3	2	3
CO5	3	3	2	-	-	3	3	3	3	3	-	3	3	2	3

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	10
Understand	40	10	20
Apply	-	30	60
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E. Electronics and Communication Engineering								
60 EC E42 - Industrial IoT and Industry 4.0								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Industry 4.0 Essentials* Sensing & actuation, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories	[9]
Industry 4.0 Evolution* Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis	[9]
Cybersecurity* Cybersecurity in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, Industrial IoT: Business Model and Reference Architecture	[9]
IIoT Layers* IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking, Big Data Analytics and Software Defined Networks: IIoT Analytics - Machine Learning and Data Science	[9]
Application Domains** Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Milk Processing and Packaging Industries, Manufacturing Industries	[9]
Total Hours:	**45**

Text Book(s):

1.	Misra S, Mukherjee A, and Roy A, “Introduction to IoT”, Cambridge University Press, 2021.
2.	Misra S, Roy C, and Mukherjee A, “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press, 2020.
3.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Cisco Press, 2017.

Reference(s):

1.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2021.
2.	Alexander Manu, “Digital Transformation and Industry 4.0: A Guide for Executives and Decision Makers”, 2022.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

<u>Assignment Activity</u>

Assignment 1- Explanatory questions in Industry 4.0 Essential, Evolution and cybersecurity.

Assignment 2 - Mini project on IIoT

Assignment 3 - Case studies on Application Domains.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Industry 4.0 Essentials**	
1.1	Sensing & Actuation	1
1.2	Industry 4.0: Globalization and Emerging Issues	1
1.3	Industry 4.0: Emerging Issues	1
1.4	The Fourth Revolution	1
1.5	LEAN Production Systems	1
1.6	LEAN Production Systems	1
1.7	Smart and Connected Business Perspective	1

1.8	Smart Factories	1
1.9	Smart Factories	1
2.0	**Industry 4.0 Evolution**	
2.1	Cyber Physical Systems	1
2.2	Next Generation Sensors	1
2.3	Collaborative Platform	1
2.4	Product Lifecycle Management	1
2.5	Product Lifecycle Management	1
2.6	Augmented Reality and Virtual Reality	1
2.7	Artificial Intelligence	1
2.8	Big Data	1
2.9	Advanced Analysis	1
3.0	**Cybersecurity**	
3.1	Cybersecurity in Industry 4.0 – Manufacturing	1
3.2	Cybersecurity in Industry 4.0 – Shipping and Cargo	1
3.3	Cybersecurity in Industry 4.0 – Medical	1
3.4	Industrial Processes	1
3.5	Industrial Sensing & Actuation	1
3.6	Industrial Internet Systems	1
3.7	Industrial Internet Systems	1
3.8	Business Model	1
3.9	Reference Architecture	
4.0	**IIoT Layers**	
4.1	IIoT Sensing	1
4.2	IIoT Processing	1
4.3	IIoT Communication	1
4.4	IIoT Networking	1
4.5	Big Data Analytics	1
4.6	Software Defined Networks	1
4.7	IIoT Analytics	1
4.8	Machine Learning	1
4.9	Data Science	1
5.0	**Application Domains**	
5.1	Oil Industries	1
5.2	Chemical industry	1
5.3	Pharmaceutical industry	1
5.4	Applications of UAVs in Industries	1
5.5	Milk Processing Industries	1
5.6	Packaging Industries	1
5.7	Manufacturing Industries	1
5.8	Smart Energy Management	1
5.9	Environmental Monitoring	1

Course Designer(s)

1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in

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60 EC E43	Remote Sensing	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To familiarize about the principles of remote sensing.
- To acquire knowledge on data acquisition and analysis of satellite data.
- To learn the application of various type of remote sensing and its satellite data.
- To study the different techniques for information extraction in remote sensing.
- To comprehensive understanding of image analysis techniques in remote sensing

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the electromagnetic remote sensing process	Understand
CO2	Select and list platforms used for data acquiring process	Understand
CO3	Discuss the various remote sensing systems, the data they produce, and their resolution characteristics.	Understand
CO4	Discuss satellite data acquisition and analysis.	Apply
CO5	Apply image analysis for Satellite data.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	30	40
Apply	-	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E43 – Remote Sensing								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Fundamentals of Remote Sensing: Processes, Radiation Principles, and Spectral Reflectance Remote Sensing Process - Radiation Principles - Spectral Reflectance Curve - EMR Interactions with Atmosphere - Earth Surface Features - Resolution Types.	[9]
Platforms Space Borne - Landsat Satellite Program - Thematic Mapper Spectral Bands - Landsat Image Interpretation - Spot Satellite Program - Spot Image Interpretation - IRS Satellite Program - IRS Image Interpretation - High Resolution Satellite System - Space Station Remote Sensing - Air borne.	[9]
Types Multi Spectral Scanning – Infrared - Thermal Remote Sensing - Thermal Scanning - Radiation Principles - Hyper Spectral Scanning - Microwave Sensing - Side Looking Radar Systems - Synthetic Aperture Radar- Radar Image Characteristics - Radar Image Interpretation - LIDAR Remote Sensing-Microwave Radiometers - Microwave Scanners.	[9]
Information Extraction Training Sets - Supervised, Unsupervised and Hybrid Classifiers - Baye's Theorem - Parametric Classification - Decision Tree – Non Parametric Classifiers - Sub-Pixel and Super-Pixel Classification – Hyper - Spectral Image Analysis - Accuracy Assessment.	[9]
Image Analysis Pattern Recognition - Boundary Detection and Representation - Textural and Contextual Analysis - Decision Concepts - Fuzzy sets - Evidential Reasoning - Expert System - Artificial Neural Network - Case Studies.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Thomas M. Lilles, Ralph W. Kiefer, Jonathan W.Chipman, "Remote Sensing and Image interpretation",7th Edition , John Wiley and Sons, Inc., New York, 2015.
2.	George Joseph, C Jeganathan, "Fundamentals of Remote Sensing", 3rd Edition, Universities Press (India) Private limited, Hyderabad, 2018.
Reference(s):	
1.	John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective" 4th Edition, Pearson , 2021.
2.	Robert Shcowebgerdt, "Remote sensing models & methods for image processing", 3rd Edition, Academic Press, 2007.
3.	John A.Richards, "Remote Sensing Digital Image Analysis" 6th Edition, Springer International Publisher, 2023.
4.	John A. Richard, XiupingJia, "Remote Sensing Digital Image Analysis: An Introduction" 5th Edition, Springer Verlag, 2012

*SDG 9– Industry, Innovation, and Infrastructure
**SDG 13 – Climate Action
***SDG 15 – Life on Land

<u>Assignment Activity :</u>

Assignment 1:
1. Seminar in Earth Surface Feature
2. Poster Presentation in Spectral Reflectance Curve

Assignment 2:
1. Prepare a case study on Remote sensing types and image analysis.
2. Simulation on Hyper and Multi Spectral Image Analysis and Accuracy Assessment.

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Assignment 3:
1. Simulation on Thematic Mapper Spectral Bands
2. Video presentation on Pattern Recognition

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Fundamentals of Remote Sensing: Processes, Radiation Principles, and Spectral Reflectance**	
1.1	Remote Sensing Process	2
1.2	Radiation Principles	1
1.3	Spectral Reflectance Curve	1
1.4	Application of Spectral Reflectance Curve	1
1.5	EMR Interactions with Atmosphere	1
1.6	Earth Surface Features	1
1.7	Resolution Types	1
1.8	Impact of Resolution on Data Quality	1
2.0	**Platforms**	
2.1	Space Borne	1
2.2	Landsat Satellite Program	1
2.3	Thematic Mapper Spectral Bands	1
2.4	Landsat Image Interpretation	1
2.5	Spot Satellite Program	1
2.6	Spot Image Interpretation	1
2.7	IRS Satellite Program	1
2.8	IRS Image Interpretation - High Resolution Satellite System	1
2.9	Space Station Remote Sensing - Air Borne	1
3.0	**Types**	
3.1	Multi Spectral Scanning	1
3.2	Infrared - Thermal Remote Sensing	1
3.3	Thermal Scanning - Radiation Principles	1
3.4	Hyper Spectral Scanning	1
3.5	Microwave Sensing	1
3.6	Side Looking Radar Systems - Synthetic Aperture Radar	1
3.7	Radar Image Characteristics - Radar Image Interpretation	1
3.8	LIDAR Remote Sensing	1
3.9	Microwave Radiometers - Microwave Scanners	1
4.0	**Information Extraction**	
4.1	Training sets - Supervised	1
4.2	Unsupervised and Hybrid classifiers	1
4.3	Baye’s Theorem	1
4.4	parametric Classification	1
4.5	Decision tree	1
4.6	Non parametric classifiers	1
4.7	sub-pixel and super-pixel classification	1
4.8	Hyper spectral image analysis	1
4.9	Accuracy assessment	1
5.0	**Image Analysis**	
5.1	Pattern Recognition	1
5.2	Boundary Detection and Representation	1
5.3	Textural Analysis	1
5.4	Contextual Analysis	1
5.5	Decision Concepts Fuzzy Sets	1
5.6	Evidential Reasoning	1

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5.7	Expert System	1
5.8	Artificial Neural Network	1
5.9	Case Studies	1

Course Designer(s)

1. Dr. K.B.Jayanthi -jayanthikb@ksrct.ac.in
2. Mrs.M.Devaki - devaki@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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60 EC E44	Advanced Wireless Communication Techniques	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the evolving paradigm of cooperative communication
- To understand concepts related to green wireless communication
- To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
- To expose the student to the energy saving techniques adopted in existing wireless components
- To provide understanding on protocols and networks related to green future wireless communication technologies

Pre-requisites

- Wireless Communication

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Recall the necessity and the design aspects of cooperative communication.	Understand
CO2	Illustrate the necessity and the design aspects of green wireless communication.	Understand
CO3	Summarize the new techniques in wireless communication.	Understand
CO4	Identify the feasibility of using mathematical models using simulation tools.	Apply
CO5	Explain the impact of the green engineering solutions in a global, economic, environmental and societal context.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	2	2	3	3	3	-	2	3	2	3
CO2	3	3	3	-	-	2	2	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	2	2	3	3	3	-	2	3	2	3
CO4	3	3	3	-	3	2	2	3	3	3	-	2	3	2	3
CO5	3	3	3	-	-	2	2	3	3	3	-		3	2	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	30	46
Apply	-	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

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<tr><td colspan="9">K.S.Rangasamy College of Technology – Autonomous R2022</td></tr>
<tr><td colspan="9">B.E - Electronics and Communication Engineering</td></tr>
<tr><td colspan="9">60 EC E44 - Advanced Wireless Communication Techniques</td></tr>
<tr><td rowspan="2">Semester</td><td colspan="3">Hours/Week</td><td rowspan="2">Total Hours</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>VII</td><td>3</td><td>0</td><td>0</td><td>45</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="8">Cooperative Communications and Green Concepts*
Network Architectures and Research Issues in Cooperative Cellular Wireless Networks - Cooperative Communications in OFDM and MIMO Cellular Relay Networks: Issues and Approaches-Fundamental Trade-Offs on The Design of Green Radio Networks - Green Modulation and Coding Schemes - Cooperative Techniques for Energy Efficiency.</td><td>[9]</td></tr>
<tr><td colspan="8">Cooperative Base Station Techniques*
Cooperative Base Station Techniques for Cellular Wireless Networks - Turbo Base Stations- Antenna Architectures for Cooperation - Cooperative Communications In 3gpp LTE-Advanced - Partial Information Relaying and Coordinated Multi-Point Transmission In LTE-Advanced.</td><td>[9]</td></tr>
<tr><td colspan="8">Relay-Based Cooperative Cellular Networks*
Distributed Space - Time Block Codes, Collaborative Relaying in Downlink Cellular Systems-Radio Resource Optimization - Adaptive Resource Allocation-Cross-Layer Scheduling Design - Network Coding in Relay-Based Networks.</td><td>[9]</td></tr>
<tr><td colspan="8">Green Radio Networks***
Base Station Power-Management Techniques - Opportunistic Spectrum and Load Management - Energy Saving Techniques in Cellular Wireless Base Stations – Power - Management for Base Stations in Smart Grid Environment - Green Communications in Cellular Networks with Fixed Relay Nodes.</td><td>[9]</td></tr>
<tr><td colspan="8">Access Techniques for Green Radio Networks*
Cross-Layer Design of Adaptive Packet Scheduling for Green Radio Networks – Energy - Efficient Relaying for Cooperative Cellular Wireless Networks - Energy Performance in TDD - CDMA Multi Hop Cellular Networks - Resource Allocation for Green Communication in Relay - Based Cellular Networks - Green Radio Test-Beds and Standardization Activities.</td><td>[9]</td></tr>
<tr><td colspan="8" align="right">Total Hours:</td><td>45</td></tr>
</table>

Text Book(s):

1.	Ekram Hossain, Dong in Kim, Vijay K. Bhargava, “Cooperative Cellular Wireless Networks”, Cambridge University Press, 2011.
2.	Ekram Hossain, Vijay K. Bhargava (Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012.

Reference(s):

1.	Richard Yu F, Yu, Zhang and Victor C. M. Leung, “Green Communications and Networking”, CRC press, 2012.
2.	Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers, 2010.
3.	insong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012.
4.	Venkataraman H, Gabriel-miro Muntean, “Green Mobile Devices and Networks: Energy Optimization and Scavenging Techniques”, CRC Press, 2012.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 3 – Good Health and Well Being
***SDG 7 – Affordable and Clean Energy

<u>Assignment Activity:</u>

Assignment 1:

1. Implementation of MIMO/OFDM system using MATLAB.
2. Poster Presentation- Fundamental Trade-Offs on The Design of Green Radio Networks.

Assignment 2:

1. Case Study-Energy Saving Techniques in Cellular Wireless Base Stations

Assignment 3:

1. Chart preparation of Network Coding in Relay-Based Networks.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Cooperative Communications and Green Concepts**	
1.1	Network Architectures	1
1.2	Research Issues in Cooperative Cellular Wireless Networks	1
1.3	Cooperative Communications in OFDM And MIMO Cellular Relay Networks	1
1.4	Issues And Approaches	1
1.5	Fundamental Trade-Offs on The Design of Green Radio Networks	1
1.6	Four Fundamental Trade-Offs	1
1.7	Green Modulation and Coding Schemes	1
1.8	Green Coding Schemes	1
1.9	Cooperative Techniques for Energy Efficiency	1
2.0	**Cooperative Base Station Techniques***	
2.1	Cooperative Base Station Techniques for Cellular Wireless Networks	1
2.2	System Model	1
2.3	Turbo Base Stations	1
2.4	Antenna Architectures for Cooperation	1
2.5	Antenna Architectures for Network	1
2.6	Cooperative Communications in 3GPP LTE-Advanced	1
2.7	Partial Information Relaying and Coordinated	1
2.8	Multi-Point Transmission in LTE-Advanced	1
2.9	Cooperative Multipoint Transmission	1
3.0	**Relay-Based Cooperative Cellular Networks**	
3.1	Distributed Space-Time Block Codes	1
3.2	Collaborative Relaying in Downlink Cellular Systems	1
3.3	Radio Resource Optimization	1
3.4	Adaptive Resource Allocation	1
3.5	Network Optimization	1
3.6	Cross-Layer Scheduling Design	1
3.7	Cross-Layer Scheduling with Two Channel States	1
3.8	Network Coding in Relay-Based Networks	1
3.9	Physical-Layer Network Coding	1
4.0	**Green Radio Networks**	
4.1	Base Station Power	1
4.2	Management Techniques	1
4.3	Opportunistic Spectrum and Load Management	1
4.4	Energy Saving Techniques in Cellular Wireless Base Stations	1
4.5	Energy-Consumption Reference Model	1
4.6	Power-Management for Base Stations in Smart Grid Environment	1
4.7	Power Management for Wireless Base Station	1
4.8	Green Communications in Cellular Networks	1
4.9	fixed relay nodes	1
5.0	**Access Techniques for Green Radio Networks**	
5.1	Cross-Layer Design	1
5.2	Adaptive Packet Scheduling for Green Radio Networks	1
5.3	Energy-Efficient Relaying for Cooperative Cellular Wireless Networks	1
5.4	Energy Consumption for Single-Hop and Multi-Hop Transmission	1
5.5	Energy Performance In TDD-CDMA Multihop Cellular Networks	1

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5.6	Resource Allocation for Green Communication in Relay-Based Cellular Networks	1
5.7	Design Of a Green Power Allocation Scheme	1
5.8	Green Radio Test-Beds	1
5.9	Green Radio Standardization Activities.	1

Course Designer(s)

1. Mr.D.Dhanasekaran - dhanasekarand@ksrct.ac.in

60 EC E45	Computer Vision: Algorithms and Applications	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To impart knowledge on image formation and processing
- To understand the computer and human vision systems
- To explore image processing techniques for computer vision applications
- To study the various concepts of deep learning for computer vision applications
- To learn object recognition methods and their applications

Pre-requisites

- Digital Image Processing

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Outline the various image interpolation techniques to enhance image quality during geometric transformations.	Understand
CO2	Apply the principles of computer and human vision systems.	Apply
CO3	Utilize the image processing techniques for computer vision.	Apply
CO4	Solve the various techniques and algorithms used in computer vision for a specific problem.	Apply
CO5	Apply object detection methods using the concept of computer vision.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	3	2	-
CO3	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	15	-	-	30	-
Understand	40	20	30	10	10	60	10
Apply	-	80	15	90	90	10	90
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E45 - Computer Vision: Algorithms and Applications								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Image Formation and Processing Digital Image, Monochrome and Color Images, Image Brightness and Contrast, 2D, 3D, and 4D Images, Geometric Transformations - Image Interpolation, Nearest - Neighbor Interpolation, Bilinear Interpolation.	[6]
Machine Vision Computer and Human Vision Systems, The Human Eye, Evolution of Computer Vision, Camera Models - Machine Vision Lighting - Machine Vision Software - Machine Vision Automation - Integration of Machine Vision Components.	[6]
Image Processing for Computer Vision Applications Image Filtering - Bilateral Filter, Comparison of Filter Techniques - Image Segmentation - Motion Analysis: Differential Motion Analysis, Optical Flow, Analysis Based on Interest Points, Detection of Specific Motion Patterns, Video Tracking and Motion Estimation.	[6]
Deep Learning for Computer Vision* Deep Learning and Neural Networks for Vision - Convolutional Neural Networks (CNN) - Transfer Learning and FineTuning Pre - Trained Models - Performance Evaluation Metrics for Computer Vision Tasks.	[6]
Emerging Trends in Machine Vision**: Computer Vision and Industry 4.0 Applications: Object Detection and Semantic Segmentation - Variety of Approaches (YOLO) - Human Pose Estimation, Face ID, Face Detection and Recognition - Vehicle Vision System.	[6]
Practical: 1. Simulate the given images to adjust the brightness, contrast and display images. 2. Simulate the simple thresholding method to segment objects from the image. 3. Simulate the nearest-neighbor interpolation for image resizing. 4. Measure the camera calibration. 5. Simulate a bilateral filter. 6. Simulate the feature detection and extraction. 7. Simulate the loading, saving, and displaying the video for multiobject tracking. 8. Simulate the loading of the pre-trained model. 9. Classify a given image dataset using the pre-trained model. 10. Simulate the YOLO v8 architecture. **Tools used: MATLAB / Open Source**	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	Sheila Anand and L.Priya , “A Guide for Machine Vision in Quality Control”, Taylor & Francis Inc,Imprint CRC Press Inc, 2019.
2.	Richard Szeliski, “Computer Vision: Algorithms and Applications”, 2nd Edition, Springer-Texts in Computer Science, 2022.

Reference(s):

1.	Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Limited, 2018.
2.	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, 2nd Edition, Cengage learning, 2013.
3.	Joe Minichino Joseph Howse, “Learning OpenCV 3 Computer Vision with Python”, 2nd Edition, Packt Publishing Ltd, , 2015.
4.	Forsyth D.A, Ponce J, “Computer Vision: A Modern Approach”, 2nd Edition, Pearson Education, 2015.

*SDG 9 - Sustainable industrialization and foster innovation

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Image Formation and Processing**	
1.1	Digital Image, Monochrome and Color Images	1

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1.2	Image Brightness and Contrast, 2D, 3D, and 4D Images	1
1.3	Geometric Transformations	1
1.4	Image Interpolation	1
1.5	Nearest-Neighbor Interpolation	1
1.6	Bilinear Interpolation.	1
2	**Machine Vision**	
2.1	Computer and Human Vision Systems	1
2.2	The Human Eye, Evolution of Computer Vision	1
2.3	Camera Models- Machine Vision Lighting	1
2.4	Machine Vision Software	1
2.5	Machine Vision Automation	1
2.6	Integration of Machine Vision Components	1
3	**Image Processing for Computer Vision Applications**	
3.1	Image Filtering-Bilateral Filter	1
3.2	Comparison of Filter Techniques, Image Segmentation	1
3.3	Motion Analysis: Differential Motion Analysis	1
3.4	Optical Flow, Analysis Based on Interest Points	1
3.5	Detection of Specific Motion Patterns	1
3.6	Video Tracking and Motion Estimation	1
4	**Deep Learning for Computer Vision**	
4.1	Deep Learning and Neural Networks for Vision	1
4.2	Convolutional Neural Networks (CNN)	1
4.3	CNN - Layers used to build ConvNets	1
4.4	Transfer Learning	1
4.5	Fine-Tuning Pre-Trained Models	1
4.6	Performance Evaluation Metrics for Computer Vision Tasks	1
5	**Emerging Trends in Machine Vision**	
5.1	Computer Vision and Industry 4.0, Applications: Object Detection	1
5.2	Semantic Segmentation, Variety of Approaches (YOLO)	1
5.3	Human Pose Estimation	1
5.4	Face ID, Face Detection	1
5.5	Face Recognition	1
5.6	Vehicle Vision System	1
Practical:		
1.	Simulate the given images to adjust the brightness, contrast and display images.	2
2.	Simulate the simple thresholding method to segment objects from the image.	2
3.	Simulate the nearest-neighbor interpolation for image resizing.	2
4.	Measure the camera calibration.	2
5.	Simulate a bilateral filter.	2
6.	Simulate the feature detection and extraction.	4
7.	Simulate the loading, saving, and displaying the video for multiobject tracking.	4
8.	Simulate the loading of the pre-trained model.	4
9.	Classify a given image dataset using the pre-trained model.	4
10.	Simulate the YOLO v8 architecture.	4

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Ms.R.Ramya - rramya@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
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60 EC E46	VLSI Testing	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the VLSI testing
- To learn the logic and fault simulation and testability measures
- To study the test generation techniques for combinational and sequential circuits
- To apply various design for testability
- To study the fault diagnosis

Pre-requisites

- VLSI and Chip Design

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe VLSI testing process	Understand
CO2	Explain logic simulation and fault simulation	Understand
CO3	Develop test vector for combinational and sequential circuits	Apply
CO4	Apply the various design for testability in testing	Apply
CO5	Perform fault diagnosis	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	-	-	-	-	-	3	2	-
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	10	20
Understand	40	30	40
Apply	-	20	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E46 - VLSI Testing								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Testing and Fault Modeling VLSI Testing Process and Test Equipment - Fault Modeling - Stuck-at-Fault - Fault Equivalence - Fault Collapsing - Fault Dominance.	[9]
Logic & Fault Simulation and Testability Measures Design Verification and Test Evaluation - Modeling Circuits for Simulation - Algorithms for True Value and Fault Simulation - SCOAP Controllability and Observability.	[9]
Test Generation for Combinational and Sequential Circuits Test Generation Algorithms - Boolean Difference - D-Algorithm – PODEM - Sequential ATPG Algorithms - Simulation Based ATPG - Genetic Algorithm Based ATPG.	[9]
Design for Testability* Testability Analysis - Scan Cell Designs - Boundary Scan Architecture - Built-In-Self-Test Architecture**-** Random Logic BIST - Test Algorithms for RAMs.	[9]
Fault Diagnosis Fault Models for Diagnosis - Generation of Vectors for Diagnosis - Combinational Logic Diagnosis - Scan Chain Diagnosis - Logic BIST Diagnosis.	[9]
Total Hours:	45

Text Book(s):	
1.	Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, “VLSI Test Principles and Architectures”, Elsevier, 2017.
2.	Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2017.
Reference(s):	
1.	Abramovici M, Breuer M A and Friedman A D, "Digital Systems and Testable Design", Jaico Publishing House, 2009.
2.	Lala P.K, “Digital Circuit Testing and Testability”, Academic Press, 2012.
3.	Crouch A.L, “Design-For-Test For Digital IC’s And Embedded Core System”, Pearson Education, 2012.
4.	Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2017.

*SDG 9 - Industry Innovation and Infrastructure

Assignment Activity:

Assignment 1:

1. Poster Presentation on Various Test Equipment
2. Simulation of Various Fault Modeling Using EDA Tool

Assignment 2:

1. Simulation of ATPG Using EDA Tool

Assignment 3:

1. Seminar Presentation on SCOAP Controllability and Observability
2. Prepare a Case Study on Test Algorithms for RAMs.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Testing and Fault Modeling**	
1.1	VLSI Development Process	1
1.2	Levels of Abstraction in VLSI Testing	1
1.3	Test Equipment- Automatic Test Equipment	1
1.4	Fault Modelling - Stuck-at-Faults	1
1.5	Transistor Faults, Open and Short Faults, Delay Faults and Crosstalk	1
1.6	Pattern Sensitivity and Coupling Faults, Analog Fault Models	1
1.7	Fault Equivalence	1
1.8	Fault Collapsing	1
1.9	Fault Dominance	1
2.0	**Logic & Fault Simulation and Testability Measures**	
2.1	Logic Simulation for Design Verification	1
2.2	Fault Simulation for Test and Diagnosis	1
2.3	Test Evaluation	1
2.4	Simulation Models	1
2.5	Algorithms for True Value Simulation- Compiled-Code and Event Driven Simulation	1
2.6	Serial Fault Simulation	1
2.7	Parallel Fault Simulation	1
2.8	SCOAP Controllability	1
2.9	Observability	1
3.0	**Test Generation for Combinational and Sequential Circuits**	
3.1	Test Generation Algorithms - Random Test Generation	1
3.2	Boolean Difference	1
3.3	D-Algorithm	1
3.4	Pseudocode for D-Algorithm	1
3.5	PODEM	1
3.6	Sequential ATPG Algorithms – Time Frame Expansion	1
3.7	Gated Clocks and Multiple Clocks	1
3.8	Simulation Based ATPG	1
3.9	Genetic Algorithm Based ATPG	1
4.0	**Design for Testability**	
4.1	SCOAP Testability Analysis	1
4.2	Probability and Simulation-Based Testability Analysis	1
4.3	Scan Cell Designs - Muxed-D Scan Cell	1
4.4	Clocked-Scan Cell and LSSD Scan Cell	1
4.5	Boundary Scan-Architecture, TAP and Bus Protocols	1
4.6	Tap Controller, Instruction Register & Set, On-Chip Test Support	1
4.7	Logic BIST Architecture	1
4.8	Random Logic BIST	1
4.9	Test Algorithms for RAMs – Functional Fault Models and Test Algorithms	1
5.0	**Fault Diagnosis**	
5.1	Fault Models for Diagnosis	1
5.2	Generation of Vectors for Diagnosis	1
5.3	Combinational Logic Diagnosis - Cause-Effect Analysis	1
5.4	Effect - Cause Analysis, Chip-Level Strategy	1
5.5	Preliminaries for Scan Chain Diagnosis, Hardware-Assisted Method	1

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5.6	Modified Inject-and-Evaluate Paradigm, Signal-Profiling-Based Method	1
5.7	Logic BIST Diagnosis	1
5.8	Interval-Based Methods	1
5.9	Masking-Based Methods	1

Course Designer(s)

1. Saravanan S – saravanan.s@ksrct.ac.in

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60 EC E47	Positioning and Navigation Systems	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To explain the fundamentals of navigation systems.
- To understand the inertial navigation systems.
- To acquire knowledge on radio navigation.
- To have an overview of global positioning systems
- To learn the hybrid navigation systems.

Pre-requisites

- Digital Communication

Course Outcomes

On the Successful Completion of the Course, Students will be able to

CO1	Discuss the advanced concepts of positioning and navigation systems and exposure on various navigation systems	Remember
CO2	Illustrate about gyroscopes and accelerometers and inertial navigation systems and its types and mechanisation	Apply
CO3	Explain the different radio navigation aids and its usage for civil and military aircrafts and satellites	Understand
CO4	Interpret the satellite navigation – GPS and its usage in aircraft and spacecraft applications	Apply
CO5	Deploy these skills effectively in the analysis and understanding of hybrid navigation systems and relative navigation in a spacecraft.	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	2	2	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	20	20	32
Apply	20	20	34
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022

B.E – Electronics and Communication Engineering

60 EC E47– Positioning and Navigation Systems

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Navigation Concepts Fundamentals of Navigation Systems and Position Fixing - Categories of Navigation - Geometric Concepts of Navigation - The Earth in Inertial Space - Different Coordinate Systems - Coordinate Transformation - Euler Angle Formulations - Direction Cosine Matrices Formulation - Quaternion Formulation.	[9]
Inertial Navigation Systems Inertial Sensors - Gyroscopes -Types - Mechanical – Electromechanical - Optical Gyro - Ring Laser Gyro - Fiber Optic Gyro - Accelerometers - Pendulous Type - Force Balance Type - MEMs - Basic Principles of Inertial Navigation - Types - Platform and Strap Down - Mechanization INS System - Rate Corrections - Acceleration Errors - Schuler Tuning.	[9]
Radio Navigation & Air Traffic Management Different Types of Radio Navigation - ADF, VOR, DME, TACAN, VORTAC - Doppler - Hyperbolic Navigations - Air Traffic Management - RADAR Surveillance - Airborne Collision Avoidance Systems.	[9]
Global Positioning System * Overview of GPS: Basic Concept, System Architecture, GPS Signals Signal Structure, Anti-Spoofing (AS), Selective Availability - GPS for Position and Velocity Determination - GPS Aided Geo - Augmented Navigation (GAGAN) Architecture - GPS Error Sources - Clock Error, Ionospheric Error, Tropospheric Error - Multipath, Ionospheric Error Estimation using Dual Frequency GPS Receiver.	[9]
Hybrid Navigation & Relative Navigation Systems ** Hybrid Navigation - Introduction to Kalman Filtering - Case Studies - Integration of GPS and INS using Kalman Filter - Relative Navigation - Fundamentals - Equations of Relative Motion for Circular Orbits Clohessy Wiltshire Equations - Sensors for Rendezvous Navigation - Relative Positioning - Point Positioning and Differential Positioning - Differential GPS and Space Based Augmentation System - Concepts - Relative GPS - Formation Flying - Figure of Merit.	[9]
Total Hours:	45

Text Book(s):

1.	Paul. D. Groves, "Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems", Artech House, 2013.
2.	Myron Kyton, Walfred Fried, "Avionics Navigation Systems", 2nd Edition, John Wiley & Sons, 1997.

Reference(s):

1.	Nagaraja, "Elements of Electronic Navigation", 2nd Edition, Tata McGraw Hill, 2000.
2.	Maxwell Noton, "Spacecraft Navigation and Guidance", Springer (London, New York), 1998.
3.	Albert Helfrick, "Practical Aircraft Electronic Systems", Prentice Hall Education, Career & Technology, 1995.
4.	Albert D. Helfrick, "Modern Aviation Electronics", 2nd Edition, Prentice Hall Career & Technology, 1994.

*SDG 9 – Industry, Innovation and Infrastructure
**SDG 13 – Climate Action

Assignment Activity:

Assignment 1:

1. Poster Presentation - Different Coordinate Systems, Mechanization INS System
2. Group Problem Solving - Direction Cosine Matrices Formulation, Schuler Tuning

Assignment 2:

1. Poster Presentation - RADAR Surveillance,
2. Group Problem Solving - GPS for Position and Velocity Determination, - GPS Aided Geo - Augmented Navigation (GAGAN) Architecture

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Assignment 3:

1. Case Studies **-** Integration of GPS and INS using Kalman Filter
2. Poster Presentation - Sensors for Rendezvous Navigation, Relative GPS

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Navigation Concepts**	
1.1	Fundamentals of Navigation Systems and Position Fixing	1
1.2	Categories of Navigation	1
1.3	Geometric Concepts of Navigation	1
1.4	The Earth in Inertial Space	1
1.5	Different Coordinate Systems	1
1.6	Coordinate Transformation	1
1.7	Euler Angle Formulations	1
1.8	Direction Cosine Matrices Formulation	1
1.9	Quaternion Formulation	1
2.0	**Inertial Navigation Systems**	
2.1	Inertial Sensors	1
2.2	Gyroscopes, Types, Mechanical	1
2.3	Electromechanical	1
2.4	Optical Gyro, Ring Laser Gyro	1
2.5	Fiber Optic Gyro	1
2.6	Accelerometers, Pendulous Type	1
2.7	Force Balance Type, MEMs	1
2.8	Basic Principles of Inertial Navigation Types, Platform and Strap Down, Mechanization INS System	1
2.9	Rate Corrections, Acceleration Errors, Schuler Tuning.	1
3.0	**Radio Navigation & Air Traffic Management**	
3.1	Different Types of Radio Navigation- ADF	1
3.2	VOR	1
3.3	DME	1
3.4	TACAN	1
3.5	VORTAC	1
3.6	Doppler - Hyperbolic Navigations	1
3.7	Air Traffic Management	1
3.8	RADAR Surveillance	1
3.9	Airborne Collision Avoidance Systems	1
4.0	**Global Positioning System**	
4.1	Overview of GPS: Basic Concept, System Architecture	1
4.2	GPS Signals Signal Structure	1
4.3	Anti-Spoofing (AS), Selective Availability	1
4.4	GPS for Position and Velocity Determination	1
4.5	GPS Aided Geo	1
4.6	Augmented Navigation (GAGAN) Architecture	1
4.7	GPS Error Sources	1
4.8	Clock Error, Ionospheric Error, Tropospheric Error	1
4.9	Multipath, Ionospheric Error Estimation using Dual Frequency GPS Receiver	1
5.0	**Hybrid Navigation & Relative Navigation Systems**	
5.1	Introduction to Kalman Filtering, Case Studies	1
5.2	Integration of GPS and INS using Kalman Filter	1
5.3	Relative Navigation, Fundamentals,	1
5.4	Equations of Relative Motion for Circular Orbits Clohessy Wiltshire Equations	1
5.5	Sensors for Rendezvous Navigation, Relative Positioning	1
5.6	Point Positioning and Differential Positioning	1
5.7	Differential GPS and Space Based Augmentation System	1

5.8	Concepts, Relative GPS	1
5.9	Formation Flying, Figure of Merit.	1

Course Designer(s)

1. Mr P Balamurugan - pbalamurugan@ksrct.ac.in

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60 EC E51	Wireless Body Area Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the basics of body area network
- To learn the hardware requirement of BAN
- To learn the various network architecture
- To understand the communication and security aspects in the BAN
- To learn the applications of BAN in the field of medicine

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Summarize the significance and role of BAN in the present contemporary world.	Understand
CO2	Discuss the hardware requirements for BAN and their applications in medicine.	Understand
CO3	Assess the efficiency of communication and the security parameters.	Understand
CO4	Describe the need for medical device regulation and regulations followed in various regions	Understand
CO5	Discuss the concepts of BAN for medical applications.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	2	-	3	3	3	-	3	3	2	3
CO2	3	3	3	-	-	2	-	3	3	3	-	3	3	2	3
CO3	3	3	3	-	-	2	-	3	3	3	-	3	3	2	3
CO4	3	3	3	-	-	2	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	-	2	-	3	3	3	-	-	3	2	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	30
Understand	40	40	70
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E51 - Wireless Body Area Networks								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

BAN BAN and Healthcare - Pervasive Patient Monitoring using BAN - Technical Challenges-Sensor Design, Biocompatibility, Energy Supply, System Security and Reliability, Context Awareness, Integrated Therapeutic Systems - Ideal BSN Architecture.	[9]
Hardware for BAN* Wireless Communication - RF Communication in Body, Antenna Design and Testing, Matching Network, Propagation, Materials, Base Station, Power Considerations, Wireless Communications for Wearable Systems, Body Area Network – Human Applications.	[9]
Network Topologies, Protocols and Standards Network Topologies - Stand – Alone BAN - Wireless Personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee - Healthcare System Standards.	[9]
Coexistence Issues with BAN Analysis of Interferers – Intrinsic, Extrinsic - Effect on transmission - Regulatory Issues - Medical Device Regulation in Asia, Security and Self-Protection - Bacterial Attacks, Virus Infection, Secured Protocols, Self-Protection.	[9]
Applications of BAN** Monitoring Patients with Chronic Disease, Hospital Patients, and Elderly Patients - Cardiac Arrhymias Monitoring - Multi Patient Monitoring Systems - Multichannel Neural Recording-Gait Analysis - Smart Garments Electronic Pill.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013.
2.	Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pvt. Ltd., Singapore, 2012.
Reference(s):	
1.	Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2.	Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3.	Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
4.	Huan-Bang Li, Kamya Yekeh Yazdandoost, Bin Zhen, “Wireless Body Area Networks”, River Publishers Series in Computing and Information Science and Technology, 2010.

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 3 – Good Health and Well Being**

Assignment activity:

Assignment 1:
1. Poster presentation on BSN Architecture for various applications.
2. Case study on Antenna Design and testing.

Assignment 2:
1. Case study on various protocol standards for BAN.

Assignment 3:
1. Case study on Body Area Network – Human Applications.
2. Poster presentation on Security for BAN

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**BAN**	
1.1	Definition, BAN and Healthcare	1
1.2	Pervasive Patient Monitoring using BAN	1
1.3	Technical Challenges-Sensor design	1
1.4	Biocompatibility	1
1.5	Energy Supply	1
1.6	System Security and Reliability	1
1.7	Context Awareness	1
1.8	Integrated Therapeutic Systems	1
1.9	Ideal BSN Architecture	1
2.0	**Hardware for BAN**	
2.1	Wireless Communication - RF Communication in Body	1
2.2	Antenna Design	1
2.3	Antenna Testing	1
2.4	Matching Network	1
2.5	Propagation	1
2.6	Materials, Base Station	1
2.7	Power Considerations	1
2.8	Wireless Communications for Wearable Systems	1
2.9	Body Area Network – Human Applications	1
3.0	**Network Topologies, Protocols and Standards**	
3.1	Network Topologies	1
3.2	Stand – Alone BAN	1
3.3	Wireless Personal Area Network Technologies - Star	1
3.4	Mesh and Hybrid topology	1
3.5	Standards - IEEE 802.15.1	1
3.6	IEEE P802.15.13	1
3.7	IEEE 802.15.14	1
3.8	Zigbee	1
3.9	Healthcare System Standards	1
4.0	**Coexistence Issues with BAN**	
4.1	Analysis of Interferers – Intrinsic, Extrinsic	1
4.2	Effect on Transmission	1
4.3	Regulatory Issues - Medical Device Regulation in Asia	1
4.4	Security	1
4.5	Self-Protection	1
4.6	Bacterial attacks	1
4.7	Virus Infection	1
4.8	Secured Protocols	1
4.9	Self-Protection	1
5.0	**Applications of BAN**	
5.1	Monitoring Patients with Chronic Disease	1
5.2	Hospital Patients	1
5.3	Elderly Patients	1
5.4	Cardiac Arrhymias Monitoring	1
5.5	Multi Patient Monitoring Systems	1

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5.6	Multichannel Neural Recording	1
5.7	Gait Analysis	1
5.8	Smart Garments	1
5.9	Electronic Pill	1

Course Designer(s)

1. Mr. A. Balachandran - abalachandran@ksrct.ac.in

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60 EC E52	Micro Electro Mechanical Systems	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To introduce and provide a broad view of MEMS and micro systems
- To familiarize with the fundamentals of MEMS products, materials for microsystems
- To learn the microsystem fabrication process
- To know the various MEMS-specific design issues and constraints
- To familiarize with the application of MEMS sensors

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Describe the basic principles of MEMS sensors and actuators.	Understand
CO2	Explain the various materials used for MEMS products.	Understand
CO3	Explain the fabrication process of MEMS devices.	Understand
CO4	Illustrate the design consideration, issues and constraints of basic MEMS sensors and actuators.	Understand
CO5	Extend the concepts of MEMS sensors in the diverse applications.	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	-	-	-	3	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	30	30	40
Understand	30	30	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E. Electronics and Communication Engineering								
60 EC E52 - Micro Electro Mechanical Systems								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

MEMS Scaling law – MEMS and Micro System Products – Microsystems and Microelectronics – Working Principle of Microsystems – Micro Actuation Techniques.	[9]
Materials for Microsystems Substrate and Wafer – Single Crystal Silicon Wafer Formation – Ideal Substrates – Mechanical Properties – Silicon Compounds – $Si0_2$, SiC, Si_3N_4 and Polycrystalline Silicon – Silicon Piezo Resistors – Gallium Arsenide – Quartz – Piezoelectric Crystals – Polymers.	[9]
Micro System Fabrication Process Photolithography – Doping Process – Ion Implantation – Diffusion – Oxidation – CVD – Physical Vapor Deposition – Deposition by Epitaxy – Etching Process – Wet and Dry Etching – Bulk Micromachining – Surface Micromachining.	[9]
Micro System Design* Design Considerations – Process Design – Mask Layout Design – Design Constraints – Selection of Materials – Manufacturing Process – Signal Transduction – Packaging Fundamentals – Packaging Techniques – Application of Micro System in Automotive Industry – Biomedical – Telecommunication – Carbon Nano Tubes.	[9]
Micro Sensors Micro Sensors – Biomedical Sensors – Piezoresistive Sensors – Pressure Sensors – Thermal Sensors – Chemical Sensors – Optical Sensors – Micro Actuation – MEMS with Actuators.	[9]
Total Hours:	**45**

Text Book(s):

1.	Tai-Ran Hus, “MEMS & Microsystems Design, Manufacture and Nano scale engineering”, 2nd Edition, John Wiley & Sons, 2020.
2.	Julian W.Gardner, Vijay K.Varadan, Osama O.Awadel Karim, “Micro sensors MEMS and Smart Devices”, John Wiley & Sons, 2013.

Reference(s):

1.	Chang Liu, “Foundations of MEMS”, 2nd Edition, Pearson Education Inc., 2012.
2.	Stephen D Senturia, “Microsystem Design”’, Springer Publication, 2000.
3.	James J.Allen, “Micro Electro Mechanical System Design”, CRC Press Publisher, 2005.
4.	Thomas M.Adams and Richard A.Layton, “Introductory MEMS: Fabrication and Application”, Springer, 2010.

*SDG 9 – Industry Innovation and Infrastructure

<u>Assignment Activity</u>

Assignment 1 - Covers Module 1 & 2
1. Questions on MEMS and Microsystems
2. Seminar /poster presentation

Assignment 2 - Covers Module 3, 4
1. Explanatory questions on design and fabrication Process

Assignment 3 - Covers Module 5
1. Seminar /poster presentation

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**MEMS**	
1.1	Scaling Law	1
1.2	MEMS	1
1.3	MEMS Products	1
1.4	Micro System Products	1
1.5	Microsystems	1
1.6	Microelectronics	1
1.7	Working Principle of Microsystems	1
1.8	Micro Actuation	1
1.9	Micro Actuation Techniques	1
2.0	**Materials for Microsystems**	
2.1	Substrate and Wafer	1
2.2	Single Crystal Silicon Wafer Formation	1
2.3	Ideal Substrates	1
2.4	Mechanical Properties	1
2.5	Silicon Compounds	1
2.6	$Si0_2$, SiC, Si_3N_4 and Polycrystalline Silicon	1
2.7	Silicon Piezo Resistors – Gallium Arsenide	1
2.8	Quartz – Piezoelectric Crystals	1
2.9	Polymers	1
3.0	**Micro System Fabrication Process**	
3.1	Photolithography	1
3.2	Doping Process-Ion Implantation	1
3.3	Diffusion	1
3.4	Oxidation	1
3.5	CVD – Physical Vapor Deposition	1
3.6	Deposition by Epitaxy	1
3.7	Etching Process-Wet & Dry Etching	1
3.8	Bulk Micromachining	1
3.9	Surface Micromachining	1
4.0	**Micro System Design**	
4.1	Design Considerations- Process Design	1
4.2	Mask Layout Design – Design Constraints	1
4.3	Selection of Materials	1
4.4	Manufacturing Process - Signal Transduction	1
4.5	Packaging Fundamentals – Packaging Techniques	1
4.6	Application of Micro System In Automotive Industry	1
4.7	Biomedical – Aerospace	1
4.8	Telecommunication	1
4.9	Carbon Nano Tubes.	1
5.0	**Micro Sensors**	
5.1	Micro Sensors	1
5.2	Biomedical Sensors	1
5.3	Piezoresistive Sensors	1
5.4	Pressure Sensors	1
5.5	Thermal Sensors	1

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5.6	Chemical Sensors	1
5.7	Optical Sensors	1
5.8	Micro Actuation	1
5.9	MEMS with Actuators	1

Course Designer(s)

1. Dr.T.Baranidharan - baranidharan@ksrct.ac.in

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60 EC E53	Rocketry and Space Mechanics	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To study the basic functions of rocket system
- To learn the basic concepts of aerodynamics of rockets and missiles
- To learn about the basic motion in space and gravitational field
- To study the concept of staging and control methods of rockets
- To learn about the space dynamics

Pre-requisite

- Satellite Communication

Course Outcomes

On the Successful Completion of the Course, Students will be able to

CO1	Recognize the basic functions of rocket system	Understand
CO2	Build the methods of aerodynamic forces and moments	Apply
CO3	Develop the motions and forces in free space and gravitational field	Apply
CO4	Summarize the rocket control and methods of staging of rockets	Understand
CO5	Discuss the solar systems in space dynamics	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	2	-	3	3	3	-	2	3	2	3
CO2	3	3	3	-	3	2	-	3	3	3	-	2	3	2	3
CO3	3	3	3	-	3	2	-	3	3	3	-	2	3	2	3
CO4	3	3	3	-	3	2	-	3	3	3	-	2	3	2	3
CO5	3	3`	3	-	3	2	-	3	3	3	-	2	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	20	20	32
Apply	20	20	34
Analyse		-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E53 – Rocketry and Space Mechanics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Rockets System Ignition System in Rockets - Types of Igniters - Igniter Design Considerations - Design Consideration of Liquid Rocket Combustion Chamber - Injector Propellant Feed Lines, Valves - Propellant Tanks Outlet and Helium Pressurized - Turbine Feed Systems - Propellant Slosh and Propellant Hammer - Elimination of Geysering Effect in Missiles - Combustion System of Solid Rockets.	[9]
Aerodynamics of Rockets and Missiles Airframe Components of Rockets and Missiles - Classification of Rockets and Missiles - Methods of Describing Aerodynamic Forces and Moments - Lateral Aerodynamic Moment - Lateral Damping Moment and Longitudinal Moment of a Rocket - Lift and Drag Forces - Drag Estimation - Rocket Dispersion - Numerical Problems.	[9]
Motion in Space and Gravitational Field One Dimensional and Two Dimensional Rocket Motions in Free Space and Homogeneous Gravitational Fields - Forces Acting on a Rocket while Passing Through Atmosphere - Description of vertical, inclined and gravity turn trajectories - Approximations to burnout velocity.	[9]
Staging and Control Rocket Vector Control - Methods - Thrust Determination - SITVC - Multi Staging of Rockets - Vehicle Optimization - Stage Separation Dynamics - Separation Techniques - Selection of Materials	[9]
Space Dynamics The Solar System - References Frames and Coordinate Systems - The Celestial Sphere - The Ecliptic - Motion of Vernal Equinox - Sidereal Time - Solar Time - Standard Time - The Earth's Atmosphere - Two Body Problem - Libration Points - R Satellite Orbits - Relations between Position and Time - Orbital Elements - Time and Keplerian Orbits, Keplerian Orbits in Space, Perturbed Orbits.	[9]
Total Hours:	**45**

Text Book(s):

1.	Stephen Corda, "Introduction to Aerospace Engineering with a Flight Test Perspective",1st Edition, Wiley, 2017.
2.	Wakker K.F, "Rocket Propulsion and Spaceflight Dynamics, Pitman Publication", United Kingdom, 2016.

References:

1.	Martin J.L. Turner, "Rocket and Spacecraft Propulsion: Principles, Practice and New Developments", 3rd Edition, Springer Publication, 2009.
2.	Sutton G.P, "Rocket Propulsion Elements", Wiley, New York, 2006.
3.	Marcel J. Sidi, "Spacecraft Dynamics and Control: An Introduction ", Cambridge University Press, 2002.
4.	Brown C.D, "Spacecraft Propulsion", AIAA Education Series, AIAA Inc., Washington DC, 1996.

Assignment Activity:

Assignment 1:

1. Poster Presentation: Types of Igniters, Classification of Rockets and Missiles
2. Group Problem Solving: Lateral Damping Moment and Longitudinal Moment of a Rocket, Numerical Problems
3. Case Studies: Latest Rockets and Missiles

Assignment 2:

1. Poster Presentation: Multi Staging of Rockets
2. Group Problem Solving: Forces Acting on a Rocket while Passing Through Atmosphere

Assignment 3:

1. Seminar Presentation: Stage Separation Dynamics
2. Case Studies: Rocket Vector Control

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Rockets System**	
1.1	Ignition System in Rockets – Types of Igniters	1
1.2	Igniter Design Considerations	1
1.3	Design Consideration of Liquid Rocket Combustion Chamber	1
1.4	Injector Propellant Feed Lines, Valves	1
1.5	Propellant Tanks Outlet and Helium Pressurized	1
1.6	Turbine Feed Systems	1
1.7	Propellant Slosh and Propellant Hammer	1
1.8	Elimination of Geysering Effect in Missiles	1
1.9	Combustion System of Solid Rockets	1
2.0	**Aerodynamics of Rockets and Missiles**	
2.1	Airframe Components of Rockets and Missiles	1
2.2	Classification of Rockets and Missiles	1
2.3	Methods of Describing Aerodynamic Forces and Moments	1
2.4	Lateral Aerodynamic Moment	1
2.5	Lateral Damping Moment	1
2.6	Longitudinal Moment of a Rocket	1
2.7	Lift and Drag Forces	1
2.8	Drag Estimation	1
2.9	Rocket Dispersion, Numerical Problems	1
3.0	**Motion in Space and Gravitational Field**	
3.1	One Dimensional and Two Dimensional Rocket Motions in Free Space	2
3.2	One Dimensional and Two Dimensional Rocket Motions in Homogeneous Gravitational Fields	2
3.3	Forces Acting on a Rocket while Passing Through Atmosphere	1
3.4	Description of Vertical	1
3.5	Inclined Trajectories	1
3.6	Description of Gravity Turn Trajectories	1
3.7	Approximations to Burnout Velocity.	1
4.0	**Staging and Control**	
4.1	Rocket Vector Control	1
4.2	Rocket Control Methods	1
4.3	Thrust Determination	1
4.4	SITVC	1
4.5	Multi Staging of Rockets	1
4.6	Vehicle Optimization	1
4.7	Stage Separation Dynamics	1
4.8	Separation Techniques	1
4.9	Selection of Materials	1
5.0	**Space Dynamics**	
5.1	The Solar System, References Frames and Coordinate Systems	1
5.2	The Celestial Sphere, The Ecliptic	1
5.3	Motion of Vernal Equinox, Sidereal Time	1
5.4	Solar Time, Standard Time	1
5.5	The Earth's Atmosphere. Two Body Problem	1

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5.6	Libration Points, R Satellite Orbits	1
5.7	Relations Between Position and Time , Orbital Elements	1
5.8	Time and Keplerian Orbits	1
5.9	Keplerian Orbits in Space, Perturbed Orbits	1

Course Designer(s)

1. Dr P Babu-pbabu@ksrct.ac.in
   Mr P Balamurugan - pbalamurugan@ksrct.ac.in

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60 EC E54	Software Defined Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane to comprehend the migration of networking functions to SDN environment
- To study SDN applications
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

Pre-requisites

- Mobile Communication and Networks

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Explain the basics of SDN and its data plane	Understand
CO2	Describe the functions of control plane	Understand
CO3	Apply the concepts of SDN in applications	Apply
CO4	Explain the operations of network function virtualization	Understand
CO5	Apply various use cases of SDN	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	25	25	40
Understand	35	25	50
Apply	-	10	10
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

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B.E - Electronics and Communication Engineering								
60 EC E54 - Software Defined Networks								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

SDN Data Plane** Evolving Network Requirements – The SDN Approach - SDN Architecture – SDN and NFV - Related Standards – SDN Data Plane – OpenFlow Logical Network Device – OpenFlow Protocol.	[9]
SDN Control Plane** SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – OpenDaylight – REST – Cooperation and Coordination among Controllers.	[9]
SDN applications** SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- Mobility and Wireless – Information-Centric Networking.	[9]
Network Function Virtualization** Network Slicing-NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases – SDN and NFV.	[9]
Network Virtualization **C-RAN*, V-RAN***, Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – OpenDaylight's Virtual Tenant Network – CoSoftware - Defined Infrastructure.	[9]
Total Hours:	**45**

Text Book(s):	
1.	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", 1st Edition, Pearson Education, 2015.
2.	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", 1st Edition, O'Reilly Media, 2013.
Reference(s):	
1.	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
2.	Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016
3.	Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.
4.	Nunes, Bruno AA, et al. "A survey of Software-Defined Networking: Past, Present, and Future of Programmable Networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.

*SDG 9 – Industry Innovation and Infrastructure
**SDG 4 – Quality Education

Assignment Activity:

Assignment 1 - Case Study, Poster Presentation on SDN Data Plane

Assignment 2 - Group Discussion on SDN Control Plane

Assignment 3 - Simulation on SDN Control Plane

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**SDN Data plane**	
1.1	Evolving Network Requirements	1
1.2	The SDN Approach	1
1.3	SDN Architecture	1
1.4	SDN Architecture	1
1.5	SDN -Related Standards	1
1.6	NFV-Related Standards	1
1.7	SDN Data Plane	1
1.8	OpenFlow Logical Network Device	1
1.9	OpenFlow Protocol	1
2.0	**SDN control plane**	
2.1	SDN Control Plane Architecture	1
2.2	SDN Control Plane Architecture	1
2.3	Southbound Interface	1
2.4	Northbound Interface	1
2.5	Control Plane Functions	1
2.6	ITU-T Model	1
2.7	OpenDaylight	1
2.8	REST	1
2.9	Cooperation and Coordination Among Controllers	1
3.0	**SDN applications**	
3.1	SDN Application Plane Architecture	1
3.2	SDN Application Plane Architecture	1
3.3	Network Services Abstraction Layer	1
3.4	Traffic Engineering	1
3.5	Measurement and Monitoring	1
3.6	Security	1
3.7	Data Center Networking	1
3.8	Mobility and Wireless	1
3.9	Information-Centric Networking	1
4.0	**Network Function Virtualization**	
4.1	Network Slicing	1
4.2	NFV Concepts – Benefits	1
4.3	NFV Concepts – Requirements	1
4.4	Reference Architecture	1
4.5	NFV Infrastructure	1
4.6	Virtualized Network Functions	1
4.7	NFV Management	1
4.8	NFV Orchestration	1
4.9	NFV Use Cases – SDN and NFV	1
5.0	**Network Virtualization**	
5.1	C-RAN	1
5.2	V-RAN	1
5.3	Virtual LANs	1
5.4	OpenFlow VLAN Support	1
5.5	Virtual Private Networks	1

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5.6	Network Virtualization	1
5.7	OpenDaylight's Virtual Tenant Network	1
5.8	CoSoftware-Defined Infrastructure	1
5.9	CoSoftware-Defined Infrastructure	1

Course Designer(s)

1. Mr.R.Satheesh kumar - satheeshkumar@ksrct.ac.in

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60 EC E55	Deep Learning	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To experiment the Convolutional Networks
- To utilize the Autoencoders
- To model the Deep Generative Models
- To model the Generative Adversarial Networks (GANs)
- To experiment with the Transformers architectures

Pre-requisites

- Machine Learning Techniques

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Apply the Convolutional Networks in computer vision applications	Apply
CO2	Construct the different types of Autoencoders	Apply
CO3	Build the different boltzmann machines of the Deep Generative Models	Apply
CO4	Develop the different Generative Adversarial Networks (GANs) to increase the efficiency	Apply
CO5	Make use of various transformer architectures for text based applications	Apply

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	3	-	-	3	3	3	-	2	3	2	3
CO2	3	3	3	-	3	-	-	3	3	3	-	2	3	2	3
CO3	3	3	3	-	3	-	-	3	3	3	-	2	3	2	3
CO4	3	3	3	-	3	-	-	3	3	3	-	2	3	2	3
CO5	3	3	3	-	3	-	-	3	3	3	-	2	3	2	3
3 - Strong; 2 - Medium; 1 - Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	20	-	-	34	-
Understand	20	20	20	20	20	33	20
Apply	20	80	20	80	80	33	80
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.E – Electronics and Communication Engineering								
60 EC E55 – Deep Learning								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	2	0	2	60	3	50	50	100

Convolutional Networks* The Convolution Operation - Motivation, Pooling - Convolution and Pooling as an Infinitely Strong Prior - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features - Applications of DL in Computer Vision.	[6]
Autoencoders* Undercomplete Autoencoders - Stochastic Encoders and Decoders - Denoising Autoencoders - Learning Manifolds with Autoencoders - Contractive Autoencoders - Applications of Autoencoders	[6]
Deep Generative Models* Boltzmann Machines - Restricted Boltzmann Machines - Deep Belief Networks - Deep Boltzmann Machines - Boltzmann Machines for Real - Valued Data - Boltzmann Machines for Structured or Sequential Outputs - Directed Generative Nets	[6]
Generative Adversarial Networks (GANs) * Vanilla GAN - CycleGAN - StyleGAN - pixelRNN - DiscoGAN - lsGAN - EfficientNet-Compound Scaling - Focus on Efficiency - EfficientNet with Transformers - Pruning and Quantization Techniques	[6]
Transformers* Bidirectional Encoder Representations from Transformers (BERT - Generative Pre-trained Transformer 3 (GPT-3) - Text-to-Text Transfer Transformer (T5) - Generalized Autoregressive Pretraining for Language Understanding (XLNet)	[6]
Practical: 1. Implement a basic ResNet architecture and compare its training behavior to a plain CNN. 2. Explore the use of dropout layers in CNN architectures to prevent overfitting. Experiment with different dropout rates at various locations in the network and observe their impact on training. 3. Demonstrate an undercomplete autoencoder to compress images for storage or transmission with minimal loss of quality compared to standard compression techniques (e.g., JPEG) 4. Perform an autoencoder with and without stochastic encoders/decoders on noisy data. How does noise injection during training affect the model's ability to reconstruct clean data and generalize to unseen noisy examples? 5. Implement a binary RBM in Python using libraries like TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the learned hidden units. 6. Implement a DBN using stacked RBMs. Train each RBM layer-wise and then fine-tune the entire network on a classification task (e.g., classifying handwritten digits). 7. Implement a vanilla GAN in Python using TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the generated images. 8. Execute the CycleGAN architecture and implement a basic version for image-to-image translation (e.g., translating horses to zebras). 9. Implement a single-layer Transformer encoder in Python using libraries like TensorFlow or PyTorch. Train it on a small dataset of sentences to predict the next word in a sequence. 10. Perform a Transformer model and visualize the attention weights learned by the model to understand how it focuses on specific parts of the input sequence. **Tools used: MATLAB / Open Source – Deep Learning Platforms**	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**
Text Book(s):	

1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", 2nd Edition, MIT Press, 2023.
2.	Nithin Buduma, Nikhil Buduma, Joe Papa, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm", 2nd Edition, O'Reilly Media, Inc., 2022.
Reference(s):	

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1.	Rajalingappaa Shanmugamani , "Deep Learning for Computer Vision", Packt Publishing, 2018
2.	Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress, 2017.
3.	https://deepmind.google/
4.	https://www.deeplearning.ai/
5.	https://blog.research.google/2017/08/transformer-novel-neural-network.html
6.	https://www.tensorflow.org/hub
7.	https://towardsdatascience.com/transformer-models-101-getting-started-part-1-b3a77ccfa14d
8.	https://roboflow.com/model/yolov5
9.	https://medium.com/swlh/resnet-with-tensorflow-transfer-learning-13ff0773cf0c
10.	https://keras.io/api/layers/regularization_layers/dropout/

*SDG 9 – Industry Innovation and Infrastructure

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1	**Convolutional Networks**	
1.1	The Convolution Operation	1
1.2	Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior	1
1.3	Variants of the Basic Convolution Function, Structured Outputs	1
1.4	Data Types, Efficient Convolution Algorithms	1
1.5	Random or Unsupervised Features	1
1.6	Applications of DL in Computer Vision	1
2	**Autoencoders**	
2.1	Undercomplete Autoencoders	1
2.2	Stochastic Encoders and Decoders	1
2.3	Denoising Autoencoders	1
2.4	Learning Manifolds with Autoencoders	1
2.5	Contractive Autoencoders	1
2.6	Applications of Autoencoder	1
3	**Deep Generative Models**	
3.1	Boltzmann Machines, Restricted Boltzmann Machines	1
3.2	Deep Belief Networks	1
3.3	Deep Boltzmann Machines	1
3.4	Boltzmann Machines for Real-Valued Data	1
3.5	Boltzmann Machines for Structured or Sequential Outputs	1
3.6	Directed Generative Nets	1
4	**Generative Adversarial Networks (GANs)**	
4.1	Vanilla GAN,	1
4.2	CycleGAN, StyleGAN	1
4.3	PixelRNN, DiscoGAN,	1
4.4	IsGAN, EfficientNet - Compound Scaling, Focus	1
4.5	Efficiency, EfficientNet with Transformers	1
4.6	Pruning and Quantization Techniques	1
5	**Transformers**	
5.1	Bidirectional Encoder	1
5.2	Representations from Transformers (BERT)	1
5.3	Generative Pre-trained Transformer 3 (GPT-3)	1
5.4	Text-to-Text Transfer Transformer (T5)	1
5.5	Generalized Autoregressive Pretraining for Language Understanding (XLNet)	2
Practical:		

1.	Implement a basic ResNet architecture and compare its training behavior to a plain CNN.	4
2.	Explore the use of dropout layers in CNN architectures to prevent overfitting. Experiment with different dropout rates at various locations in the network and observe their impact on training.	2
3.	Demonstrate an undercomplete autoencoder to compress images for storage or transmission with minimal loss of quality compared to standard compression techniques (e.g., JPEG)	4
4.	Perform an autoencoder with and without stochastic encoders/decoders on noisy data. How does noise injection during training affect the model's ability to reconstruct clean data and generalize to unseen noisy examples?	4
5.	Implement a binary RBM in Python using libraries like TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the learned hidden units.	2
6.	Implement a DBN using stacked RBMs. Train each RBM layer-wise and then fine-tune the entire network on a classification task (e.g., classifying handwritten digits).	2
7.	Implement a vanilla GAN in Python using TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the generated images.	4
8.	Execute the CycleGAN architecture and implement a basic version for image-to-image translation (e.g., translating horses to zebras).	2
9.	Implement a single-layer Transformer encoder in Python using libraries like TensorFlow or PyTorch. Train it on a small dataset of sentences to predict the next word in a sequence.	4
10.	Perform a Transformer model and visualize the attention weights learned by the model to understand how it focuses on specific parts of the input sequence.	2

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Dr.D. Mugilan - mugilan@ksrct.ac.in

60 EC E56	Biomedical Instrumentation	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To introduce the various biological sensors and signal conditioning devices used in bio-medical field
- To familiarize with the measurements and modern methods of imaging techniques
- To learn the various methods of non-electrical parameter measurement in bio- medical applications
- To Provide latest knowledge of medical assistance / techniques and therapeutic equipment
- To learn the latest trends in biomedical instrumentation

Pre-requisites

- Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Familiarize the role of instrumentation system and its components in biological field	Remember
CO2	Outline the procedure involved in the measurement of medical imaging techniques	Understand
CO3	Explain the working principle of non-electrical parameter measurements	Understand
CO4	Demonstrate the usage of assisting and therapeutic equipment	Understand
CO5	Explain the recent trends in medical instrumentation	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	2	-	3	3	3	-	-	3	2	3
CO2	3	3	3	-	-	2	-	3	3	3	-	-	3	2	3
CO3	3	3	3	-	-	2	-	3	3	3	-	-	3	2	3
CO4	3	3	3	-	-	2	-	3	3	3	-	-	3	2	3
CO5	3	3	3	-	-	2	-	3	3	3	-	-	3	2	3
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	40
Understand	40	40	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S. Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E56 – Biomedical Instrumentation								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Electro – Physiology and Bio Sensors Origin of Bio Potentials, Bio Potential Electrodes, ECG – EEG – EMG – Lead Systems and Recording Methods – Typical Waveforms and Signal Characteristics, Bio Sensors – Need of Sensors, Working Principle of Bio Sensor, Types of Biosensors and their Applications	[9]
Medical Imaging Equipments X-Ray Machine – Radio Graphic and Fluoroscopic Techniques – Computer Tomography – MRI – Ultrasonography – Endoscopy – Thermography – Bio-Telemetry – Different types of Biotelemetry System and Patient Monitoring.	[9]
Non-Electrical Parameter Measurements Measurement of Blood Pressure – Cardiac Output – Heart Rate, Heart Sound Pulmonary Function Measurements – Spirometer – Photo Plethysmography – Body Plethysmography, Blood Gas Analyzers: pH of Blood, Measurement of Blood PCO_2, PO_2.	[9]
Assisting and Therapeutic Equipments Pacemakers – Defibrillators – Ventilators – Diathermy – Heart – Lung machine – Audio Meters – Dialyzers – Lithotripsy – Electrical Safety in Medical Environment: Shock Hazards – Instruments for Checking Safety Parameters of Biomedical Equipments.	[9]
Recent Trends in Medical Instrumentation* Laser in Medicine – Cryogenic Application – Telemedicine, Case Study: Handheld Devices Such as Infrared Thermometer – Pulse Oximeter – Blood Glucose Meter – Surgical Robotics – Telesurgery – Artificial Intelligence in Medical Imaging.	[9]
Total Hours:	**45**

Text Book(s):

1.	Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 2nd Edition, Pearson Education, New Delhi, 2016.
2.	John G. Webster, “Medical Instrumentation Application and Design”, 5th Edition, John Wiley and Sons, New York, 2020.

Reference(s):

1.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2014.
2.	Arumugam A, ‘Bio-Medical Instrumentation”, 3rd Edition, Anuradha Publications, Chennai, 2017.
3.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Pearson Education, 2019.

***** SDG 3 - Good health and well-being

Assignment Activity

Assignment 1- Covers Module 1 & 2

1. Seminar / Poster presentation

Assignment 2- Covers Module 3, 4

1. Seminar / Poster presentation

Assignment 3- Covers Module 5

1. Case Studies on Recent Trends in Medical Devices

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Electro – Physiology and Bio Sensors**	
1.1	Origin of Bio Potentials, Bio Potential Electrodes	1
1.2	ECG – EEG	1
1.3	EMG	1
1.4	Lead Systems and Recording Methods	1
1.5	Typical Waveforms and Signal Characteristics	1
1.6	Bio Sensors – Need of Sensors	1
1.7	Working Principle of Bio Sensor	1
1.8	Types of Biosensors and their Applications	1
1.9	Applications of Biosensors	1
2.0	**Medical Imaging Equipments**	
2.1	X-Ray Machine	1
2.2	Radio Graphic and Fluoroscopic Techniques	1
2.3	Computer Tomography	1
2.4	MRI – Ultrasonography	1
2.5	Endoscopy	1
2.6	Thermography	1
2.7	Bio-Telemetry	1
2.8	Different types of Biotelemetry System	1
2.9	Patient Monitoring System	1
3.0	**Non-Electrical Parameter Measurements**	
3.1	Measurement of Blood Pressure	1
3.2	Cardiac Output	1
3.3	Heart Rate, Heart Sound Pulmonary Function Measurements	1
3.4	Spirometer	1
3.5	Photo Plethysmography	1
3.6	Body Plethysmography	1
3.7	Blood Gas Analysers	1
3.8	pH of Blood	1
3.9	Measurement of Blood PCO_2, PO_2	1
4.0	**Assisting and Therapeutic Equipments**	
4.1	Pacemakers	1
4.2	Defibrillators, Ventilators	1
4.3	Diathermy	1
4.4	Heart–Lung Machine	1
4.5	Audio Meters	1
4.6	Dialyzers	1
4.7	Lithotripsy	1
4.8	Electrical Safety In Medical Environment: Shock Hazards	1
4.9	Instruments for Checking Safety Parameters of Biomedical Equipment's.	1
5.0	**Recent Trends In Medical Instrumentation**	
5.1	Laser In Medicine	1
5.2	Cryogenic Application	1
5.3	Introduction to Telemedicine	1
5.4	Case Study: Handheld Devices Such as Infrared Thermometer	1
5.5	Pulse Oximeter	1

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5.6	Blood Glucose Meter	1
5.7	Surgical Robotics	1
5.8	Telesurgery	1
5.9	Artificial Intelligence in Medical Imaging	1

Course Designer(s)

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Dr.T.Baranidharan - baranidharan@ksrct.ac.in

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60 EC E57	Massive MIMO Networks	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell massive MIMO systems.
- To learn about channel estimation in multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

Pre-requisites

- Mobile communication and Networks

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Discuss about massive MIMO networks.	Understand
CO2	Describe the massive MIMO propagation channels.	Understand
CO3	Find the channel estimation in single cell and multicell massive MIMO systems.	Understand
CO4	Extend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.	Understand
CO5	Infer the case studies in single-cell deployment and multi-cell deployment	Understand

Mapping with Programme Outcomes

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
CO5	3	3	3	3	3	3	3	3	3	3	-	3	3	3	-
3 - Strong; 2 - Medium; 1 – Some															

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	12	12	20
Understand	48	48	80
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus								
K.S.Rangasamy College of Technology – Autonomous R2022								
B.E - Electronics and Communication Engineering								
60 EC E57 - Massive MIMO Networks								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Massive MIMO Networks Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model	[9]
The Massive MIMO Propagation Channel Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels	[9]
Single-Cell Systems Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility	[9]
Multi-Cell Systems Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion - Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference	[9]
Case Studies ** Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies	[9]
Total Hours:	**45**

Text Book(s):	
1.	Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016. (UNITS II-V)
2.	Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017. (UNIT I)
Reference(s):	
1.	Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018
2.	Leibo Liu, Guiqiang Peng, Shaojun Wei, “Massive MIMO Detection Algorithm and VLSI Architecture”, Springer 2019
3.	Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, “mmWave Massive MIMO A Paradigm for 5G”, Elsevier, 2017

**SDG 9 – Industry Innovation and Infrastructure

<u>Assignment Activity:</u>

Assignment 1

Massive MIMO hybrid beam forming using MATLAB.

Assignment 2

1. Single cell massive MIMO downlink communications using MATLAB.
2. Multicell massive MIMO downlink communications using MATLAB.

Assignment 3

Channel estimation in massive MIMO system using MATLAB

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Massive MIMO Networks**	
1.1	Definition of Massive MIMO	1
1.2	Correlated Rayleigh Fading,	1
1.3	System Model for Uplink and Downlink	1
1.4	Basic Impact of Spatial Channel Correlation	1
1.5	Basic Impact of Spatial Channel Correlation	1
1.6	Channel Hardening and Favourable Propagation	1
1.7	Channel Hardening and Favourable Propagation	1
1.8	Local Scattering Spatial Correlation Model	1
1.9	Local Scattering Spatial Correlation Model	1
2.0	**The Massive MIMO Propagation Channel**	
2.1	Favorable Propagation and Deterministic Channels	1
2.2	Capacity Upper Bound	1
2.3	Distance from Favorable Propagation	1
2.4	Favorable Propagation and Linear Processing	1
2.5	Singular Values and Favorable Propagation	1
2.6	Favorable Propagation and Random Channels-	1
2.7	Independent Rayleigh Fading-	1
2.8	Uniformly Random Line-of-Sight (UR-LoS)	1
2.9	Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels	1
3.0	**Single-Cell Systems**	
3.1	Uplink Pilots and Channel Estimation	1
3.2	Orthogonal Pilots- De-Spreading of the Received Pilot Signal	1
3.3	-MMSE Channel Estimation, Uplink Data Transmission	1
3.4	Zero-Forcing -Maximum-Ratio. Downlink Data Transmission	1
3.5	-Linear Precoding-Zero-Forcing-Maximum-Ratio	1
3.6	Discussion Interpretation of the Effective SINR Expressions-	1
3.7	Implications for Power Control-Scaling Laws and Upper Bounds on the SINR	1
3.8	Near-Optimality of Linear Processing when M >> K	1
3.9	Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility	1
4.0	**Multi-Cell Systems**	
4.1	Uplink Pilots and Channel Estimation	1
4.2	Uplink Data Transmission	1
4.3	Zero-Forcing -Maximum-Ratio	1
4.4	Downlink Data Transmission -Zero-Forcing	1
4.5	Maximum-Ratio, Discussion	1
4.6	Asymptotic Limits with Infinite Numbers of Base Station Antennas	1
4.7	Asymptotic Limits with Infinite Numbers of Base Station Antennas	1
4.8	The Effects of Pilot Contamination	1
4.9	Non-Synchronous Pilot Interference	1

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5.0	**Case Studies**	
5.1	Single-Cell Deployment	1
5.2	Example: Fixed Broadband Access in Rural Area	1
5.3	Multi-Cell Deployment: Preliminaries and Algorithms	1
5.5	Multi-Cell Deployment Examples	1
5.6	Mobile Access - Dense Urban 178 Scenario	1
5.7	Suburban Scenario	1
5.8	Minimum Per-Terminal Throughput Performance	1
5.9	Additional Observations - Comparison of Power Control Policies	1

Course Designer(s)

1. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

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