K.S.Rangasamy College of Technology

(Autonomous Institution affiliated to Anna University, Chennai)

Curriculum & Syllabus

of

B.E. Mechatronics Engineering

(For the batch admitted in 2021–2022)

R 2018

Accredited by NAAC A++, Approved by AICTE,Affiliated to Anna University, Chennai.

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

VISION

- To become a pioneer in producing competent Mechatronics Engineers, researchers and entrepreneurs through quality education

MISSION

- To produce competent and ethically bound Mechatronics professionals by imparting the technical knowledge and skills through quality teaching learning process
- To build an environment that is favourable for employability skills through collaborations with academia and industry
- To groom the students to focus on higher studies, research, entrepreneurship and be committed to the societal welfare and quality of life by creating an effective ecosystem

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Core competencies: Our graduates apply engineering knowledge to solve problems in Mechatronics and relevant fields.

PEO 2: Employability: Our graduates demonstrate technical and professional skills to ethically address the industrial and societal needs.

PEO 3: Higher Studies, Research and Entrepreneurship: Our graduates pursue higher studies, research and entrepreneurship in diverse fields.

PROGRAM OUTCOMES (POs)

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: Specify, design and develop automation systems for the given engineering applications.

PSO2: Design and evaluate mechatronic systems using the state-of-the-art equipment and software tools.

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

The B.E. Mechatronics 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	1	3	2	2	1	1	1	2	2	3	1
PEO 2	3	3	3	2	2	1	1	1	2	2	3	1
PEO 3	3	2	3	2	2	1	1	1	3	2	3	1

Contributions: 1- low, 2- medium, 3- high

MAPPING: MECHATRONICS ENGINEEIRNG (UG)

Year	Sem.	Course Name	PO											
			1	2	3	4	5	6	7	8	9	10	11	12
I	I	Communication Skills I	1	1	1	1	1	2	1	2	3	3	2	3
		Calculus and Differential Equations	3	3	3	2	3							2
		Applied Chemistry	3	3	3	3	2	2	3	2	1	1	1	1
		Engineering Mechanics	3	2	2	3								2
		Basic Electrical Engineering	3	3	3	1	1	2	2	1				1
		Constitution of India								2	2	1		2
		Chemistry Laboratory	3	3	3	3	3	3	2	1	1		2	1
		Engineering Practices Laboratory	3	2	1			3	1		3		3	2
	II	Communication Skills II	1	2	1	2	1	2	1	2	3	3	2	3
		Laplace Transform and Complex Variables	3	3	2	2	3							2
		Applied Physics	3	3	3	2	2	2	2	2	1	1	-	-
		Programming for Problem Solving	1	3		2	3			2				2
		Engineering Drawing	3	3	3	3	3	1		1		3	1	1
		Environmental Science	3	2	3	3	3	3	3	3	3	3	2	2
		Engineering Physics Laboratory	3	2	2	1	3	2	2	3	1	2	2	1
		Programming for Problem Solving Laboratory	1	3		2	3			2				2
II	III	Partial Differential Equations and Statistics	3	3	3	2	2							2
		Analog Devices and Digital Circuits	3	1	2	3		2		3	3			3
		Strength of Materials	3	2	2	1	2	1	3		2	1	1	2
		Thermodynamics	3	2	2	2	2							
		Manufacturing Technology	2	3	2	2	3	2	2	3			2	1
		Universal Human Value	3	3	2	2	2	3	3	3	3	3	2	1
		Manufacturing Technology Laboratory	3	2	1		2	3		1	3			3
		Analog Devices and Digital Circuits Laboratory	2	2	3	1	.2	.	3	2	2	.2		
		Career Competency Development I	1	1	1	1	1	2	1	2	3	3	2	3
	IV	Industrial Drives and Control	2	3	3	2	3	2	2	1			1	1
		Fluid Mechanics and Fluid Machines	3	1	2	3		1	3	2	3		2	
		Theory of Machines	3	3	3	2	2	2	2	3	1	1	2	2
		Hydraulic and Pneumatic Control	3	2	3	2	2	1	1		2	2	2	2

		Applied Materials Technology	2	2	2		2	1	1		3	2	1	1
		Start-ups and Entrepreneurship	3	2	3	3	3	1	1	1			3	2
		National Cadet Corps*(Air wing)	3	2	1	1	3	3	3	3	3	3	3	3
		National Cadet Corps*(Army Wing)	-	-	-	-	-	1	-	3	-	-	-	-
		Industrial Drives and Control Laboratory	3	3	2		1							3
		Applied Mechanics Laboratory	2	2	1	1								2
		Career Competency Development II	2	2	1	1	1	2	1	1	2	3	2	3
III	V	Microprocessors and Microcontrollers	3	1	1	2	2		1	1				1
		System Design and Control	1	2		1	3	3	2	1		2		1
		Sensors and Instrumentation	3	2	2	3	2	2	1		2	3	2	2
		Machine Design	3	2	2	1	2	1	3		2	1	1	2
		Microprocessors and Microcontrollers Laboratory	3	1	1			1						
		Metrology and Dynamics Laboratory	3	2	2			3	1		3		3	2
		Career Competency Development III	2	3	2	2	1	3			2	3	2	1
	VI	Programmable Automation Controllers	3	1	1	2	2		1	1				1
		Computer Aided Design and Manufacturing	3	2	2	3	3	3			3	3	3	3
		Robotics Engineering	2	3	2	2	1	3			2	3	2	1
		Robotics and Machine Vision laboratory	2	3	2	2	1	3			2	3	2	1
		Computer Aided Manufacturing Laboratory	2	3	2	2	1	3			2	3	2	1
		Career Competency Development IV	2	3	2	2	1	3			2	3	2	1
IV	VII	Industrial Automation Protocols	3	2	2	2	2	2	2	1	2	1	1	3
		Embedded System	2	2		3		2	2			2		
		Autonomous Vehicle	3	2	1	2	2							2
		Research Skill Development -I	3	3	2	2	2	2	1	2	1	3	2	1
		Industrial Automation and Control Laboratory	2	2	1	1	3					3	3	2
		Embedded System Laboratory	3	2	1	2	1	1			1	3	2	2
		Project Work-Phase I	3	3	3	3	3	3	3	3	3	3	3	3
		Career Competency Development V	2	3	2	2	1	3			2	3	2	1
	VIII	Total Quality Management	3	2	3	2	1	3	2	1	2	2	3	2
		Research Skill Development -II	3	3	3	2	2	2	1	1	1	2	2	1
		Project Work -Phase II	3	3	3	2	2	2	1	1	1	2	2	1

SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 EN 001	Communication Skills I	HS	2	1	1	0	2
2.	50 MA 001	Calculus and Differential Equations	BS	4	3	1	0	4
3.	50 CH 001	Applied Chemistry	BS	**3**	3	0	0	3
4.	50 ME 003	Engineering Mechanics	ES	**4**	3	1	0	4
5.	50 EE 001	Basic Electrical Engineering	ES	**3**	3	0	0	3
6.	50 MY 001	Constitution of India	MY	2	2	0	0	0
PRACTICALS								
7.	50 CH 0P1	Chemistry Laboratory	BS	4	0	0	4	2
8.	50 ME 0P1	Engineering Practices Laboratory	ES	4	0	0	4	2
			Total	**26**	**15**	**3**	**8**	**20**

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 EN 002	Communication Skills II	HS	2	1	1	0	2
2.	50 MA 002	Laplace Transform and Complex Variables	BS	4	3	1	0	4
3.	50 PH 001	Applied Physics	BS	3	3	0	0	3
4.	50 CS 001	Programming for Problem Solving	ES	3	3	0	0	3
5.	50 ME 001	Engineering Drawing	ES	6	2	0	4	4
6.	50 MY 002	Environmental Science	MY	2	2	0	0	0
PRACTICALS								
7.	50 PH 0P1	Engineering Physics Laboratory	BS	4	0	0	4	2
8.	50 CS 0P1	Programming for Problem Solving Laboratory	ES	4	0	0	4	2
			Total	**28**	**14**	**02**	**12**	**20**

SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 MA 003	Partial Differential Equations and Statistics	BS	4	3	1	0	4
2.	50 MC302	Analog Devices and Digital Circuits	PC	3	3	0	0	3
3.	50 ME 004	Strength of Materials	PC	4	3	1	0	4
4.	50 ME 006	Thermodynamics	PC	4	3	1	0	4
5.	50 MC303	Manufacturing Technology	PC	3	3	0	0	3
6.	50 MY 004	Universal Human Value*	MY*	3	2	1	0	3*
PRACTICALS								
7.	50 MC 3P1	Manufacturing Technology Laboratory	PC	4	0	0	4	2
8.	50 MC 3P2	Analog Devices and Digital Circuits Laboratory	PC	4	0	0	4	2
9.	50 TP 0P1	Career Competency Development I	EEC	2	0	0	2	0
			Total	**31**	**17**	**4**	**10**	**22**

R8/ w.e.f.27/12/2023
Passed in the BoS Meeting Held on 24/11/2023
Approved in Academic Council Meeting held on 23/12/2023

BoS Chairman

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 MC 401	Industrial Drives and Control	PC	3	3	0	0	3
2.	50 ME 005	Fluid Mechanics and Fluid Machines	PC	4	3	1	0	4
3.	50 MC 402	Theory of Machines	PC	4	3	1	0	4
4.	51 MC 403	Hydraulic and Pneumatic control	PC	5	3	0	2	4
5.	50 MC 404	Applied Materials Technology	PC	3	3	0	0	3
6.	50 MY 014	Start-ups and Entrepreneurship	MY	2	2	0	0	0
7.	50 GE 00*	National Cadet Corps	GE*	4	2	0	2	3*
PRACTICALS								
8.	50 MC 4P1	Industrial Drives and Control Laboratory	PC	4	0	0	4	2
9.	50 MC 4P2	Applied Mechanics Laboratory	PC	4	0	0	4	2
10.	50 TP 0P2	Career Competency Development II	EEC	2	0	0	2	0
			Total	**31**	**17**	**02**	**12**	**22**

SEMESTER V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 MC 501	Microprocessors and Microcontrollers	PC	3	3	0	0	3
2.	51 MC 502	System Design and Control	PC	4	3	1	0	4
3.	50 MC 503	Sensors and Instrumentation	PC	3	3	0	0	3
4.	50 MC 504	Machine Design	PC	4	3	1	0	4
5.	50 MC E1*	Elective -I	PE	3	3	0	0	3
6.	50 MC L1*	Open Elective-I	OE	3	3	0	0	3
PRACTICALS								
7.	50 MC5P1	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
8.	50 MC 5P2	Metrology and Dynamics Laboratory	PC	4	0	0	4	2
9.	50 TP 0P3	Career Competency Development III	EEC	2	0	0	2	0
			Total	**30**	**18**	**2**	**10**	**24**

SEMESTER VI

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 MC 601	Programmable Automation Controllers	PC	4	3	1	0	4
2.	50 MC 602	Computer Aided Design and Manufacturing	PC	3	3	0	0	3
3.	51 MC 603	Robotics Engineering	PC	3	3	0	0	3
4.	50 MC E2*	Elective -II	PE	3	3	0	0	3
5.	50 MC E3*	Elective -III	PE	3	3	0	0	3
6.	50 MC L2*	Open Elective-II	OE	3	3	0	0	3
PRACTICALS								
7.	50 MC 6P1	Robotics and Machine Vision Laboratory	PC	4	0	0	4	2
8.	50 MC 6P2	Computer Aided Manufacturing Laboratory	PC	4	0	0	4	2
9.	50 TP 0P4	Career Competency Development IV	EEC	2	0	0	2	0
			Total	**29**	**18**	**1**	**10**	**23**

SEMESTER VII

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 MC 701	Industrial Automation Protocols	PC	3	3	0	0	3
2.	50 MC 702	Embedded System	PC	3	3	0	0	3
3.	50 MC 703	Autonomous Vehicle	PC	3	3	0	0	3
4.	50 MC E4*	Elective -IV	PE	3	3	0	0	3
5.	50 MC E5*	Elective -V	PE	3	3	0	0	3
6.	50 MC L3*	Open Elective-III	OE	3	3	0	0	3
7.	50 AC 001	Research Skill Development -I	AC	1	1	0	0	0
8.	50 GE 00*	National Cadet Corps	GE*	4	2	0	2	3*
PRACTICALS								
9.	50 MC 7P1	Industrial Automation and Control Laboratory	PC	4	0	0	4	2
10.	50 MC 7P2	Embedded System Laboratory	PC	4	0	0	4	2
11.	50 MC 7P3	Project Work-Phase I	EEC	4	0	0	4	2
12.	50 TP 0P5	Career Competency Development V	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**24**

SEMESTER VIII

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 HS 003	Total Quality Management	HS	3	3	0	0	3
2.	50 AC 002	Research Skill Development -II	AC	1	1	0	0	0
PRACTICALS								
3.	50 MC 8P1	Project Work -Phase II	EEC	16	0	0	16	8
4.	50 TP 0P6	Internship	EEC	0	0	0	0	3*
			Total	**20**	**4**	**0**	**16**	**11**

*Internship Extra 3 Credits is offered

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 166

Note: 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, EEC-Employability Enhancement Courses, AC-Audit Courses & MY- Mandatory Courses

Honours Degree – Robotics and Automation

S.No	Course Code	Course Name	L	T	P	Credits
1.	50 MC H01	Medical Robotics	03	0	0	03
2.	50 MC H02	AI for Robotics	03	0	0	03
3.	50 MC H03	Robot Kinematics and Dynamics	03	0	0	03
4.	50 MC H04	Applied and Industrial Robotics	03	0	0	03
5.	50 MC H05	Robotic Programming	03	0	0	03
6.	50 MC H06	Sensors and Machine Vision Systems	03	0	0	03
		Total	**18**	**0**	**0**	**18**

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BoS Chairman

HUMANITIES AND SOCIAL SCIENCES (HS)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 EN 001	Communication Skills I	HS	2	1	1	0	2
2.	50 EN 002	Communication Skills II	HS	2	1	1	0	2
3.	50 HS 003	Total Quality Management	HS	3	3	0	0	3

BASIC SCIENCE (BS)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MA 001	Calculus and Differential Equations	BS	4	3	1	0	4
2.	50 CH 001	Applied Chemistry	BS	3	3	0	0	3
3.	50 CH 0P1	Chemistry Laboratory	BS	4	0	0	4	2
4.	50 MA 002	Laplace Transform and Complex Variables	BS	4	3	1	0	4
5.	50 PH 001	Applied Physics	BS	3	3	0	0	3
6.	50 PH 0P1	Engineering Physics Laboratory	BS	4	0	0	4	2
7.	50 MA 003	Partial Differential Equations and Statistics	BS	4	3	1	0	4

ENGINEERING SCIENCES (ES)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 ME 003	Engineering Mechanics	ES	4	3	1	0	4
2.	50 EE 001	Basic Electrical Engineering	ES	3	3	0	0	3
3.	50 ME 0P1	Engineering Practices Laboratory	ES	4	0	0	4	2
4.	50 CS 001	Programming for Problem Solving	ES	3	3	0	0	3
5.	50 ME 001	Engineering Drawing	ES	6	2	0	4	4
6.	50 CS 0P1	Programming for Problem Solving Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MC 302	Analog Devices and Digital Circuits	PC	3	3	0	0	3
2.	50 ME 004	Strength of Materials	PC	4	3	1	0	4
3.	50 MC 303	Manufacturing Technology	PC	3	3	0	0	3
4.	50 MC 3P1	Manufacturing Technology Laboratory	PC	4	0	0	4	2
5.	50 MC 3P2	Analog Devices and Digital Circuits Laboratory	PC	4	0	0	4	2
6.	50 ME 006	Thermodynamics	PC	4	3	1	0	4
7.	50 MC 401	Industrial drives and control	PC	3	3	0	0	3
8.	50 ME 005	Fluid Mechanics and Fluid Machines	PC	4	3	1	0	4
9.	50 MC 402	Theory of Machines	PC	4	3	1	0	4
10.	51 MC 403	Hydraulic and Pneumatic control	PC	5	3	0	2	4
11.	50 MC 404	Applied Materials Technology	PC	3	3	0	0	3
12.	50 MC 4P1	Industrial Drives and Control Laboratory	PC	4	0	0	4	2
13.	50 MC 4P2	Applied Mechanics Laboratory	PC	4	0	0	4	2
14.	50 MC 501	Microprocessors and Microcontrollers	PC	3	3	0	0	3
15.	51 MC 502	System Design and Control	PC	4	3	1	0	4
16.	50 MC 503	Sensors and Instrumentation	PC	3	3	0	0	3
17.	50 MC 504	Machine Design	PC	4	3	1	0	4
18.	50 MC5P1	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
19.	50 MC 5P2	Metrology and Dynamics Laboratory	PC	4	0	0	4	2
20.	50 MC 601	Programmable Automation Controllers	PC	4	3	1	0	4

21.	50 MC 602	Computer Aided Design and Manufacturing	PC	3	3	0	0	3
22.	51 MC 603	Robotics Engineering	PC	3	3	0	0	3
23.	50 MC 6P1	Robotics and Machine Vision Laboratory	PC	4	0	0	4	2
24.	50 MC 6P2	Computer Aided Manufacturing Laboratory	PC	4	0	0	4	2
25.	50 MC 701	Industrial Automation Protocols	PC	3	3	0	0	3
26.	50 MC 702	Embedded System	PC	3	3	0	0	3
27.	50 MC 703	Autonomous Vehicle	PC	3	3	0	0	3
28.	50 MC 7P1	Industrial Automation and Control Laboratory	PC	4	0	0	4	2
29.	50 MC 7P2	Embedded System Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SEMESTER V, ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MC E11	Wireless Sensor Networks	PE	3	3	0	0	3
2.	50 MC E12	Automobile Technology	PE	3	3	0	0	3
3.	50 MC E15	Modern Vehicle System	PE	3	3	0	0	3
4.	50 MC E14	Composite Materials	PE	3	3	0	0	3
5.	50 HS 004	Principles of Management	PE	3	3	0	0	3

SEMESTER VI, ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MC E27	Industry 4.0	PE	3	3	0	0	3
2.	50 MC E26	Non-conventional Machining Processes	PE	3	3	0	0	3
3.	50 MC E23	Design of Transmission Systems	PE	3	3	0	0	3
4.	50 MC E24	Industrial Design and Applied Ergonomics	PE	3	3	0	0	3
5.	51 MC E25	Virtual Reality and Augmented Reality	PE	3	3	0	0	3

SEMESTER VI, ELECTIVE III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MC E31	Operations Research	PE	3	3	0	0	3
2.	50 MC E32	Design of Material Handling Equipments	PE	3	3	0	0	3
3.	51 PT T01	Creo for Design	PE	3	3	0	0	3
4.	50 MC E34	MEMS and NEMS	PE	3	3	0	0	3
5.	50 MC E35	Product Design and Costing	PE	3	3	0	0	3

SEMESTER VII, ELECTIVE IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MC E45	Drone Technology	PE	3	3	0	0	3
2.	50 MC E47	Non Destructive Testing	PE	3	3	0	0	3
3.	50 MC E43	New and Renewable Energy Sources	PE	3	3	0	0	3
4.	50 MC E44	Machine Learning and Condition Monitoring	PE	3	3	0	0	3
5.	50 MC E46	Finite Element Method	PE	3	3	0	0	3

SEMESTER VII, ELECTIVE V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	51 PT T02	Creo for Production Engineering	PE	4	2	0	2	3
2.	51 MC E55	Rapid Prototyping	PE	4	2	0	2	3
3.	51 MC E56	PC Based Instrumentation	PE	4	2	0	2	3
4.	51 MC E57	Medical Mechatronics	PE	4	2	0	2	3
5.	51 MC E53	Fundamentals of Arduino	PE	4	2	0	2	3

OPEN ELECTIVES I / II / III / IV(OE)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MC L05	Robotics and Automation	OE	3	3	0	0	3
2.	50 MC L06	Applied Ergonomics	OE	3	3	0	0	3
3.	50 MC L01	Industrial Safety Engineering	OE	3	3	0	0	3
4	50 MC L08	Fire Safety	OE	3	3	0	0	3
5	50 MC L10	Robotics and Control	OE	3	3	0	0	3
6	50 MC L11	Digital Transformation in Manufacturing	OE	3	3	0	0	3

SEMESTER IV, GENERAL ELECTIVE (GE)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 GE 001	National Cadet Corps (Air Wing)	GE*	4	2	0	2	3
2.	50 GE 002	National Cadet Corps(Army Wing)	GE*	4	2	0	2	3

SEMESTER VII & SEMESTER VIII, AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 AC 001	Research Skill Development -I	AC	1	1	0	0	0
2.	50 AC 002	Research Skill Development -II	AC	1	1	0	0	0

MANDATORY COURSES(II/III/IVMY)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 MY 001	Constitution of India	MY	2	2	0	0	-
2.	50 MY 002	Environmental Science	MY	2	2	0	0	-
3.	50 MY 004	Universal Human Value	MY	3	2	1	0	3*
4.	50 MY 014	Start-ups and Entrepreneurship	MY	2	2	0	0	-

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 TP 0P1	Career Competency Development I	EEC	2	0	0	2	-
2.	50 TP 0P2	Career Competency Development II	EEC	2	0	0	2	-
3.	50 TP 0P3	Career Competency Development III	EEC	2	0	0	2	-
4.	50 TP 0P4	Career Competency Development IV	EEC	2	0	0	2	-
5.	50 TP 0P5	Career Competency Development V	EEC	2	0	0	2	-
6.	50 TP 0P6	Internship	EEC	2/4/8 (weeks)	0	0	0	1/2/3
7.	50 MC 7P3	Project Work-Phase I	EEC	4	0	0	4	2
8.	50 MC 8P1	Project Work -Phase II	EEC	16	0	0	16	8

R8/ w.e.f.27/12/2023
Passed in the BoS Meeting Held on 24/11/2023
Approved in Academic Council Meeting held on 23/12/2023

BoS Chairman

SUMMARY

S.No.	Category	Credits Per Semester								Total Credits	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	2	2	-	-	-	-	-	3	**07**	**4.21**
2.	BS	9	9	4	-	-	-	-	-	**22**	**13.25**
3.	ES	9	9	-	-	-	-	-	-	**18**	**10.84**
4.	PC	-	-	18	22	18	14	13	-	**85**	**51.20**
5.	PE	-	-	-	-	3	6	6	-	**15**	**9.03**
6.	OE	-	-	-	-	3	3	3	-	**09**	**5.42**
7.	EEC	-	-	-	-	-	-	2	8	**10**	**6.02**
8.	MY	MY I	MY II	3*	MY IV	-	-	-	-	**03***	**-**
9.	AC	-	-	-	-	-	-	AC I	AC II	**-**	**-**
10.	GE*	-	-	-	3*		-	-	-	**03***	**-**
	Total	**20**	**20**	**22**	**22**	**24**	**23**	**24**	**11**	**166**	**100**

GE* is an optional, Extra credit is offered
UHV* Extra credit is offered

K.S.Rangasamy College of Technology – Autonomous								R2018
50 EN 001 – Communication Skills I								
Common to all Branches								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I	**1**	**1**	**0**	**30**	**2**	**40**	**60**	**100**

Objective(s)	• 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
Course Outcomes	**At the end of the course, the student will be able to** 1 Utilize digital literacy tools to develop listening skills & make use of contextual clues to infer meanings of unfamiliar words 2 Able to select, compile & synthesize information using communication strategies for an effective oral presentation 3 Skim & Scan the textual content & infer meanings of unfamiliar words to develop reading & vocabulary skills 4 Generate ideas from sources to develop coherent content and support with relevant details in writing 5 Recognize the basic phonetic patterns of language & execute it for competent loudreading

Note: Hours notified against each unit in the syllabus are only indicative but are not decisive. Faculty may decide the number of hours for each unit depending upon the concepts and depth. Questions need not be asked based on the number of hours notified against each unit in the syllabus**.**

Listening

Listening to Short Audios – Watching Short Videos - answering MCQs and Vocabulary Check- Listening to Short Comprehension Passages – Guided Listening – Listening to songs and cognizing the lyrics. [04]

Speaking

Brainstorming – Group Discussion (unstructured) – Self Introduction - Just a Minute (JaM) - Short Narratives – Cue Cards – Picture Cards – Conversational Practices (Preliminary). [04]

Reading

Silent Reading – Scanning and Skimming - Reading short and Medium Passages – Cognition of Theme and Inferential Meaning - Academic and Functional Vocabulary List (350 words) – Word Power Check - Loud Reading – Modulation and Pronunciation Check. [04]

Writing

Functional Vocabulary and Word Power – Data Interpretation - Paragraph Writing – Letter Writing –Email Writing – Conversational Fill Ups. [03]

Total Hours: 15 + 15 (Tutorial) = 30 hours

Text Books

1.	M.Ashraf Rizvi, 'Effective Technical Communication', 2nd Edition, McGraw Hill Education (India) Private Limited, Chennai, 2018
2.	Norman Lewis, 'Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book', Penguin Random House India, 2020

References:

1.	Paul Emmerson and Nick Hamilton ,'Five Minute Activities for Business English', Cambridge University Press, N.York, 2005
2.	Arthur Brookes and Peter Grundy ,' Beginning to Write: Writing Activities for Elementary and Intermediate Learners', Cambridge University Press, N.York, 2003
3.	Michael McCarthy and Felicity O Dell , 'English Vocabulary in Use: Upper Intermediate', Cambridge University Press, N.York, 2012
4.	https://learningenglish.britishcouncil.org/en/listening

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 EN 001 & Communication Skills I	CO1	1	1		1	1	1	1	2	3	3	2	3		1
	CO2	1	1		3	2	1		2	3	3	3	3		2
	CO3	1	2	1	2	1	1	2	1	2	3	2	3	1	1
	CO4	1	2	1	1	2	2	1	2	1	3	3	3		3
	CO5	1	1		1	1	1	1	1	3	3	1	3		

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MA 001 - Calculus and Differential Equations

Common to All Branches

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

Objective(s)

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This course deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.
- Development of mathematical skills to solve the differential equations.

Course Outcomes

At the end of the course, the students will be able to

1 Apply Cayley - Hamilton theorem to find inverse matrix and transformation techniques to reduce quadratic form into canonical form.
2 Determine the circle of curvature, evolute and envelope of the curves.
3 Analyze the Jacobian methods and the constrained maxima and minima function.
4 Solve the linear and simultaneous differential equations.
5 Evaluate definite and indefinite integrals using different techniques.

The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the numbers hours indicated.

Matrices

Characteristic equation–Eigen values and Eigen vectors of areal matrix–Properties of Eigen values and Eigen vectors–Cayley-Hamilton theorem (without proof) – Orthogonal transformation of a symmetric matrix to diagonal form–Reduction of quadratic form to canonical form by orthogonal transformation-Nature of quadratic form**.** [08]

Differential Calculus

Curvature – radius of curvature (Cartesian and polar co-ordinates) – Centre of curvature – Circle of curvature – Involute and evolute–envelope. [09]

Functions of Several Variables

Partial differentiation – Homogeneous functions and Euler's theorem – Jacobians – Taylor's series for functions oftwo variables – Maxima and minima of functions of two variables – Constrained maxima and minima : Lagrange's Method of Un determined Multipliers. [09]

Differential Equations

Linear differential equations of second and higher order with constant co-efficient - R.H.S is $e^{\alpha x}$,$\sin\alpha x$,$\cos\alpha x$, $x^n n>0$, $e^{\alpha x}\sin\beta x$,$e^{\alpha x}\cos\beta x$,$e^{\alpha x}x^n x^n\sin\alpha x$ and $x^n\cos\alpha x$– Differential equations with variable co-efficients: Cauchy's and Legendre's form of linear equation–Method of variation of parameters – Simultaneous first – order linear equations with constant co-efficients. [09]

Integral Calculus

DefiniteandIndefiniteintegrals-Substitutionrule-TechniquesofIntegration-Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of Srrational functions – Improper integrals. [10]

Total Hours: 45 + 15(Tutorial) = 60 hours

Text book(s) :	
1	Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014. Web site: https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html
2	Veerarajan.T., "Engineering Mathematics", for Semesters I and II , Tata McGraw Hill Publishing Co., New Delhi., 2010.
Reference(s) :	
1	Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia)Limited, New Delhi, 2016.
2	Integral Equations,calculus of variations and its applications- Dr. P. N. Agrawal, Dr. D. N. Pandey, NPTEL online video courses.
3	Matrix Analysis with Applications - Dr. S. K. Gupta Dr. Sanjeev Kumar, Matrix Solvers -prof.Somnath Roy NPTEL online video courses.
4	Dr.P.Kandasamy, Dr.K.Thilagavathy,Dr.K.Gunavathy , "Engineering Mathematics-II", S.Chand & Company Ltd, New Delhi.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MA001 & Calculus and Differential Equations	CO1	3	3	3	3	3							2	3	
	CO2	3	3	2	2	2							2	3	
	CO3	3	3	3	2	2							2	3	
	CO4	3	3	3	3	2							2	3	
	CO5	3	3	3	2	3							2	3	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 CH 001 Applied Chemistry

Common to All Branches

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

Objective(s)

- To rationalize the periodic properties such as ionization potential, electron affinity, oxidationstate, electro negativity, atomic and molecular orbitals
- To analyze the thermodynamic functions, concept of cells and corrosion of metals and its controlmethods
- To help the learners to analyze the hardness of water and its removal
- To endow with an overview of spectroscopy principles and its applications
- To recall the basics of stereochemistry and reaction mechanism

Course Outcomes

At the end of the course, the student will be able to:

1. Rationalize the periodic properties, variation of orbitals, interactions and orbitals with energylevel diagrams
2. Analyze the thermodynamic functions, cell potentials and corrosion with its control measures
3. Recognize the sources hardness of water and its removal
4. Interpret the ranges of the electromagnetic spectrum used for exciting different molecular energylevels in various spectroscopic techniques Review of stereochemistry and types of chemical reactions with their mechanism

Periodic properties

Effective nuclear charge - atomic and ionic sizes - ionization energies - electron affinity – electro negativity - polarizability - oxidation states - penetration of orbitals- variations of s, p, d and f orbital energies of atoms - electronicconfigurations, ionic, dipolar and Vander- waals interactions. Hard Soft Acids and Bases (HSAB). Molecular orbitals of diatomic molecules - plots of the multicenter orbitals. Equations for atomic and molecularorbitals. Energy level diagrams of diatomics. Pi-molecular orbital of butadiene and benzene. [09]

Chemical equilibria and corrosion

Thermodynamic functions - energy - entropy - enthalpy- free energy - Gibbs-Helmholtz equation - Van 't Hoff isotherm. Cell potentials - Nernst equation - applications - EMF series - applications - Poteniometric and Conductometric titrations.

Corrosion- types of corrosion - chemical and electrochemical corrosion - mechanism - Factors influencing corrosion - Corrosion control methods (impressed current and sacrificial anode methods) - Corrosion inhibitors. [09]

Water chemistry

Sources - Water quality parameters - impurities in water and their effects. Hardness - Estimation of hardness -

effect of hard water in various Industries-Softening of water- external treatment-zeolite process- ion-exchange process- internal treatment-carbonate, phosphate and calgon Conditioning-Desalination- reverse osmosis - electrodialysis. Boiler troubles - methods of prevention. [09]

Analytical techniques and applications

Absorption laws - Ultra Violet spectroscopy (UV) - Principle - Instrumentation (Block diagram) - applications. Infra-Red spectroscopy (IR)- Instrumentation (Block diagram) - selection rule - types of fundamental vibrations - applications. Nuclear Magnetic Resonance spectroscopy (NMR) - Principle - selection rule - Instrumentation (Block diagram) - chemical shift - factors influencing the chemical shift -applications. Atomic Absorption Spectroscopy (AAS)
- Principle - Instrumentation (Block diagram) -applications. [09]

Concepts in Organic chemistry

Structural isomerism- types - Stereoisomerism - geometrical (Maleic and Fumaric acids) - optical isomerism (Lactic and Tartaric acids) - symmetry - chirality- enantiomers - diastereomers - optical activity - absolute configurations. Introduction to reactions - substitution - addition - oxidation - reduction - cyclization and ring openings - mechanism. [09]

Total Hours: 45

Text book(s) :

1	Jain. P.C. and Monica Jain, "Engineering Chemistry", Dhanpatrai Publishing Co. New Delhi, 14th edition, 2015.
2	Dr. S.Vairamand Dr. Suba Ramesh, "Engineering Chemistry", Wiley India Private Limited , 2nd edition,January 2013.

Reference(s) :

1	Puri B. R., Sharma L.R., and Pathania M.S., "Principles of Physical Chemistry", Vishal Publishing Company,Delhi, 2017.
2	Dara. S.S, "A Text Book Of Engineering Chemistry", S Chand & Co. Ltd., 2014.
3	Bahl B.S. and Arun Bahl, "Advanced Organic Chemistry", S.Chand, New Delhi, 2014.
4	Sharma B K. Instrumental Methods of Chemical Analysis, Goel Publishing House Meerut, 23th edition; 2014.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 CH 001 & Applied Chemistry	CO1	3	3	2	2	2	2	2	2		1	1	2	2	2
	CO2	3	3	3	2	2	2	3	2	1	1	1	1	2	3
	CO3	3	3	3	3	2	3	3	3	3	1	2	3	3	3
	CO4	3	3	3	3	3	3	3	1	2	1	2	3	2	2
	CO5	3	3	3	3	2	2	2	2	1	1	1	1	1	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 ME 003 – Engineering Mechanics

Common to all branches

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

Objective(s)

- To learn a process for analysis of static objects, concepts of force, moment, and mechanical equilibrium in two and three dimensions.
- To learn the equilibrium of rigid bodies such as frames, trusses, beams.
- To identify the properties of surfaces and solids by using different theorem.
- To impart basic concept of dynamics of particles.
- To understand the concept of friction and elements of rigid body dynamics.

Course Outcomes

At the end of the course, the student will be able to

1. Use scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Apply basic knowledge of scientific concepts to solve real-world problems.
3. Calculate the properties of surfaces and solids using various theorems.
4. Analyse and solve problems on kinematics and kinetics.
5. Draw a shear force and bending moment diagrams, analysis of rigid body dynamics and calculation of frictional forces on contact surfaces.

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Basics and Statics of Particles

Introduction -Units and Dimensions-Laws of Mechanics–Principle of Transmissibility-Lame's theorem, Parallelogram and triangular Law of forces–Vectors–Vectorial representation of forces and moments.

Vector operations

Addition, subtraction, dot product, cross Product-Coplanar Forces–Resolution and Composition of forces–Equilibrium of a particle–Forces in Space-Equilibrium of a particle in Space-Equivalent systems of Forces-Single equivalent force. [12]

Equilibrium of Rigid Bodies

Free body diagram–Types of supports and their reactions–requirements of stable equilibrium–Static determinacy, Moments and Couples–Moment of a force about a point and about an axis–Vectorial representation of moments and couples–Varignon's Theorem-Equilibrium of Rigid bodies in two dimensions.

Trusses: Introduction, axial members, calculation of forces on truss members using method of Joints-Method of sections. [12]

Properties of Surfaces and Solids

Determination of Areas and Volumes-Centroid, Moment of Inertia of plane area (Rectangle, circle, triangle using Integration Method; T section, I section, Angle section, Hollow section using standard formula) - Parallel axis theorem and perpendicular axis theorem- Polar moment of inertia -Mass moment of inertia of thin rectangular section - Relation between area moment of inertia and mass moment of inertia. [12]

Dynamics of Particles

Displacement, Velocity, acceleration and their relationship–Relative motion -Projectile motion in horizontal plane–Newton's law–Work Energy Equation – Impulse and Momentum. [12]

Elements of Rigid Body Dynamics, Friction and Beams

Translation and Rotation of Rigid Bodies: Velocity and acceleration–General Plane motion: Crank and Connecting rod mechanism.

Friction

Frictional force–Laws of Coloumb friction–Simple contact friction–Ladder Friction-Rolling resistance–Ratio of tension in belt.

Transverse bending on beams

Types of beams: Supports and loads – Shear force and bending moment in beams – Cantilever, simply supported and overhanging beams. [12]

Total Hours: 45 + 15 (Tutorial) = 60

Text book(s) :

1. Rajasekaran, S., Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., 3rd Edition, 2017.
2. Beer, F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", Statics and Dynamics, McGraw-Hill International, 11th Edition, 2016.

Reference(s) :

1. Jayakumar, V. and Kumar, M, "Engineering Mechanics", PHI Learning Private Ltd, New Delhi, 2012
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd.,
3. Bansal R.K," Engineering Mechanics" Laxmi Publications (P) Ltd, 2011.
4. Irving H. Shames, Engineering Mechanics: Statics and Dynamics", Pearson Education Asia Pvt. Ltd, 4thEdition, 2003.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
50 ME 003 & Engineering Mechanics	CO1	3	2	2	3								2	3	1	1
	CO2	3	2	2	3								2	3	1	1
	CO3	3	2	2	3								2	3	1	2
	CO4	3	2	2	3								2	3	1	2
	CO5	3	2	2	3								2	3	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 EE 001 - Basic Electrical Engineering								
Common to all branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Objective(s)	• To understand and determine the electrical quantity in DC and AC circuits. • To understand the working principle of electrical machines by applying Faraday's laws of electromagnetic induction. • To know the sources of electric power generation and explain the working principles of different types of power plant. • To understand the various components of low voltage electrical installation and basic house wiring. • To implement the principles of energy conservation and understand the need of earthing and safety measures.
Course Outcomes	**At the end of the course, the students will be able to** 1. Analyze the fundamentals of electric circuits excited by DC and AC supply. 2. Explain the construction and working of DC and AC electrical machines and identify their applications. 3. Describe the operation of various types of power plant with their layouts 4. Recognize the significance of various components of low voltage electrical installations. 5. Demonstrate the various types of wiring used in domestic and to know safety measures.

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

DC and AC Circuits - Electrical circuit elements (R, L and C), Voltage and current sources - Kirchhoff's current and voltage laws - Serial and parallel circuits - Analysis of simple circuits with DC excitation. Representation of sinusoidal waveforms, Peak and RMS values, Phasor representation, Real power, Reactive power, Apparent power, Power factor. Analysis of singlephase AC circuits consisting of R, L, C, RL, RC, RLC combinations. [12]

DC Machines - Construction, Types and Operation, Simple Problems - Applications. [06]

AC Machines - Faraday's laws of electromagnetic induction - Transformers: Construction, Working principle, Types, Losses in transformers, Regulation, Efficiency and applications.
Generation of rotating magnetic fields - Three phase induction motor: Construction, working principle, Characteristics, Starting - Single phase induction motor: Construction, working principle and applications - Synchronous generators: Construction, Working principle and applications. [08]

Electrical Power Generation Systems - Sources of electrical energy: Renewable and nonrenewable - Principles and schematic diagram of Hydroelectric power plant, Thermal power plant, Nuclear power plant, Solar PV system and Wind energy conversion systems. [05]

Electrical Installations and House Wiring - Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB - Types of Batteries, Important Characteristics for Batteries - UPS.
Single phase and three phase systems: Three phase balanced circuits, Phase sequence, voltage and current relations in star and delta connections - Basic house wiring tools and components - Domestic wiring: Service mains, meter board, distribution board, energy meter. Different types of wiring: staircase, fluorescent lamp and ceiling fan. [08]

Electrical Energy Conservation & Safety - Elementary calculations for energy consumption - BEE Standards - Electrical energy conservation - Methods. Electric shock, Precautions against shock, Objectives of earthing, Types of earthing - Basic electrical safety measures at home and industry. [06]

Total Hours: 45

Text book(s) :

1	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2017.
2	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2017.

Reference(s) :

1	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2	E. Hughes, "Electrical and Electronics Technology", Pearson, 2016.
3	V. D.Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2015.
4	Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall, 2006.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 EE 001 &Basic Electrical Engineering	CO1	3	3			2					2	3		3	2
	CO2	3	3	1	1			2		2		2	1	3	2
	CO3	3	3	2	2			2	2	1			1	3	3
	CO4	3	3		2		2					2	2	3	2
	CO5	3	3	2	1	2	2			2		2	2	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MY 001 - Constitution of India								
Common to all Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	2	0	0	30	-	100	-	100

Objectives	• To know the premises informing the twin themes of liberty and freedom from a civil rights perspective. • To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in theearly years of Indian nationalism. • To address the role of socialism in India after the commencement of the Bolshevik Revolutionin 1917 and its impact on the initial drafting of the Indian Constitution. • To gain knowledge on bill passing • To acquire knowledge on function of election commission
Course Outcomes	**At the end of the course the students will be able to:** 1. Discuss the growth of the demand for civil rights in India for the bulk of fns before the arrival of Gandhi in Indian politics. 2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. 3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. 4. Discuss the passage of the Hindu Code Bill of 1956. 5. Explain the functions of Election Commission

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted forquestions in the examinations shall not depend on the number of hours indicated.

History of Making of the Indian Constitution

History - Drafting Committee, (Composition & Working) [05]

Philosophy of the Indian Constitution

Preamble - Salient Features [05]

Contours of Constitutional Rights & Duties

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation -Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties. [05]

Organs of Governance

Parliament - Composition - Qualifications and Disqualifications - Powers and Functions Executive - President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions. [05]

Local Administration

District's Administration head: Role and Importance, - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Pachayati raj: Introduction, PRI: ZilaPachayat - Electedofficials and their roles, CEO ZilaPachayat: Position and role- Block level: Organizational Hierarchy (Different departments) -Village level: Role of Elected and Appointed officials - Importance of grass root democracy. [05]

Election Commission

Election Commission: Role and Functioning- Chief Election Commissioner and Election Commissioners- State Election Commission: Role and Functioning- Institute and Bodies for the welfare of SC/ST/OBC and women.[05]

Total Hours: 30

Text book(s) :

1. The Constitution of India, 1950 (Bare Act), Government Publication
2. S.N, Busi, Ambedkar, B.R.,"Framing of Indian Constitution", 1st Edition, 2015.

Reference(s) :

1. Basu, D D., "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. M.P Jain, "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.
3. S R Bhansali, Textbook on The Constitution of India, Universal Publishers, 2015
4. M P Jain, Outlines of Indian Legal and Constitutional History, Lexisnexis, 2014

Pre-requisite: **NIL**

R8/ w.e.f.27/12/2023
Passed in the BoS Meeting Held on 24/11/2023
Approved in Academic Council Meeting held on 23/12/2023

BoS Chairman

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MY 001 **&** Constitution of India	CO1								2	2	1		2		
	CO2								2	2	1		2		
	CO3								2	2	1		2		
	CO4								2	2	1		2		
	CO5								2	2	1		2		

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 CH 0P1- Chemistry Laboratory

Common to all branches

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

Objective(s)

- To test the knowledge of theoretical concepts.
- To develop the experimental skills of the learners.
- To facilitate data interpretation.
- To enable the learners to get hands-on experience on the principles discussed in theory sessions.
- To expose the learners to various industrial and environmental applications.

Course Outcomes

At the end of the course, the student will learn about

1. Estimate the amount of hardness, alkalinity, chloride ion and dissolved oxygen in watersample
2. Estimate the amount of barium chloride and mixture of acids by conductometry
3. Estimate the amount of ferrous ion by potentiometry
4. Estimate the amount of acid by pH metry and apply the knowledge of pH determination forhealth drinks, beverages, soil, effluent and other biological samples
5. Estimate the amount of ferrous ion by spectrophotometry
6. Determine the percentage of corrosion by weight loss method

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of chloride content in water sample (Argentometric method).
4. Determination of dissolved oxygen in boiler feed water (Winkler's method).
5. Estimation of barium chloride by conductometric precipitation titration.
6. Estimation of mixture of acids by conductometric titration.
7. Estimation of ferrous ion by potentiometric titration.
8. Estimation of HCl, beverages and other biological samples by pH meter.
9. Estimation of iron content by spectrophotometry method.
10. Determination of corrosion rate and inhibitor efficiency by weight loss method.

Total Hours: 60

Text book(s) :

1. Dr. S.Vairamand Dr. Suba Ramesh, "Engineering Chemistry", Wiley India Private Limited , Delhi, 2nd edition, January 2013.
2. S.S. Dara, "A Text Book on Experiments and Calculations Engineering", S.Chand & Co., Ltd., 2nd edition, 2003

Reference(s) :

1. Mendham. J, Denney. R.C, Barnes. J.D, and Thomas. N.J.K, "Vogel's Text Book of Quantitative Chemical Analysis", Pearson Education, 6th edition, 2009.
2. O P Vermani , and A K Narula, "Applied Chemistry : Theory And Practice, New Age International (P)
3. Gary D. Christian, "Analytical Chemistry", John Wiley & Sons, 6th edition, 2007.
4. Chatwal Anand, "Instrumental Methods of Chemical Analysis", Himalaya Publications, 5th Edition,2019.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 CH 0P1**&** Chemistry Laboratory	CO1	3	3	3	3	3	3	3	3	2		3	2	3	2
	CO2	3	3	3	3	3	3	2	3	1		2	1	2	1
	CO3	3	3	3	3	3	3	3	2	3		2	1	3	2
	CO4	3	3	3	3	3	3	2	1			2		2	3
	CO5	3	3	3	3	3	3	2	1			2	1	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K. S. Rangasamy College of Technology – Autonomous **R2018**

50 ME 0P1 – Engineering Practices Laboratory

Common to all branches

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

Objective(s)	• To acquire skills in basic engineering practices. • To identify the hand tools and instruments. • To provide hands on experience in Fitting, Carpentry, Sheet metal, Welding and lathe shop. • To provide practical training on house hold wiring and electronic circuits. • To offer real time activity on plumbing connections in domestic applications.
Course Outcomes	**At the end of the course, the student will be able to** 1. Perform facing, plain turning, drilling. 2. Make a model of fitting and carpentry: Square, Dovetail and Cross lap joints. 3. Fabricate the models of sheet metal and welding joints. 4. Construct and demonstrate electrical and electronic wiring circuit. 5. Construct the water pipe line in plumbing shop.

Machine shop

Safety aspects in machine shop, Study of Lathe and Radial drilling machine, Turning, Facing and Drilling.

Fitting and Carpentry

Safety aspects in Fitting and Carpentry, Study of tools and equipments, Preparation of models- Square, Dove tail joint, Cross Lap.

Sheet Metal and Welding

Safety aspects in Sheet metal and Welding, Study of tools and equipments, Sheet metal models - Scoope, Cone, Tray, Preparation weld joints -Lap, butt, T-joints. Study of Gas Welding and Equipments.

Electrical Wiring & Electronics

Safety aspects of Electrical wiring, Study of Electrical Materials and wiring components, Wiring circuit for a lamp using single and stair case switches. Wiring circuit for fluorescent lamps, Basic electronic circuit.

Plumbing

Study of plumbing tools, assembly of G.I. pipes/ PVC and pipe fittings, Cutting of threads in G.I.Pipes/PVC by thread cutting dies.

Smithy, Plastic moulding and Glass cutting

Safety aspects in smithy, plastic moulding and glass cutting, Study of tools and equipments

Lab Manual :

1. "Engineering Practices Lab Manual", Department of Mechanical Engineering, KSRCT.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
50 ME 0P1 & Engineering Practices Laboratory	CO1	3	2	2	1	3	2	2	3	1	2	2	1	3	1	2
	CO2	3	2	2	1	3	2	2	3	1	2	2	1	3	1	2
	CO3	3	2	2	1	3	2	2	3	1	2	2	1	3	1	2
	CO4	3	2	2	1	3	2	2	3	1	2	2	1	3	1	2
	CO5	3	2	2	1	3	2	2	3	1	2	2	1	3	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 EN 002 – Communication Skills II								
Common to all Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	1	1	0	30	2	40	60	100

Objective(s)	• 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
Course Outcomes	**At the end of the course, the student will be able to** 1. Identify speaker's purpose and tone, comprehend relationship between ideas and respondto the listening content 2. Use communication strategies, vocabulary and appropriate grammatical structures for effective oral interactions 3. Make inferences and predictions, develop reading speed, build academic vocabulary by utilizing digital literacy tools on textual comprehension 4. Use a variety of accurate sentence structures with functional vocabulary, apply the conventions of academic writing and use peer and teacher feedback for effective writing. 5. Demonstrate proficiency in communication skills in academic and professional contexts

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Advanced English Listening Module

Extended Listening to Podcasts – Listen and Watch Video Clips - answering Inferential Multiple Choice Questions and Vocabulary Check- Listening to Lengthy Discourses – Structured Listening – Listening to Songs and Cognizing the Lyrics-Listening to popular speeches, news briefs and stories. [04]

Oral Communication

Debates – Group Discussion (Structured) and rotate roles – Elevator Speech – Prepared Talk – Extempore – Brief Technical presentations- Spin-a-Yarn – Short Film reviews – talk on silent videos – Dialogues and Role plays (Intermediate & Higher Level) – Interviews [04]

Critical Reading Process

Silent Reading – Scanning and Skimming - Reading comprehension with logical reasoning questions – Cognition of Theme and Inferential Meaning – advanced Academic and Functional Vocabulary List (1000 words) – word webs and semantic threads - Loud Reading – Modulation and Pronunciation Check – Mind maps – Note making – Deep Reading Skills. [04]

Academic Writing Practices

Sentence Equivalence and Text completion tasks – Data Interpretation - Essay Writing – Letter Writing – Business Emails – Conversational Fill Ups-Rewordify (select a text and simplify/enhance the language)- Reports on events. [03]

Total Hours: 15 + 15 (Tutorial) = 30 hours

Text Books:

1. M.Ashraf Rizvi, 'Effective Technical Communication', 2nd Edition, McGraw Hill Education (India) Private Limited, Chennai, 2018
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, N.York, 2005
2. Ruth Wainry B, 'Stories: Narrative Activities for The Language Classroom', Cambridge University Press, N.York, 2005
3. Stuart Edman, 'English Vocabulary in Use: Upper Intermediate', Cambridge University Press, N.Y, 2006
4. https://www.khanacademy.org/test-prep/sat/sat-reading-writing-practice

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 EN 002 – Communication Skills II	CO1	1	2		2	1	1	1	2	3	3	2	3		1
	CO2	1	2	1	3	2	1		2	3	3	2	3		2
	CO3	1	2	1	2	1	1	2	2	2	3	2	3	1	2
	CO4	1	3	1	2	2	2	1	2	2	3	3	3	1	2
	CO5	1	1	1	1	1	1	1	1	3	3	2	3	1	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MA 002 - Laplace Transform and Complex Variables

Common to All Branches

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

Objective(s)

- Multiple integration is used to solve problems involving volume and surface area.
- Vector calculus can be widely used for modeling the various of physics.
- Introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of the fundamental concepts of complex analysis such as analytic function and complex integral.
- Identify and construct complex - differentiable function.
- Laplace Transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

Course Outcomes

At the end of the course, the students will be able to

1. (i) Evaluate double and triple integrals.
   (ii) Understand the concept of Beta and Gamma functions.
2. Apply the concept of vector calculus to verify Green's, Stoke's and Gauss divergence theorems.
3. Construct analytic function and bilinear transformation.
4. Expand the functions as Taylor's and Laurent's series and evaluate the complex integrals.
5. Apply Laplace transform techniques for solving differential equations.

The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the numbers hours indicated.

Multiple Integrals

Double integration – Cartesian and polar coordinates – Change of order of integration – Area between two curves – Area as double integral – Triple integration in Cartesian coordinates. Beta and Gamma functions**:** Relationship between Beta and Gamma functions – Properties – Problems**.** [09]

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 - Green's theorem in the plane - Gauss divergence theorem -Stokes' theorem(without proof)- verification of the above theorems and evaluation of integrals using them. [09]

Analytic Functions

Analytic functions – Necessary conditions (Cauchy–Riemann equations)- Polar form of Cauchy–Riemann equations – Sufficient conditions (without proof) – Properties of analytic functions – Harmonic function –Harmonic conjugate – Construction of analytic functions– Conformal mapping: w = z + a, az, 1/z-Bilinear transformation. [09]

Complex Integration

Cauchy's Integral theorem (without proof) – Cauchy's integral formula – Taylor's and Laurent's series (without proof) Classification of singularities – Cauchy's residue theorem – Contour integration – Circular and semi-circular contours (excluding poles on real axis). [08]

Laplace Transforms

Conditions for existence – Transform of elementary functions – Basic properties – Shifting theorems- Derivatives andintegralsoftransforms—Transformofunitstepfunction–Dirac'sdeltafunction-Initialandfinalvaluetheorem– Transform of periodic functions. Inverse Laplace transform – Convolution theorem(excluding proof) – Solution of secondorderordinarydifferentialequationwithconstantco-efficients–simultaneousequationsoffirstorderwithconstantco-efficients. [10]

	Total Hours: 45 + 15(Tutorial) = 60 hours
Text book(s) : :	
1.	Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014. Website: https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html
2.	Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Limited, New Delhi, 2016.
Reference(s) :	
1.	Bali.N.P and Dr.Manish Goyal,"A text book of Engineering Mathematics",8th edition,Laxmi Publications (P) Ltd,2011
2.	Veerarajan.T., "Engineering Mathematics", for Semesters I and II , Tata McGraw Hill Publishing Co., New Delhi., 2010.
3.	Dr.P.Kandasamy Dr.K.Thilagavathy Dr.K.Gunavathy , "Engineering Mathematics -II", S.Chand & Company Ltd, New Delhi.
4.	SWAYAM online video courses.(www.swayamprabha.gov.in)

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MA 002 & Laplace Transform and Complex Variables	CO1	3	3	3	2	3							2	3	
	CO2	3	3	2	2	3							2	3	
	CO3	3	3	3	2	2							2	3	
	CO4	3	3	2	2	3							2	3	
	CO5	3	3	2	3	3							2	3	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50PH001 Applied Physics							
B.E. Mechatronics Engineering							
Semester	**Hours/week**				**Credit**	**Maximum marks**	
	L	**T**	**P**	**Total hrs**	**C**	**CA**	**ES**	**Total**
II	3	0	0	45	3	40	60	100

Objectives

- Analyze the crystal parameters to investigate crystal structures, crystal growthtechniques and to classify the type of the defect present in the crystal
- To enrich the understanding of various types of materials and their applications in engineering and technology.
- To enable the students to correlate the theoretical principles with application oriented studies in electrostatics.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, classifications of magnetic materials and its applications.
- To introduce advanced materials and nano technology for engineering applications

Course Outcomes

At the end of the course, the student will be able to

1. Explain the basics of crystals and different crystal growth techniques.
2. Solve the engineering problems like plastic deformation, slip and twinning by materialtesting methods.
3. Gain the knowledge on electrostatics and dielectric materials.
4. Expand the knowledge on magneto static boundary conditions and magnetic materials.
5. Acquire a broad view of smart materials and nanomaterials.

Note: The hours given against each topic are of indicative. The faculty has the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Crystal Physics

Introduction-Fundamental terms of crystallography–Bravais lattice–SC, FCC, BCC, HCP crystals-Miller indices-Relation between inter planer distance and inter atomic distance-Crystal defects–Crystal growth techniques-solution, melts (Bridgman and Czochralski) and vapour growth techniques. [09]

Properties of Matter and Materials Testing

Properties of matter: Hooke's Law - Stress -Strain Diagram - Elastic Moduli - Relation between elastic constants - Poisson's Ratio - Expression for bending moment and depression - Cantilever - Expression for Young's modulus by Non uniform bending and its experimental determination.

Materials testing: Mechanism of plastic deformation- slip and twinning – types of fracture – Vickers Hardness

test - fatigue and creep test. [09]

Electrostatics

Maxwell's equation for electrostatics – E due to straight conductors, circular loop, infinite sheet of current-electric field intensity (D) - Electric potential - dielectrics - dielectric polarization -internal field – Clausius-Mossotti equation - dielectric strength – Dielectric loss- Break down mechanism-applications. [09]

Magnetostatics

Maxwell's equation for magnetostatics - B in straight conductors, circular loop, infinite sheet of current - Lorentz force, magnetic field intensity (H) – Biot–Savart's Law – Ampere's Circuit Law –Magnetic flux density (B) – magnetic materials – Classification – properties-Domain theory of ferromagnetism- Hysteresis- Hard and Soft magnetic materials-Ferrites: structure, preparation and applications-Applications. [09]

Advanced Materials and Nanotechnology

New Engineering Materials: Metallic glasses – preparation, properties and applications – Shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications – advantages and disadvantages of SMA

Nano Materials: Properties- Top-down process: Ball Milling method – Bottom-up process: Vapour Phase Deposition method- Carbon Nano Tube (CNT): Properties, preparation by electric arc method, Applications. [09]

Total Hours: 45

Text book(s) : :

1. V.Rajendran, "Engineering Physics", Tata McGraw Hill, New Delhi (2011)
2. Brijlal and N.Subramanian, Electricity and magnetism,6th Edition, Agra, Ratan & Prakash (2006)

Reference (s) :

1. W.H.Hayt and A.John Buck, "Engineering electromagnetics", 6thEdition Tata McGraw Hill, New Delhi. (2014)
2. David J Griffith, "Introduction to Electrodynamics",2nd Edition, Newdelhi, Prentice Hall of India Pvt. Ltd.(1997)
3. K.A.Gagadhar & Ramanathan and P.M.,Khanna, "Electromagnetic field theory", 5thEdition, Publishers,New Delhi. 2013.
4. Dattuprasad and Ramanlal Joshi, (2016) "Engineering Physics" Tata McGraw hill Education.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 PH 001 & Applied Physics	CO1	3	3	2	2	2	2	2	2	2	2	-	-	2	2
	CO2	3	3	3	2	2	-	2	2	2	1	1	-	2	1
	CO3	3	2	3	2	2	1	2	1	-	2	-	-	2	2
	CO4	3	3	3	1	3	2	2	2	1	1	-	-	1	-
	CO5	3	3	3	2	2	3	-	1	1	1	-	-	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 CS 001 - Programming for Problem Solving

Common to all Branches

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

Objective(s)

- To learn the evolution of computers and examines the most fundamental element of the C language
- To examine the execution of branching, looping statements, arrays 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

Course Outcomes

At the end of the course, the student will be able to:

1. Infer the evolution, generation, representation of problem and recognize the concepts of data types and expressions
2. Annotate the concept of console Input and output features and examine the execution of branching, looping statements, arrays and strings
3. Recognize the concepts of functions, recursion, storage class specifies and pointers with its features
4. Comprehend basic concepts of structures, unions, user defined data types and preprocessor
5. Interpret the file concepts using proper standard library functions

Note: Hours notified against each unit in the syllabus are only indicative but are not decisive. Faculty may decide the number of hours for each unit depending upon the concepts and depth. Questions need not be asked based on the number of hours notified against each unit in the syllabus.

Introduction to Computer and Programming

Introduction to Computers - Evolution of computers - Generations of computers and Programming Languages– Introduction to components of a computer system -Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart–Pseudocode with examples. From algorithms to programs– variables (with data types)– Type Qualifiers - Constants – Operators –expressions and precedence. [09]

I/O, Branching, Loops and Arrays

Console I/O– Unformatted and Formatted Console I/O – Conditional Branching and Loops -Writing andevaluation of conditionals and consequent branching -Iteration and loops - Arrays (1-D, 2-D), Character arrays and Strings [09]

Functions and Pointers

Functions: Scope of a Function – Library Functions and User defined functions - Function Prototypes –Function Categorization - Function Arguments - Arguments to main function - The return Statement - Recursion - 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– Dynamic memory allocation [09]

Structures, Unions, Enumerations, Typedef and Preprocessors

Structures - Arrays of Structures- Arrays and Structures within Structures - Passing Structures to Functions - Structure Pointers - Unions – Bit Fields - Enumerations - typedef – The preprocessor and comments. [09]

File

File: Streams –Reading and Writing Characters - Reading and Writing Strings -,File System functions - Random Access Files [09]

Total Hours: 45

Text book(s) : :

1	Herbert Schildt, “The Complete Reference C”, Fourth Edition, Tata McGraw Hill Edition, 2010.
2	Byron Gottfried, “Programming with C”, Third Edition, McGraw Hill Education, 2014.

Reference(s) :

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

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 CS 001 & Programming for Problem Solving	CO1	1	3		2	2							1		
	CO2	1	3		3	3			2				2	3	3
	CO3	1	3		2	3			2				2	2	3
	CO4	1	3		3	3			2				2	3	3
	CO5	1	3		2	3			2				2	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 ME 001 - Engineering Drawing

Common to Civil, MECH, MCT & TXT

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I/II	2	0	4	90	4	50	50	100

Objective(s)

- To acquire various concepts like dimensioning, conventions and standards.
- To impart the graphic skills for converting pictorial views of solids in to orthographic views.
- To learn the concept of projection of solids.
- To understand the section of solids and development of surfaces.
- To learn the concept of isometric projection.

Course Outcomes	**At the end of the course, the student will be able to** 1. Use the drafting instruments and construct the conic sections 2. Convert the pictorial views of solids in to orthographic views 3. Draw the projections of regular solids and floor plans 4. Draw the true shape of sections and develop the lateral surfaces of right solids 5. Sketch the three dimensional view of solids for given orthographic views.

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Introduction to Engineering Drawing and Plane Curves

Use of drawing instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning – Drawing sheet layouts - Title block – Line types – Scales: plain, diagonal and vernier scales. Construction of ellipse, parabola and hyperbola (Eccentricity method) - Construction of rectangular hyperbola - Construction of cycloids, epicycloids and hypocycloids. [7+12]

Orthographic Projection

Introduction to orthographic projections – Planes of projection – Projection of points and lines inclined to both planes – Projection of planes (Inclined to one plane and parallel to other – Inclined to both planes) - Conversions of pictorial views to orthographic views. [6+12]

Projection of Solids and Floor plan

Projections of simple solids: prism, pyramid, cylinder and cone (Axis of solid inclined to both HP and VP) - Floor plans: windows, doors and fixtures such as water closet (WC), bath sink, shower etc. [5+12]

Sections of solids and Development of surfaces

Sections of solids :Prism, Cylinder, Pyramid, Cone – Auxiliary Views - Draw the sectional orthographic views of geometrical solids, objects from industry - Development of surfaces of Right solids – Prism, Pyramid, Cylinder and Cone. [6+12]

Isometric Projection

Principles of isometric projection – Isometric scale – Isometric projections of simple solids: Prism, pyramid, cylinder and cone - Isometric projections of frustum and truncated solids - Combination of two solid objects in simple vertical positions. [6+12]

Total Hours: 90

Text book(s) :

1. Bhatt N.D., "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 53rd Edition, Gujarat, 2014.
2. Basant Agarwal and C.M.Agarwal., "Engineering Drawing", McGraw Hill Education, 2013.

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. Venugopal K., "Engineering Graphics", New Age International (P) Limited, 2014.
4. Dhawan, R.K., "A Text Book of Engineering Drawing" 3rd Revised Edition,S.Chand Publishing,New Delhi,2012.

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 ME 001 & Engineering Drawing	CO1	3	3	3	3	3	1	1	1		3	2	2	3	2
	CO2	3	3	3	3	3	1		1		3	1	1	3	2
	CO3	3	3	3	3	3	1		1		3	1	1	3	2
	CO4	3	3	3	3	3	1		1		3	1	1	3	2
	CO5	3	3	3	3	3	1		1		3	1	1	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MY 002 - Environmental Science							
Common to All Branches							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
II	2	0	0	30	-	100	-	100
Objectives	• To help the learners to analyze the importance of ecosystem and biodiversity. • To familiarize the learners with the impacts of pollution and control.						

	• To enlighten the learners about waste and disaster management. • To endow with an overview of food resources, human health, population, awareness. • To recognize the social responsibility in environmental issues.
Course Outcomes	**At the end of the course, the student will be able to:** **1.** Recognize the concepts and issues related to environment, ecosystem and biodiversity. **2.** Analyze the source, effects, and control measures of pollution. **3.** Enlighten of solid waste and disaster management. **4.** Awareness about food resources, population and health issues. **5.** Analyze the social issues and civic responsibilities.

Environmental Studies, Ecosystem and Biodiversity

Environmental studies - Scope and multidisciplinary nature - Need for public awareness - Ecosystem - Structure and function. Biodiversity - Values of biodiversity - Endangered and endemic species - Hot spots - India a mega biodiversity nation - Threats - Conservation - In-situ and ex-situ - Case studies. [06]

Environmental Pollution

Pollution - Air, water, soil, noise and nuclear - sources, effects and control measures - Impacts of mining - Environment protection act- Case studies. [06]

Waste and Disaster Management

Waste - Solid waste - e-waste - sources, effects and control measures. Disaster management - Earth quakes - Landslides - Floods - Cyclones - Tsunami - Disaster preparedness - Case studies. [05]

Food Resources, Human Population And Health

World food problems - over grazing and desertification - effects of modern agriculture. Population - Population explosion and its impacts - HIV/AIDS - Cancer- Role of IT in environment and human health - Case studies. [06]

Social Issues and the Environment

Unsustainable to sustainable development - Use of alternate energy sources - Rain water harvesting - Water shed management - Deforestation - Greenhouse effect - Global warming - Climate change - Acid rain - Ozone layer depletion - Waste land reclamation. Consumerism and waste products - Role of an individual in conservation of natural resources - Case studies. [07]

Total Hours: 30

Text book(s) :

1	Anubha Kaushik and C P Kaushik, "Perspectives in Environmental Studies " , New Age International Publishers, New Delhi, 6th edition , January 2018.
2.	Tyler Miller. G, "Environmental Science", Cengage Publications, Delhi, 16th edition, 2018.

Reference(s) :

1.	Gilbert M.Masters and Wendell P. Ela, "Environmental Engineering And Science", PHI Learning Private Limited, New Delhi, 3rd Edition, 2013.
2.	Rajagopalan. R, "Environmental Studies" Oxford University Press, New Delhi, 2nd Edition, 2012.
3.	Deeksha Dave and Katewa. S.S, "Environmental Studies", Cengage Publications, Delhi, , 2ndEdition , 2013.
4.	Cunningham, W.P. and Saigo, B.W. Environment Science, Mcgraw-Hill, USA. 9th edition, 2007.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MY 002 & Environmental Science	CO1	2	1	2	1	1	2	3	3	3	3		2	2	3
	CO2	3	3	3	3	2	3	3	3	3	3	2	2	2	3
	CO3	3	3	3	3	2	3	3	3	3	3	2	2	2	3
	CO4	2	2	2	3	3	3	3	3	2	2	3	2	2	3
	CO5	3	3	3	3	3	3	3	3	3	3	3	2	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							R2018
50PH0P1 Engineering Physics Laboratory							
Common to - MECH, MCT, TXT, FT, BT, NST, CIVIL							
Semester	**Hours/week**			**Total Hrs**	**Credit**	**Maximum marks**	
	L	**T**	**P**	60	**C**	**CA**	**ES**	**Total**
II	0	0	4		2	60	40	100

Objectives	• To gain practical knowledge by applying the experimental methods to correlate with the Physics theory. • Demonstrate an ability to make physical measurements and understand the limits of precision in measurements • To introduce different experiments to test basic understanding of physics concepts applied in optics and electronics. • To enable the students to correlate the theoretical principles with application oriented studies. • Analyze the behavior and characteristics of various materials for its optimum utilization
Course Outcomes	**At the end of the course, Students will able to** 1. Know the concept stress, strain and elastic limit of a given sample. (1-3) 2. Grasp the knowledge of dependency of viscosity and surface of a liquid. (4-6) 3. Have a knowledge of diffraction property of light through grating and fiber opticcable(7-8) 4. Gain the dielectric constant of a given material. (9) 5. Acquire the knowledge of semiconductor photovoltaic solar cells.(10)

LIST OF EXPERIMENTS

1. Determination of Young's modulus of a steel bar by uniform bending method.
2. Determination of Young's modulus of a cantilever (Pin & Microscope method).
3. Determination of rigidity modulus of a wire by torsional pendulum.
4. Comparison of co-efficient of viscosity of two different liquids by Poiseuille's method.
5. Co-efficient of viscosity of highly viscous liquids.
6. Comparison of surface tension of two different liquids by capillary rise method.
7. Determination of NA, acceptance angle, and wave length of a given laser by using optical fiber.
8. Determination of wavelength of mercury spectral lines – spectrometer grating.
9. Determination of dielectric constant.
10. V-I characteristics of solar cell.

Total Hours= 60

Lab Manual

"Physics Lab Manual", Department of Physics , KSRCT

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 PH 0P1 & Engineering Physics Laboratory	CO1	3	3	2	2	2	2	2	2	2	2	-	2	2	2
	CO2	3	3	3	2	2	-	2	2	2	1	1	2	2	1
	CO3	3	2	3	2	2	1	2	1	-	2	2	-	2	2
	CO4	3	3	3	1	3	2	2	2	1	1	-	1	1	-
	CO5	3	3	3	2	2	3	-	1	1	1	2	-	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 CS 0P1 - Programming for Problem Solving Laboratory

Common to All Branches

Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

Objective(s)	• 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
Course Outcomes	**At the end of the course the students will be able to** 1. Apply how to read, display basic information and use selection and iterative statements 2. Demonstrate C program to manage collection of related data 3. Design and Implement different ways of passing arguments to functions, Recursion and implement pointers concepts 4. Develop a C program to manage collection of different data using structures, Union, user-defined data types and preprocessor directives 5. Demonstrate C program to store and retrieve data using file concepts

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.
Lab Manual	
Lab Manual "Programming for Problem Solving Laboratory "Department of CSE,KSRCT.	

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 CS 0P1 & Programming for Problem Solving Laboratory	CO1	1	3		2	2							1		
	CO2	1	3		3	3			2				2	3	
	CO3	1	3		2	3			2				2		1
	CO4	1	3		3	3			2				2	2	
	CO5	1	3		2	3			2				2		1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							R2018
50 MA 003 - Partial Differential Equations and Statistics							
Common to Mechanical Engineering and Mechatronics Engineering							
Semester	Hours / Week			Total hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
III	3	1	0	60	4	40	60	100

Objective(s)	• To develop the mathematical skills for solving partial differential equations • To understand Fourier series representation of periodic signals. • To appreciate physical significance of fourier series techniques in solving one dimensionalwave and heat equations. • To provide an understanding of the statistical methods and distribution concept by which reallife problems areanalyzed. • To design and analyse the statistical experiments
Course Outcomes	**At the end of the course, Students will able to** 1. i] Formulate partial differential equations and solve the standard partial differential equations ii) applytheappropriatemethodtosolveLagrange'slinearequationsandsolve linear partial differential equations with constant coefficients. 2. i] Obtain the Fourier series expansion for the periodic function. ii) Understand the notions of half–range Fourier series and harmonic analysis 3. i] know about the procedure to find the solution of one-dimensional wave equation with zero or non-zero velocity. ii) understand the procedure to find the solution of one-dimensional heat equation with steady state condition. 4. Calculate and apply measures of central tendency, measures of dispersion, correlation and regression. 5. i] Test the statistical hypothesis using t, F and¤²distributions. ii) Analyze the design of experiments using one - way and two – way classifications.

The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the numbers hours indicated.

Partial Differential Equations

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Non-linear partial differential equations of first order [Type I – IV] – Solution of partial differential equations of first order –

Lagrange's linear equations – Linear partial differential equations with constant coefficients [09]

Fourier Series

Dirichlet's conditions – Fourier series – Odd and even functions – Half range Fourier series – Root mean square value of a function – Parseval's identity –Harmonic analysis. [08]

Boundary value problems

Classification of second order quasi - linear partial differential equations – Solution of one-dimensional wave equation – Solution of one-dimensional heat equation–Problems. [08]

Basic Statistics

Measures of central tendency: Mean, Median and Mode- measures of dispersion: Range, Quartile deviation and Standard deviation –measures of skewness : Bowley's co-efficient of skewness - Pearson's co-efficient of skewness - moments - kurtosis – correlation – rank correlation–regression. [12]

Testing of hypothesis and Design of experiments

Small sample tests based on t, F and 3^2distributions – Contingency table [Test for Independency] – Goodness of fit – One way classification – Completely randomized design – RBD – Two way classification –Latin square design. [08]

Total Hours: 45 + 15[Tutorial] = 60 hours

Text book[s]:

1	Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.Web site: https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html
2	Gupta, S.C, and Kapur, J.N., "Fundamentals of Mathematical Statistics", Sultan Chand, Ninth edition, New Delhi, 1996.

Reference(s) :

1	Veerarajan T., "Probability, Statistics and Random process", 3rd Edition, Tata Mc-Graw Hill Publications, New Delhi, 2008.
2	Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Lakshmi Publications Pvt Ltd, New Delhi, 2014.
3	Mathematical methods and its applications ,Dr. P. N. Agrawal,Dr. S. K. Gupta, NPTEL online video courses
4	Basic statistics – nptel nptel.ac.in/courses/105103140/2

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MA 003 & Partial Differential Equations and Statistics	CO1	3	3	3	3	3							2	3	
	CO2	3	3	3	3	3							2	3	
	CO3	3	3	3	3	2							2	3	
	CO4	3	3	3	2	2							2	3	
	CO5	3	3	3	2	3							2	3	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 302 - Analog Devices and Digital Circuits

B.E. Mechatronics Engineering

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

Objectives

- To procure the fundamental knowledge in semiconductor diodes and applications
- To impart the fundamental knowledge in the areas of transistors and amplifiers.
- To equip learners with Boolean algebra and design of combinational logic circuits.
- To acquaint learners with fundamentals and design of sequential circuits
- To educate learners with the basics of memory devices and implement combinational circuits using the same.

Course Outcomes

At the end of the course, the students will be able to:

1. Demonstrate the characteristics of Semiconductor Diodes
2. Describe the characteristics of transistor and amplifiers
3. Practice the Boolean techniques and design combinational circuits.
4. Design Synchronous sequential circuit using flipflops.
5. Construct combinational logic functions using Programmable Logic Devices

Semiconductor Diodes and Applications

Intrinsic and Extrinsic semiconductors - drift and diffusion current -formation of PN junction – VI characteristics of diode – static and dynamic resistance. Zener diode – photo diode – light emitting diode – laser diode – optocoupler- Clipper and Clamper - voltage regulator and multipliers. [09]

Transistor and Operational Amplifiers

Construction & operation of BJT - Transistor characteristics - CE, CB and CC configuration - Construction & operation of JFET and MOSFET – FET characteristics - Ideal Op-Amp characteristics - Open loop , Closed loop configurations - Inverting & non-inverting amplifier – voltage follower - Summing amplifier- Comparators - Schmitt Trigger – Instrumentation Amplifier. [09]

Boolean Algebra and Combinational Circuits

Boolean postulates and laws - Minimization of Boolean expressions - Karnaugh map minimization - Quine-McCluskey method of minimization.

Combinational circuits: Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – BCD adder – Multiplexer – Demultiplexer – Encoder – Decoder– Parity checker – parity generators – Code converters – Magnitude Comparator. [10]

Sequential Circuits

Latches, Flip-flops – SR, JK, D, T and Master-Slave – Characteristic Equation – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops –Synchronous and Asynchronous Up/Down counters – Modulo–n counter, Registers – shift registers – Universal shift registers. [09]

Memory and Programmable Logic Devices

Classification of memories: ROM – PROM – EPROM – EEPROM – RAM – Write operation – Read operation – Static RAM Cell - Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PROM, PLA and PAL. [08]

Total hours: 45

Text book(s) : :

1	Thomas L. Floyd, "Electronic Devices", Prentice Hall of India Pvt. Ltd.,Pearson Education Pvt. Ltd., New Delhi, 10thEdition, 2017.
2	Satish K Karna, "Digital Electronics", Vikas Publishing House Pvt. Ltd, New Delhi, 2nd Edition, 2017

Reference(s) :

1	David A.Bell, "Electronic Devices and Circuits", Oxford University Press, New Delhi, 5th Edition 2013.
2	Salivahanan S and Arivazhagan S, "Digital Circuits and Design", Vikas Publishing House Pvt. Ltd, New Delhi, 4th Edition, 2013.
3	Bishnu Charan Sarkar and Suvra Sarkar, "Analog Electronics Devices and Circuits", Damodar Group, West Bengal , 2019.
4	B.L. Theraja, A.K. Theraja, "A Text Book of Electrical Technology, Electronic Devices and Circuits", S. Chand Reprint, 2013

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 302 & Analog Devices and Digital Circuits	CO1	2	3	2	3	3	1	1	1		3	2	2	3	2
	CO2	3	3	3	3	3	1		2		3	1	1	3	2
	CO3	2	3	3	2	3	1	2	1		2	1	1	2	2
	CO4	3	3	3	3	3	1		1		2	1	1	3	2
	CO5	3	3	3	3	2	1		2		3	2	1	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 ME 004 - Strength of Materials

Common to MECH & MCT

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

Objective(s)

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading
- The main objective of the course will be to show how to determine the deflection of various beams.
- Understand the concept of buckling and be able to solve the problems related to isolated bars.
- Understanding the adequacy of mechanical and structural elements under different loads is essential for the design and safe evaluation of any kind of structure.

Course Outcomes	**At the end of the course, the student will be able to** 1. Estimate the stress intensity and deformation in solid bodies subjected to various types of loading and compute the principal stresses and strains by analytical and graphical methods. 2. Apply the concepts of shear force and bending moment diagrams in design of machine elements. 3. Estimate the slope and deflection in determinate beams 4. Compute the deflection and stress developed in shaft and springs. 5. Calculate the stresses, strains and deformation of the thin, thick cylindrical and spherical

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questionsin the examinations shall not depend on the number of hours indicated.

Stress, strain and deformation of solids

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- thermalstresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle. [09]

Transverse bending on beams

Beams and types transverse loading on beams- shear force and bend moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. [09]

Deflection of Beams

Deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. [09]

Torsion

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of leaf and helical springs. [09]

Thin, Thick Cylinders, Spheres and Columns

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure. Columns - Euler's theory, slenderness ratio, Rankine formula. [09]

Total Hours: 45 + 15(Tutorial) = 60

Text book(s) :

1.	Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2015.
2.	Rajput R K., "A Textbook of Strength of Materials (Mechanics of Solids)" 7th edition, S Chand and Company Ltd., New Delhi, 2018.

Reference(s) :

1.	Subramanian, R., "Strength of Materials", Oxford University Press, 2007.
2.	Rattan, S.S., "Strength of Materials", 2nd Edition, Tata McGrawHill Publishing Co. Ltd., New Delhi 2011.
3.	James M. Gere and Timoshenko, "Mechanics of Materials",CBS Publisher, New Delhi, 6thEdition, 2012.
4	Beer, F., Johnston, E.R., and Dewolf, J.T., "Mechanics of Materials", Tata McGrawHill Publishing Co. Ltd., New Delhi 2011.

Pre-requisite: **Basic Knowledge of Engineering Mechanics –Statics and Dynamics**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 ME 004 & Strength of Materials	CO1	3	2					2					1	1	
	CO2	3	3	1									1	2	
	CO3	3	3	2	1								1	3	
	CO4	3	3	2	3	2							1	3	
	CO5	3	3	1	2									2	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 ME 006 - Thermodynamics							
Common to MECH & MCT							
Semester	Hours / Week			Total hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
III	3	1	0	60	4	40	60	100

Objective(s)	• To evaluate the properties of changes in open, closed and isolated systems. • To apply the concept of thermodynamics laws to various practical applications such as heat engines, heat pump and refrigeration systems. • To analyze the performance of steam power cycles. • To derive the mathematical relation for thermodynamic properties. • To understand the properties and process of psychrometry
Course Outcomes	**At the end of the course, the student will be able to** 1. Describe the basic concepts of zeroth law and first law of thermodynamics and apply the concepts of first law of thermodynamics to open and closed system. 2. Relate the concept of second laws of thermodynamics to heat engine, refrigeration & air-conditioning cycles and discuss the concept of increase in entropy. 3. Recognize the behaviour of pure substances and the performance of Rankine cycle with reheat and regenerative cycle. 4. Describe the concept of Joule Thomson effect, Clausius Clapeyron equation, Equation of state and Compressibility and apply the differential equations for energy, Maxwell's equations and specific heat relations. 5. Recognize the presence of moisture in atmosphere, its properties and also understand the application of psychrometric processes.

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Basic Concepts and First Law

Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases. First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady Flow. [12]

Second Law and Availability

Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy, perpetual-motion machines, Exergy– simple problems. [12]

Properties of Pure Substance and Steam Power Cycles

Properties of pure substances - Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes. Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. [12]

Thermodynamic Relations

Gas mixtures –Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, TdS relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient. [12]

Psychrometry

Psychrometry and psychrometric chart, property calculations of air vapour mixtures. Psychrometric process – Sensible heating / cooling - cooling and dehumidification - heating and humidification - adiabatic mixing, evaporative cooling. [12]

Note: Use of standard steam tables, Mollier diagram & Psychometric chart are permitted for examination.

Total Hours: 45 + 15(Tutorial) = 60

Text book(s) :

1.	Cengel, Y. A., "Thermodynamics - An Engineering Approach", 8th Edition, Tata McGraw Hill Pub., New Delhi, 2015.
2.	Nag. P.K., "Engineering Thermodynamics", 6thEdition, Tata McGraw-Hill Publications, New Delhi, 2017.

Reference(s) :

1.	Moran, M. J. and Shapiro, H. N., "Fundamentals of Engineering Thermodynamics", 8th Edition, John Wiley and Sons, 2014.
2.	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., "Fundamentals of Thermodynamics", 6thEdition, John Wiley and Sons, 2003.
3.	Holman,J.P., "Thermodynamics", 4thEdition, McGraw-Hill Publications, 1995.
4	Rajput, R.K., "A Textbook of Engineering Thermodynamics, 4th Edition, Laxmi Publications, 2010.

Pre-requisite: **Mathematics**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 ME 006 & Thermodynamics	CO1	3	2	1	2	2								2	2
	CO2	3	2	3	2	2								2	2
	CO3	3	2	3	2	2								2	1
	CO4	3	2	1	2	2								2	1
	CO5	3	2	2	2	2								2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								**R2018**
50 MC 303 – Manufacturing Technology								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Objectives

- To enlighten the learners about the concepts of basic manufacturing processes and casting techniques.
- To impart the fundamental knowledge in the area of metal joining.
- To endow with an overview of metal forming processes.
- To understand the working of standard machine tools such as lathe, drilling, milling and allied machines.
- To gain adequate knowledge in the area of gear making and non-conventional machining processes.

Course Outcomes

At the end of the course, the students will be able to

1. Discuss the basic concepts of casting and its inspection process.
2. Gain the knowledge of various welding process.
3. Outline the various methods involved in forming processes.
4. Illustrate the construction, working principles of various machine tools.
5. Identify the different methods of gear manufacturing, micro machining processes and need for automation processes.

Metal Casting Processes

Introduction to casting process - Pattern: materials, types, allowances - Moulding: green sand moulding,moulding sand and its properties - Cores: types and making - Casting: sand mould casting, investment casting, die casting and continuous casting - Melting furnaces: Cupola and induction furnaces - Casting defects: causes and remedies - Non-destructive testing: liquid penetrate test, x-ray diffraction and ultrasonic test. [09]

Metal Joining Processes

Introduction to welding process - Principle of arc and gas welding - Tools and equipments - Filler and flux materials - Flame types - Weld defects - Safety in welding - Other welding processes: Resistance welding, ultrasonic welding, gas tungsten arc welding and gas metal arc welding - Electron beam welding and Laser beam welding - Brazing and soldering [09]

Forming Processes

Introduction to hot and cold working - Forging: open and close die forging, upsetting - Rolling: high roll mills and shape rolling - Extrusion: forward and backward, tube extrusion - Drawing of wires, Rods and tubes - Sheet metal work:Shearing, bending and drawing operations - Stretch forming –Introduction of HERF methods [09]

Machining Processes

Cutting tool: materials, properties, Cutting fluids - Basic machine tools: centre lathe, radial drilling machine, universal milling machine and shaping machine-Constructional features, operations, work and tool holding devices - Grinding: surface and centreless grinding. [09]

Gear Manufacturing and Micromachining

Introduction to gears - Gear tooth terminology - Methods of gear manufacturing: gear forming and gear generating- Gear finishing processes – Micromachining: Introduction to micromachining processes - Ultrasonic micromachining, Electrodischarge micromachining, Electron beam micromachining, Laser beam micromachining, Electrochemical micromachining. [09]

Total Hours: 45

Text book(s) :

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2nd Edition,2010.
2. Rajput, R.K., “A Textbook of Manufacturing Technology”, Laxmi publications Ltd, New Delhi, 2014.

Reference(s) :

1.	Hajra Choudhury S.K, “Elemets of workshop Technology, Vol I and II”, Media Promotors, Bombay Edition 2011.
2.	P. N. Rao, “Manufacturing Technology - Vol I and II”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.
3.	V.K.Jain, “Introduction to Micromachining”.Narosha Publishing House, New Delhi, 2014.
4.	P. K. Mishra, “Non-Conventional Machining”, Narosha Publishing House, New Delhi, 2014.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 303 **&** Manufacturing Technology	CO1	1	3	2	3	2	3	2			3	2	2	1	2
	CO2	2	3	2	2	1	3		2	2	3		3	3	3
	CO3	2	3	3	2	2	2	1			2	3	2	2	1
	CO4	2	2	2	3	1	2		2	1	1		3	2	3
	CO5	2	3	1	3	3	2	2	3		2	2	1	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MY 004 - Universal Human Value

Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	2	1	0	45	3	40	60	100

Objective(s)

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

Course Outcomes

At the end of the course, the students will be able to

1. Become more aware of themselves, and their surroundings
2. Responsible in life, and in handling problems with sustainable solutions
3. Maintain human relationships and human nature
4. Committed towards human values, human relationship and human society
5. Improve critical ability and apply it day-to-day life

Note: Hours notified against each unit in the syllabus are only indicative but are not decisive. Faculty may decide the number of hours for each unit depending upon the concepts and depth. Questions need not be asked based on the number of hours notified against each unit in the syllabus**.**

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. [09]

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. [09]

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. [09]

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. [09]

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 [09]

Total Hours: 45

Text Book(s):

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

Reference(s)

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

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MY 004 **&** Universal Human Value	CO1	3	3	3	2	2	3	3	3	2	3	3	1	3	3
	CO2	3	3	3	2		3	3	3	2	3	2	1	3	3
	CO3	3	3	2			3	3	3	3	3	2	1	3	3
	CO4	3	3	3			3	3	3	3	3	2	2	3	3
	CO5	3	3	1			3	3	3	3	3	2	2	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 3P1 – Manufacturing Technology Laboratory

B.E. Mechatronics Engineering

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	4	60	2	60	40	100

Objectives

- To enhance the students knowledge of various machine tools.
- To analyze the machine setup and different operation techniques of machine tools.
- To gain the knowledge of various method to perform the operation using machine tools.
- Demonstration and study of the milling and shaping machines.
- The main emphasis will be on a complete understanding of the machine capabilities and Processes.

Course Outcomes

At the end of the course, the students will be able to

1. Perform the operation of plain turning (external and internal), facing and thread cutting operation (internal and external) in a lathe.
2. Develop the knowledge of eccentric turning, taper turning and knurling operations.
3. Make the operations using drilling machine and operations performed using shaping machine.
4. Develop a spur gear using milling machine and machining spur/ helical gear using gear hobbling machine.
5. Perform the operation of given workpiece using shaper and grinding machine.

1. Machining a work piece by facing, plain turning operations using a lathe.
2. Machining a work piece by internal and external thread cutting operations using a lathe.
3. Machining a work piece by eccentric turning operations using a lathe.
4. Machining a work piece by taper turning and knurling operation using a lathe.
5. Performing a work piece by drilling reaming and tapping operations using a drilling machine.
6. Machining a work piece by hexagonal component using shaping machine.
7. Machining a work piece by spur gear using milling machine.
8. Generating a work piece by spur/helical gear using gear hobbing machine.
9. Machining a work piece by dove tail and key way using shaping machine.
10. Grinding a work piece by flat and cylindrical surfaces using grinding machine.

Total Hours:60

Text book(s) :	
1	E.PaulDegarmo, J.T.Black, Ronald A.Kohser, “Materials and process in Manufacturing” Prentice – Hall of India (p) Ltd., New Delhi.2005.
2	Roy A. Lindberg, “Processes and Materials of Manufacture”, Prentice Hall of India Learning. Ltd., New Delhi, 2015.
Reference(s) :	
1.	Hajra Choudhury S.K, “Elemets of workshop Technology, Vol I and II”, Media Promotors, Bombay Edition 2011.
2.	P. N. Rao, “Manufacturing Technology - Vol I and II”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018
3.	Rajput, R.K., “A Textbook of Manufacturing Technology”, Laxmi publications Ltd, New Delhi, 2014.
4.	Phillip F. Ostwald and Jairo Munoz, “Manufacturing Processes and Systems”, Wiley India, Bangalore, 2008.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 3P1 **&** Manufacturing Technology Laboratory	CO1	1	3	1	3	1	2		2		2	3	2	2	3
	CO2	2	2	2	2	2		2		2		2		3	1
	CO3	2	2	3	3	2	1		2		1		3	3	3
	CO4	1	2	3	2	1		1	3		2	2	2	3	2
	CO5	2	1	1	2	2	2	3				2	2	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 3P2- Analog Devices and Digital Circuits Laboratory

B.E. Mechatronics Engineering

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	4	60	2	60	40	100

Objectives	• To Learn the Volt-Ampere characteristic of semiconductor diodes and assessing performance of rectifier circuit using filter • To Evaluate frequency response and understand the behavior of amplifier circuits • To explore a basic knowledge of bit manipulation and Develop the ability to analyze and design digital electronic circuits • To illustrate the different analog electronic circuits and their application in practice. • To illustrate the different digital electronic circuits and their application in practice.
Course Outcomes	**At the end of the course, the students will be able to:** 1. Analyze the characteristics of semiconductor devices and determine the input and output parameters. 2. Identify the various operating regions and analyze the characteristics of BJT 3. Understand the fundamentals of digital electronic circuit and their application in practice. 4. Construct basic combinational circuits and verify their functionalities 5. Design and implement synchronous and asynchronous sequential circuits.

LIST OF EXPERIMENTS

1. Study the VI Characteristics of PN junction diode and Zener diode
2. Study the ripple and regulation characteristics of full wave rectifier with and without capacitor filter.
3. Construct the clipper and clamper circuit using PN junction diode
4. Determination of Input and Output Characteristics of BJT
5. Construct differential amplifier circuit using BJT and obtain CMRR value
6. Design and verify the operation of 4-bit Magnitude Comparator using IC 7485.
7. Design and implementation of 4 bit binary Adder/ Subtractor using IC 7483
8. Design and implementation of Multiplexer and De-multiplexer using IC 741XX
9. Construction and verification of 4 bit ripple counter and Mod-10 Ripple counters
10. Design and study the operation of a 3-bit synchronous up/down counter

Total Hours: 60

Lab Manual

“Analog Devices and Digital Circuits Lab Manual”, Department of Mechatronics Engineering , KSRCT

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 3P2 & Analog Devices and Digital Circuits Laboratory	CO1	2	3	1	3	1	2		2		2	3	2	2	3
	CO2	2	2	2	2	2		2		2		2		3	2
	CO3	3	1	3	3	2	1		2	1	1		3	1	3
	CO4	3	2	3	2	1		1	3		2	2	2	1	2
	CO5	2	1	1	2	2	2	3				2	2	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								**R2018**
Semester III								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
50 TP 0P1	**Career Competency Development I**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Course Objectives	• To help learners to enrich their grammatical correctness and vocabulary efficacy in the academic and professional contexts. • To help the learners to frame syntactical structures of sentences and comprehend the meaning of reading passages effectively • To help learners to adeptly sequence the information, draft letters and correct usage of foreign words with correct spelling and punctuation. • To help the learners to introduce themselves and involve in situation conversations professionally • To help learners to make various modes of presentations and express their opinion in a conducive way.							
Course Outcomes	**At the end of the course, the student will be able to** 1. Reinforce the essential grammatical correctness and vocabulary efficacy in the academic and professional contexts 2. Generate syntactical structures and infer the semantics in the reading passages effectively 3. Reorganize and compose the sequential information, letter drafts, and interpret the appropriate usage of foreign words with correct spelling and punctuation 4. Demonstrate their introduction and relate to situational conversations adeptly 5. Exhibit various modes of presentations and organize their opinions in an expressive way							
Unit–1	**Written Communication–Part1**							**Hrs**
Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition - Change of Voice - Change of Speech - Synonyms & Antonyms - One WordSubstitution- Using the same Word as Different Parts of Speech- Odd Man Out **Materials:** Instructor Manual, Word power Made Easy Book								8
Unit–2	**Written Communication –Part2**							
Analogies - Sentence Formation - Sentence Completion - Sentence Correction - Idioms & Phrases - Jumbled Sentences, Letter Drafting (Formal Letters) - Reading Comprehension (Level 1) – Contextual Usage-**Materials:** Instructor Manual, Word power Made Easy Book								6
Unit–3	**Written Communication –Part3**							
Jumbled Sentences, Letter Drafting (Formal Letters)-Foreign Language Words used in English--Spelling& Punctuation(Editing) **Materials:** Instructor Manual, Newspapers								4
Unit–4	**Oral Communication–Part1**							
Self-Introduction-SituationalDialogues/RolePlay(TelephonicSkills)-OralPresentations-Prepared-'JustA Minute 'Sessions (JAM) **Materials:** Instructor Manual, Newspapers								6
Unit–5	**Oral Communication–Part2**							
Describing Objects/Situations/People, Information Transfer-Picture Talk-News Paper and Book Review **Materials:** Instructor Manual, Newspapers								6
							Total	**30**

Evaluation Criteria			
S.No.	**Particular**	**Test Portion**	**Marks**
1	Evaluation 1 Written Test	50Questions–30 Questions from Unit 1 &2 , 20 Questions from Unit3, (External Evaluation)	50
2	Evaluation2 Oral Communication 1	Self-Introduction, Role Play & Picture Talk from Unit-4 (External Evaluation by English and MBA Dept.)	30
3	Evaluation3 Oral Communication 2	Book Review & Prepared Speech from Unit-5(External Evaluation by English and MBA Dept.)	20
		Total	**100**

Reference Books

1. Aggarwal, R.S."A Modern Approach to Verbal and Non-verbal Reasoning", Revised Edition 2008,Reprint 2009,S.Chand&CoLtd.,NewDelhi.
2. Word power Made Easy by Norman Lewis W.R.GOYAL Publications

Note:

- InstructorcancoverthesyllabusbyClassroomactivitiesandAssignments (5Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough workpages
- Each Assignment has 20questionsfromUnit1,2andUnit5and5questionsfromUnit3and4
- Evaluation has to be conducted as like Lab Examination.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50TP0P1– Career Competency Development I	CO1	1	1	1	1		2	1	2	3	3	2	3	1	
	CO2	1	1	1	1	1	2	1	2	3	3	3	3	1	1
	CO3	1	1	1	1	1	2	1	2	3	3	2	3		1
	CO4	1	1	1	1		2	1	1	2	3	2	3	1	1
	CO5	1	1	1	1	1	2	1	2	3	3	2	3	1	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								**R2018**
50 MC 401- Industrial Drives and Control								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	40	60	100

Objectives	• To learn the structure of Electric Drive systems and their role in various applications. • To impart the knowledge on control strategies of DC and AC motors. • To understand the operation of D.C motor speed control using converters and choppers. • To acquire the knowledge of thyristor based speed control methods of A.C motors. • To provide the knowledge on construction, working and control strategies of special drives.
Course Outcomes	**At the end of the course, Students will be able to** 1. Understand the need of electrical drives and their applications in various industries. 2. Describe the speed control and braking methods of DC & AC drives. 3. Apply the solid state speed control techniques in DC drives. 4. Apply the solid state speed control techniques in AC drives. 5. Understand the principle of operation of special drives and their applications.

Introduction of Electrical Drives

Basic Elements of a drive system – Types of Electrical Drives – Choice of electrical drives – Multi quadrant operation of drives – Heating and cooling curves – classes of duty – Selection of power rating for drive motors– Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. [09]

Starting and speed Control of Drives

Starting of DC Motors – Types of Braking – Conventional Speed Control of DC Motors: Armature Voltage Control, Field Flux Control, Ward Leonard Control. Starting of AC Motors – Types of Braking – Conventional Speed Control of Induction Motors: Stator Voltage Control, Stator Frequency Control, Rotor Resistance Control. [10]

Solid State Speed Control of DC Drives

Single Phase and Three Phase Fully controlled Converter: Principle of operation and waveforms of single phase and three phase fully controlled converter fed DC drive – Choppers Fed DC Motor Drive – Applications. [09]

Solid State Speed Control of AC Drives

Voltage/Frequency Control of induction motor, Voltage Source Inverter and Current Source Inverter–VSI fed Three Phase Induction Motors–CSI Fed Three Phase Induction Motors-Static Rotor Resistance Control–Static Scherbius and static Kramer Drives block diagram and explanation–Applications. [09]

Special motor Drives

Stepper motors – Permanent magnet, Variable reluctance, Single and multi-stack configurations, Hybrid motor. Switched reluctance motors – AC & DC Servo motors – Brushless DC motors. [08]

Total Hours: 45

Text book(s) :

1	Gopal.K.Dubey ,"Fundamentals of Electrical Drives" Narosa Publishing House, 2nd Edition, 2013.
2	Theraja,B.L and Theraja, A.K., "A text book of Electrical Technology–Volume II (AC & DC Machines)"S.Chand & Company Ltd., New Delhi, 2005.

Reference(s) :

1	Vedam Subrahmanyam, "Electric Drives Concepts and Applications" Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2001.
2	M.D.Singh and K.B. Khanchandani, "Power Electronics", Tata Mc Graw Hill Publishing Company Ltd.,New Delhi, 2008.
3	Shepherd Hullay&Liag,"Power Electronics & Motor Control", Cambridge University Press.
4	Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 401 & Industrial Drives and Control	CO1	3	3	1	3	1	2	1	2	1	2	3	2	2	2
	CO2	2	2	2	2	2		2		2		2		3	2
	CO3	3	3	3	3	3	1		2	1	1		3	2	3
	CO4	3	2	3	1	1		1	3		2	2	2	1	2
	CO5	3	1	1	2	2	2	3				2	2	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 ME 005 - Fluid Mechanics and Fluid Machines

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

Objective(s)

- To learn about the properties of fluids, manometry and buoyancy
- To learn mass and momentum conservation laws for fluid flows.
- To understand the pressure and velocity variation in flow of fluids through pipes
- To acquire the importance of dimensional analysis.
- To analyze the flow in water pumps and turbines.

Course Outcomes

At the end of the course, the student will be able to

1. Explain and evaluate the various properties of fluids, manometry and buoyancy.
2. Estimate the mass and momentum conservation laws for fluid flows.
3. Evaluate the velocity and pressure variation in flow through pipes.
4. Analyze the similarity of motion between model and prototype
5. Evaluate the performance of pumps and turbines.

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Fluid Properties and Fluid Statics

Units and Dimensions – Fluid Properties – Density, Specific gravity, Viscosity, Surface tension, capillarity, compressibility and bulk modulus - Fluid Statics - Pascal's law – Pressure measurements – Atmospheric, vacuum pressure and gauge pressure – simple and differential manometers - Buoyancy – Centre of buoyancy – meta center and meta center height. [10]

Fluid Kinematics and Fluid Dynamics

Types of fluid Flow – types of flow line – control volume - velocity field and acceleration - Continuity equation and momentum equation - stream and potential function – Euler's and Bernoulli's Equation and its applications. [09]

Flow through circular conduits

Laminar flow through circular pipes - Hagen Poiseuille equation – Turbulent flow - Boundary layer concepts – Darcy Weisbach equation, friction factor, Moody's diagram -Loss of energy in pipes. [08]

Dimensional Analysis

Need for dimensional analysis **–** methods of dimensional analysis - Similitude – types of similitude – Dimensionless parameters – application of dimensionless parameters – Model analysis. [08]

Hydraulic Pumps and Turbines

Impact of jet – force exerted by a jet on moving plates. Classification – construction, working principles and design of Pelton wheel and Francis turbines – head, losses, work done and efficiency – specific speed – operation characteristics – Governing of turbines – Classification of pumps – centrifugal pump and reciprocating pump - working principle – discharge, work done and efficiencies- cavitation in pumps – Submersible pumps – Types and applications. [10]

Total Hours: 45+15(Tutorial)=60

Text book(s) :

1.	R.K Rajput A Textbook of Fluid Mechanics and Hydraulic Machines S.Chand& company Ltd. 6th Edition 2015.
2..	Modi P. N and Seth S.M "Hydraulics and mechanics, including Hydraulic machines" standard book house, Delhi 2017.

Reference(s) :

1.	Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi, 9th Edition, 2017.
2.	CengelYunus A. and Cimbala, John M., "Fluid Mechanics", Tata McGraw - Hill, New Delhi, 3rd Edition, 2015.
3.	Ramamrutham.S. "Hydraulics Fluid Mechanics and Fluid Machines", 8th Edition, DhanpatRai Publishing company (P) Ltd, New Delhi, 2014.
4.	Ojha, C.S.P., Chandramouli, P.N. and Berndtsson, R., "Fluid Mechanics and Machinery", Oxford University Press, 2010

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 ME 005 & Fluid Mechanics and Fluid Machines	CO1	3	3	2	2	1	1	1	2	1	2	1	2	3	2
	CO2	3	3	3	3	1	1	1	2	1	2	1	2	3	2
	CO3	3	3	3	2	1	1	1	2	1	2	1	2	3	2
	CO4	3	3	3	3	1	1	1	2	1	2	1	2	3	2
	CO5	3	3	3	3	1	2	1	2	1	2	1	3	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC 402 – Theory of Machines								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	1	0	60	4	40	60	100
Objectives	• To learn various mechanisms and find their velocity and acceleration. • To generate the cam profile for radial cams • To understand the basic concept of toothed gearing. • To plot the turning moment diagram of crank rotation at various strokes. • To understand the effects of vibration and importance of balancing in machine components							

Course Outcomes	**At the end of the course the students will be able to** 1. Acquaintance with basic mechanism and the layout of linkages in the assembly of system. 2. Design and analyze the velocity and acceleration of different mechanism and construct the cam profile for the given follower motion 3. Determine speed ratio for simple, compound and planetary gear systems 4. Understanding the process of providing continuous energy to the system when the energy source is discontinuous. 5. Identify the effects of vibration and balancing in machine components

Simple Mechanism

Introduction - Kinematic links, structure- comparison between machine and structure, joints, Kinematic pairs classification- types of constrained motion. Kinematic chain-classification- degrees of freedom – Kutzbach criterion, Gruebler's criterion - Grashof's law - Mechanism - Inversions of four bar and slider crank chain - Mechanical advantage – Description of straight line mechanisms: Peaucellier and Hart's mechanism. [12]

Kinematics Analysis of Linkages and Cam

Kinematic analysis of simple mechanism - Determination of velocity and acceleration by using Graphical method for four bar and slider crank mechanism. Classification of cams and follower - Radial cam nomenclature - Analysis of follower motions: uniform velocity, simple harmonic motion and uniform accelerationand retardation - Construction of cam profile for a radial cam. [12]

Gears and Gear Trains

Gear tooth profiles - gear tooth action - Interference and undercutting - requirement of minimum number of teeth in gears - Gear trains - Simple and compound gear trains -Determination of speed and torque in epicyclic gear trains. [12]

Turning Moments and Flywheels

Introduction, turning moment diagram for a single cylinder double acting steam engine - Turning moment diagram for a four stroke internal combustion engine - Fluctuation of energy- determination of maximum fluctuation energy - co-efficient of fluctuation of energy - Flywheel: co-efficient of fluctuation of speed - energy stored in a flywheel - Dimensions of the flywheel rim- Introduction to governors and gyroscope. [12]

Vibration and Balancing

Free, forced and damped vibrations of single degree of freedom systems, Critical speed of shaft logarithmic decrement - Force transmitted to supports. Static and dynamic balancing - balancing of revolving masses, single and multi-cylinder engines. Reciprocating masses - single cylinder engines. [12]

Total Hours: 60

Text book(s) :

1	R S Khurmi and J K Gupta, "Theory of Machines", S.Chand and Company Ltd., New Delhi, 2017.
2	Sadhu Singh, "Theory of Machines", Pearson Education, 2012.

Reference(s) :

1	S S Rattan, "Theory of Machines", Tata McGraw-Hill Education (India) Pvt. Ltd., 2016.
2	J S Rao and R V Dukkipati, "Mechanism and Machine Theory", Bohem press, 2007.
3	P L Ballaney, "Theory of Machines", Khanna Publishers, New Delhi, 2005.
4	J S Brar and R K Bansal, "A Text Book of Theory of Machines", Laxmi Publications (P) Ltd., 2020.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 402 & Theory of Machines	CO1	1	1	3	1	2	3	2							
	CO2	2	2	2	2	1	2								
	CO3	3	2	3	2	2	2	1							
	CO4	2	1	2	3	1	2								
	CO5	2	2	1		3		2							

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
51 MC 403 – Hydraulic and Pneumatic Control								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	2	60	4	50	50	100

Objectives	• To familiarize about the basics fundamentals of hydraulic and pneumatic transmission power using pressurized fluids. • To understand working principles, operation of hydraulic and pneumatic components. • To expose to various techniques for choosing pumps, valves and pneumatics components for suitable application. • Have exposure to diagnose / troubleshoot hydraulic, pneumatic, electro pneumatic circuits. • To design the circuits using pneumatic / hydraulic components for a small scale industrial application.
Course Outcomes	**At the end of the course the students will be able to** 1. Explain the fundamental properties of fluids and understand the applications, advantages of fluid power system. 2. Identify the various pumps, valves, actuators and its working principles in hydraulic circuit. 3. Describe and illustrate the construction and working principles of various compressors, pneumatic valves and FRL unit importance in pneumatic circuit. 4. Design and develop the hydraulic and pneumatic circuit for various applications. 5. Know the application of fluid power circuit in industry..

Fluid Power System

Introduction to fluid power - properties of fluids: Viscosity index, Oxidation index, Demulsibility, Lubricity, Rust prevention, Pour point, Flash point and Fire point, Types of hydraulic fluids - Advantages and drawbacks of fluid power - Applications of fluid power – Fluid power components and symbols- Pascal's law: Multiplication of Force - Analysis of simple hydraulic jack - Applications of Pascal's law: Hand operated hydraulic jack, Air to Hydraulic Pressure Booster **[09]**

Hydraulic Pumps, Actuator and Valves

Pumps Pumping theory - Pump classification - working principle of Gear pump, Vane pump, Screw pump - Hydraulic Actuators: Hydraulic motors – gear and vane motors, Hydraulic cylinders: single acting and double acting cylinders, Special type cylinders: rodless, tandem and telescopic - Hydraulic valves: Pressure Control Valve types, Direction control valve types, Flow control valve types, Counter balance valve. **[09]**

Pneumatic System

Properties of air-Compressors: Rotary compressor - Screw compressor, vane compressor - Piston Compressor: Single and Multi-Stage Compressor - Filter, Regulator and Lubricator Unit - Valves: Direction control valves, Two way, Three way, Four way valves - Pneumatic check valves - Flow control valve, Pneumatic shuttle valve - AND type valve - Quick exhaust valve. **[09]**

Design of Hydraulic and Pneumatic Circuits

Construction of Hydraulic circuits - Fail safe circuit - Regenerative circuit - pressure intensifier circuits - Accumulator circuits. Construction of Pneumatic circuits: Cascade method - sequence circuit.Electro - pneumatic circuit – IoT based solenoid valve. **[09]**

Industrial Automation

Fluid power circuit for hydraulic braking system-Fluid power circuit for robot arm for pick and place-Pneumatic automation for Industry 4.0-Hydraulic system for Industry 4.0**-** Trouble shooting of Fluid power system **[09]**

Hands on Session:

1. Assembling of hydraulic components for basic Hydraulic circuit.
2. Assembling of pneumatic components for basic Pneumatic circuit.
3. Assembling of pneumatic components for Meter in & Meter out circuit
4. Assembling of pneumatic components for Synchronizing circuit.
5. IoT based pneumatic circuit **[15]**

Total Hours: 60

Text book(s) :

1	Anthony Esposito, "Fluid Power with Applications", Pearson Education New Delhi, 2015.
2.	Srinivasan R ,"Hydraulic and Pneumatic Controls",2nd Edition', Vijay Nicole Imprint (P) Ltd., Chennai, 2016.

Reference(s) :

1	S. R. Majumdar, "Oil Hydraulics", Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014.
2	S. R. Majumdar, "Pneumatic systems - Principles and Maintenance", Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014.
3	Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2015.
4	James L. Johnson, "Introduction to Fluid Power", Delmar Thomson Learning, 2013.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 403 & Hydraulic and Pneumatic Control	CO1	3	2	1	2	2	2	2	1	2	2	2	2	3	3
	CO2	2	2	2	1	1	1	2	1	2	1	2	2	2	2
	CO3	2	2	1	2	2	1	2	1	2	1	2	2	3	2
	CO4	2	3	3	2	3	2	1	1	2	2	2	2	2	3
	CO5	2	2	2	2	3	1	1	1	2	1	3	2	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC 404- Applied Materials Technology								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	40	60	100

Objectives	• To impart knowledge on the structure and properties of alloys. • To understand heat treatment processes and hardening techniques. • To acquire knowledge in ferrous and non-ferrous materials. • To impart knowledge on Powder metallurgy processes and applications. • To identity and select suitable characterization techniques for material testing.
Course Outcomes	**At the end of the course the students will be able to** 1. Understand the various types of alloy structures using iron carbide equilibrium diagram and phase changes of various structures. 2. Identify heat treatment process for engineering applications and case hardening process - carburizing, nitriding and cyaniding. 3. Predict the effect of alloying additions on ferrous and non- ferrous metals. 4. Comply the properties of ceramic materials and powder metallurgy for engineering applications and production of different metal powders. 5. Utilize the mechanism of plastic deformation process, testing of mechanical properties and metallographic procedures.

Constitution of Alloys and Phase Diagrams

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, types and construction of phase diagrams, Iron – Iron carbide equilibrium diagram, eutectic, peritectic, eutectoid and peritectoid reactions. [08]

Heat Treatment

Definition – full annealing, stress relief and recrystallisation – normalising, hardening and tempering of steel, austempering, martempering - TTT diagrams -hardenability, jominy end quench test – case hardening, carburising, nitriding, cyaniding, flame and induction hardening. [10]

Ferrous and Non Ferrous Metals

Classification of steel and cast iron- effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA - gray, white, malleable - alloy cast irons - copper and copper alloys – aluminum and aluminum alloys – bearing alloys, Ni-based super alloys and titanium alloys. [09]

Non-Metallic Materials and Powder Metallurgy

Engineering ceramics – properties and applications of Al_2O_3, SiC - powder metallurgy process - steps involved-characteristics of metal powders - advantages and limitations, major applications: aerospace, nuclear, metal cutting and automobile industries. [09]

Mechanical Properties and Testing

Mechanism of plastic deformation - slip and twinning - types of fracture - Destructive testing: testing of materials under tension, compression and shear loads - hardness tests: Brinell, Vickers and Rockwell - impact test: Izod and Charpy - fatigue and creep test – metallography - preparation of specimen, metallurgical microscope and Scanning Electron Microscope. [09]

Total Hours: 45

Text book(s) :

1.	Khanna O.P, "A Text Book of Material Science and Metallurgy", Dhanpat Rai Publishers, 2016.
2.	Sidney H.Avner "Introduction to Physical Metallurgy" Tata McGraw-Hill Companies Inc., New Delhi, 2012

Reference(s) :

1	William D. Callister, "Material Science and Engineering: An Introduction", Wiley India Pvt Ltd, New Delhi, 2012
2	Raghavan.V., "Materials Science and Engineering: A First Course",5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2009
3	George E. Dieter, "Mechanical Metallurgy", Tata McGraw-Hill Companies Inc., New Delhi, 2013
4	R Balasubramaniyam, " Callister's Materials Science and Engineering", Second edition, Wiley,2014.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 404 & Applied Materials Technology	CO1	3	1	2	3	1	1	2	1	2	1	2	3	2	1
	CO2	2	3	3	3	2	2	1	1	1	2	2	3	2	1
	CO3	3	2	1	1	1	2	2	1	2	1	2	3	2	1
	CO4	3	2	1	2	1	2	1	2	1	2	3	2	1	1
	CO5	2	2	2	2	2	2	1	2	2	2	2	2	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MY 014 – Start-ups and Entrepreneurship

Common to all Branches

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

Objectives	• To provides practical proven tools for transforming an idea into a product or service that creates value for others. • To build a winning strategy, how to shape a unique value proposition, prepare a business plan • To impart practical knowledge on business opportunities • To inculcate the habit of becoming entrepreneur • To know the financing, growth and new venture & its problems
Course Outcomes	**At the end of the course, the student will be able to** 1. Transform ideas into real products, services and processes, by validating the idea, testing it, and turning it into a growing, profitable and sustainable business. 2. Identify the major steps and requirements in order to estimate the potential of an innovative idea as the basis of an innovative project. 3. Reach creative solutions via an iteration of a virtually endless stream of world-changing ideas and strategies, integrating feedback, and learning from failures along the way. 4. Apply the 10 entrepreneurial tools in creating a business plan for a new innovative venture. 5. Apply methods and strategies learned from interviews with startup entrepreneurs and innovators.

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. [06]

Business Opportunity Identification and Preparing a Business Plan

Business ideas, methods of generating ideas, and opportunity recognition, Idea Generation Process, Feasibility study, preparing a Business Plan: Meaning and significance of a business plan, components of a business plan. [06]

Innovations

Innovation and Creativity - Introduction, Innovation in Current. Environment, Types of Innovation, School of Innovation, Analysing the Current Business Scenario, Challenges of Innovation, Steps of Innovation Management, Experimentation in Innovation Management, Participation for Innovation, Co-creation for Innovation, Proto typing to Incubation. Blue Ocean Strategy-I, Blue Ocean Strategy-II. Marketing of Innovation, Technology Innovation Process [06]

Financing and Launching the New Venture

Importance of new venture financing, types of ownership, venture capital, types of debt securities, determining ideal debt-equity mix, and financial institutions and banks.

Launching the New Venture: Choosing the legal form of new venture, protection of intellectual property, andformation of the new venture. [06]

Managing Growth and Rewards in New Venture

Characteristics of high growth new ventures, strategies for growth, and building the new ventures. Managing Rewards: Exit strategies for Entrepreneurs, Mergers and Acquisition, Succession and exit strategy, managing failures – bankruptcy. [06]

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 GlobalEconomy”, 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 BusinessBooks, 2011
4	Howard Love, “The Start-Up J Curve: The Six Steps to Entrepreneurial Success”, Book Group Press,2011

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MY 014 &Startups and Entrepreneurship	CO1	3	3	3	3	1	3	1	2	1		2	2	2	1
	CO2	2	3	3	2	2		2	2	2		2	2	3	
	CO3	3	2	3	1	2				1	3	1	3	3	
	CO4	3	3	3	3	3	2	2	1		1	3	3	3	
	CO5	3	2	3	3	3			2			3	2	2	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC 4P1- Industrial Drives and Control Laboratory								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	4	60	2	60	40	100
Objectives	• To acquire knowledge about speed control of DC drives. • To determine the performance characteristics of the given DC drives. • To provide the knowledge about speed control of AC drives. • To determine the performance characteristics of the given AC drives. • To acquire the knowledge of solid state speed control of AC & DC drives.							
Course Outcomes	At the end of the course, Students will be able to 1. Test and analyze the performance of DC motors under different load conditions. 2. Test and analyze the performance of induction motors under different load conditions. 3. Analyze the performance of conventional speed control systems for DC motors. 4. Design power electronics based speed control systems for DC drives. 5. Design power electronics based speed control systems for Induction motor drives.							
1. Load characteristics of DC shunt motor and compound motor. 2. Load characteristics of DC series motor. 3. Load test on three-phase squirrel cage induction motor. 4. Load test on three-phase slip ring induction motor. 5. Load test on single phase induction motor. 6. Speed control of DC shunt motor. 7. Speed control of DC shunt motor using controlled rectifier. 8. Speed control of DC shunt motor using chopper. 9. Speed control of three–phase induction motor by V/F method. 10. Speed control of three phase induction motor (Voltage control).								
Total Hours: 60								
Text book(s) :								
1	Gopal.K.Dubey, ”Fundamentals of Electrical Drives” Narosa Publishing House, 2nd Edition, 2013.							
Reference(s) :								
1	Vedam Subrahmanyam, “Electric Drives Concepts and Applications” Tata Mc Graw Hill PublishingCompany Ltd., New Delhi, 2001.							

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 4P1 & Industrial Drives and Control Laboratory	CO1	1	3		3	2		3		1	3	1			3
	CO2		1		1	2	1		1	2				3	2
	CO3	2	1		2	1	2	1	2	2	1	2	1	1	1
	CO4	2			1	2		1		1		1	2	2	2
	CO5		2	1	1	2	3		3	1	2		1	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC 4P2 – Applied Mechanics Laboratory								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	4	60	2	60	40	100

Objectives	• To conduct the experimental study on structural members using tension, compression, torsion, deflection and impact tests. • To facilitates experimental knowledge about coefficient of discharge and friction factor. • To emphasize the concept of Bernoulli's principle using orifice meter. • To analyze the performance characteristics of turbines, • To analyze the performance characteristics of pumps.
Course Outcomes	**At the end of the course, the students will be able to** 1. Understand the tensile and compressive behaviors of metals and springs. 2. Understand the impact, deflection and torsional behaviors of mechanical members. 3. Apply the Bernoulli's principle to estimate the rate of flow using orifice meter and determine the friction factor for various pipes. 4. Analyze the performance characteristics of turbines 5. Analyze the performance characteristics of pumps.

1. Determination of tensile behavior of given metals.
2. Determination of tensile and compressive behaviors of given helical springs.
3. Determination of impact strength of given metal specimen using Charpy and Izod testers.
4. Determination of deflection value on given simply supported beam.
5. Determination of torsional strength on mild steel rod.
6 Determination of coefficient of discharge of orifice meter.
7. Determination of friction factor for a given set of pipes.
8. Determination of Pelton wheel performance under various interval loads.
9. Determination of Kaplan turbine performance under various interval loads.
10. Determination of centrifugal pump performance under various interval loads.

Total Hours: 60

Text book(s) :

1.	Dr.R.K.Bansal,"A Textbook of Strength of Materials", Laxmi Publications (P) ltd., New Delhi, 2010.
2.	Dr.R.K.Bansal,"A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi. 2010.

Reference(s) :

1.	R.Subramanian," Strength of Materials", Oxford Publications, 2010.
2.	R.K.Rajput," Strength of Materials", Laxmi Publications, 2010.
3.	Sadhu Singh,"Fluid Mechanics", Khanna Publishing House, Delhi.
4.	Modi and Seth."Fluid Mechanics", Standard Publishers.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 4P2 & Applied Mechanics Laboratory	CO1	2	1	1	2	2		3					1	2	3
	CO2	2	1	3	1	2		2						2	2
	CO3	3	3	1	1	2		2						2	1
	CO4	2	1	1	1	2		1						2	2
	CO5	2	1	1	1	2		2						2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology-Autonomous Regulation							R2018
Semester IV							
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**	
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
50 TP 0P2	**Career Competency Development II**	**0**	**0**	**2**	**0**	**100**	**00**	**100**

Course Objectives	• To help the learners to paraphrase the reading passages, to draft continuous writing and review texts in the academic and professional contexts • To help the learners to acquire the phonetic skills of the language and express themselves precisely for effective professional presentations • To help the learners to enrich their verbal reasoning and ability to match the employability requirements of the corporates • To help the learners to comprehend the preliminary level of aptitude skills required to attend placement and competitive online exams • To help the learners to comprehend the Pre - Intermediate level of aptitude skills required to attend placement and competitive online exams
Course Outcomes	**At the end of the course, the student will be able to** 1. Interpret and infer the meaning in the reading passages, organize continuous writing and review texts both academically and professionally. 2. Adapt to and demonstrate the phonetic skills accurately for effective presentations professionally. 3. Interpret the various concepts of verbal reasoning and relate for the concepts to the requirements of the competitive exams and employability 4. Infer the concepts of preliminary level of aptitude skills pertaining to competitive exams and company recruitments. 5. Infer the concepts of pre-intermediate level of aptitude skills pertaining to competitive exams and company recruitments.

Unit–1	**Written Communication–Part3**	**Hrs**
Reading Comprehension Level 2 (Paraphrasing Poems) - Letter Drafting - Email Writing – Paragraph Writing - Newspaper and Book Review Writing - Skimming and Scanning - Interpretation of Pictorial Representations. **Practices:** Sentence Completion-SentenceCorrection-JumbledSentences-Synonyms&Antonyms – Using the Same Word as Different Parts of Speech-Editing **Materials:** Instructor Manual, Word power Made Easy Book, News Papers		6
Unit–2	**Oral Communication–Part3**	4
Self-Introduction-Miming(BodyLanguage)-IntroductiontotheSoundsofEnglish-Vowels, Diphthongs & Consonants, Introduction to Stress and Intonation - Extempore - News Paper and Book Review-Technical Paper Presentation. **Material:** Instructor Manual ,Newspapers		
Unit–3	**Verbal Reasoning–Part1**	8
Analogies-Alphabet Test-Theme Detection-Family Tree- Blood Relations (Identifying relationships among group of people) -Coding &Decoding-Situation ReactionTest –Statement & Conclusions **Material:** Instructor Manual, Verbal Reasoning by R.S.Aggarwal		
Unit–4	**Quantitative Aptitude –Part1**	6
ProblemonAges-Percentages-ProfitandLoss-Simple&CompoundInterest-Averages-Ratio, Proportion **Material:** Instructor Manual, Aptitude Book		
Unit–5	**Quantitative Aptitude –Part2**	6
Speed, Time&WorkandDistance-PipesandCisterns-MixturesandAllegations-Races-ProblemonTrains - Boats and Streams **Practices**: Puzzles, Sudoku, Series Completion, Problem on Numbers **Material:** Instructor Manual ,Aptitude Book		
	Total	**30**

Evaluation Criteria

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation 1 Written Test	50Questions–30 Questions from Unit 1 &2 , 20 Questions from Unit3, (External Evaluation)	50
2	Evaluation2 Oral Communication 1	Self-Introduction, Role Play & Picture Talk from Unit-4 (External Evaluation by English and MBA Dept.)	30
3	Evaluation3 Oral Communication 2	Book Review & Prepared Speech from Unit-5(External Evaluation by English and MBA Dept.)	20
		Total	**100**

Reference Books

3. Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint20 S. Chand & Co.Ltd., NewDelhi.
4. Word power Made Easy by Norman Lewis W.R. GOYAL Publications

Note:

- InstructorcancoverthesyllabusbyClassroomactivitiesandAssignments (5Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough workpages
- Each Assignment has 20questionsfromUnit1,2andUnit5and5questionsfromUnit3and4
- Evaluation has to be conducted as like Lab Examination.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 TP 0P2– Career Competency Development II	CO1	1	2	1	1	1	1	1	1	1	3	2	3	1	1
	CO2		1		1	1	1	1	1	2	3	2	3	1	1
	CO3	1	1	1	1	2	3	1	1	2	3	2	3	2	2
	CO4	3	2	2	2	1	2	1	1	2	3	2	3	3	3
	CO5	3	2	2	2	1	2	1	1	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 501 – Microprocessors and Microcontrollers

B.E. Mechatronics Engineering

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

Objectives	• To study the architecture of 8085, 8086 microprocessors, 8051& ARM microcontrollers. • To study the addressing modes &instructions sets of 8085, 8086 8051 & ARM. • To introduce the need & use of Interrupt structure. • To understand the architecture and programming of various advanced microcontroller. • To introduce the commonly used peripheral / interfacing ICs and study its simple applications
Course Outcomes	**At the end of the course, the students will be able to** 1. Understand the basic element, functions of microprocessor and assembly language programs. 2. Understand the architecture concepts of 8086 microprocessor and its operation. 3. Understand functional and architectural characteristics of 8051 microcontroller and assembly language programs. 4. Compare advanced microcontroller concepts and memory organization techniques. 5. Interface and apply the concepts of microprocessor and microcontroller to mechatronics systems.

8085 Microprocessor

Evolution of microprocessors- Architecture–Functionalblockdiagram–Instructionset–Addressingmodes–Timing diagrams–Assembly language programming–Interrupts and memory interfacing. [09]

8086 Microprocessor

Advanced microprocessor family overview, Introduction to Harvard architecture - 8086 internal architecture, Pin diagram and function of each pin, 8086 programming model - Memory Segmentation - Generation of Physical address - Concept of queue in 8086. [09]

8051 Microcontroller

Microcontroller Hardware- I/O Pins, Ports- External memory–Counters and Timers-–Serial data I/O- Interrupts- 8051 Assembly Language Programming: Instruction set of 8051, Addressing modes, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions. [09]

ARM Microcontroller

Introduction to ARM microcontroller - Internal architecture, I/O pins, Ports, Timers –Interrupts- Memory organization - Concept of Pipelining -Basic features and comparison of ARM, PIC, AVR, Arduino and Raspberry Pie Microcontrollers. [09]

Applications

Interfacing of ADC,DAC, stepper motor, speed control of DC motor interfacing, traffic light control and case study of washing machine control. [09]

Total Hours: 45

Text book(s) : :	
1	Krishna Kant, “Microprocessors and Microcontrollers Architecture, Programming and System Design 8085, 8086, 8051, 8096”, Prentice Hall of India, New Delhi, 8th Edition, 2011.
2.	Ajay V. Deshmukh, “Microcontrollers Theory and Applications”, Tata McGraw Hill Publishing company Ltd, New Delhi 2011.
Reference(s) :	
1.	Mathur S,Panda J, “Microprocessor and Microcontrollers”, PHI Learning, 2018.
2.	Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, 2nd Edition, Prentice Hall of India, 2015
3.	R.S. Goankar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2010.
4.	A.K. Ray and K.M. Bhurchandi, “Advanced Microprocessors and Peripherals”, 2nd Edition, Tata McGraw-Hill Publishing company Ltd, 2010.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 501 & Microprocessors and Microcontrollers	CO1	1	1	1	1	1	2	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	2	2
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	2	2	2	2	1	1	1	2	3	3	3	3	3
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							R2018
51 MC 502 - System Design and Control							
B.E. Mechatronics Engineering							
Semester	Hours / Week			Total hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
V	3	1	0	60	4	40	60	100

Objectives

- To describe feedback control and basic components of control systems
- To understand the various time domain and frequency domain tools for analysis and design of linear control systems.
- To study the methods to analyze the stability of systems from transfer function forms
- To describe the methods of designing compensators
- To understand the concept of state space analysis

Course outcomes

At the end of the course, the students will be able to

1. Understand the open loop and closed loop control system and able to design develop mathematical model, Translations and Rotational systems transfer function.
2. Learn about time domain specifications and about various types of test input.
3. Learn about frequency domain specifications and design and develop different frequency response plots.
4. Understand the concept of stability and knowledge about Root locus, Routh Hurwitz Criterionand Nyquist Plots.
5. Design Lag, Lead, Lag-lead network and knowledge about State space Analysis

Systems and Their Representation

Introduction to Control System: Open and Closed loop Systems Examples –Residential Heating System, Automobile Drive System, and Temperature Control System. Transfer function: Mathematical Model- Mechanical Model- Translational & Rotational Systems, Electrical Model, Block Diagram Reduction Techniques, Signal flow Graph using Manson’s Gain Rule –Related problems. [09]

Time Response Analysis

Introduction – The Performance Specifications: Transient Response-Rise time, Peak time, Peak Overshoot, Settling time, Measure of performance of the Standard Second Order System -Steady State Response-Steady State Error Constants and System Type Numbers. Types of Test Inputs: Step, Ramp, Parabolic, Impulse -First and Second Order System Response. Feed Back Control System Characteristics: - Proportional, Integral, Derivative, PID Modes of Feedback Control. [09]

Frequency Response Analysis

Introduction –The Performance Specifications in Frequency Domain- The Bode Plots – The Polar Plots–Nichols Chart-determination of closed loop response from open loop response [09]

Stability of Control Systems

Introduction-Characteristic Equation, Location of Roots in S-plane for Stability. Stability Criterion: Bounded input Bounded output Stability, Zero input Stability, Routh Hurwitz Criterion. Root locus construction: Root locus Concept, Guidelines for Sketching Root Loci, Selected illustrative Root Loci-Gain Margin and Phase Margin. Nyquist Stability Criterion Selected illustrative Nyquist Plots. [09]

Compensator Design and Analysis Using Simulation Tool

Types of compensator - Lag ,Lead and Lag-lead networks-Compensator design using Bode Plot, Simulation tool – block diagram - Time Response Analysis - Frequency Response Analysis [09]

Total Hours: 45 + 15(Tutorial) = 60

Text book(s) :

1	I.J Nagrath and M.Gopal "Control System Engineering", New Age international publisher, New Delhi,2016
2	Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, New delhi, 2012

Reference(s) : :

1	M.N. Bandyopadhyay, "Control Engineering Theory and Practice", Prentice Hall of India, 2006.
2	Chesmond C.J. "Basic Control System Technology", Viva Low Priced Student Edition, 1998
3	Leonard N.E. and William Levine, "Using MATLAB to Analyze and Design Control Systems"
4	Gopal M. "Control System Principles and Design", 3rd Edition ,Tata McGraw-Hill, New Delhi,2010

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 MC 502 & System Design and Control	CO1	3	3	2	2	1	1	1	2	1	2	1	2	3	2
	CO2	3	3	3	3	1	1	1	2	1	2	1	2	3	2
	CO3	3	3	3	2	1	1	1	2	1	2	1	2	3	2
	CO4	3	3	3	3	1	1	1	2	1	2	1	2	3	3
	CO5	3	3	3	3	1	2	1	2	1	2	1	3	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 503 -Sensors and Instrumentation

B.E. Mechatronics Engineering

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

Objectives	• To expose the students various sensors and transducers for measuring mechanical quantities. • To make the students familiar with the specifications of sensors and transducers. • To teach the basic conditioning circuits for various sensors and transducers. • To introduce about advancements in sensor technology. • To educate the advance trends and application of sensors.
Course Outcomes	**At the end of the course, the students will be able to** 1. Explain fundamental physical and technical base of sensors. 2. Examine the suitable specification of mechanical transducers for different measurement applications Outline the various methods involved in forming processes. 3. Demonstrate the working of electrical transducers which can measure the temperature, displacement, load, light intensity and angle. 4. Illustrate the working and characteristics of smart sensors. 5. Choose the appropriate sensors for machine tools, manufacturing process, machine vision and environmental applications.

Introduction

Function block of instrumentation - Intelligent instruments- classification of sensors -–Performance Characteristics-Static & Dynamic Characteristics-Errors in Measurement- Calibration and Standards-I/O elements [09]

Mechanical Transducer

Introduction-Temperature Measurement-Pressure Measurement-Force Measurement-Torque Measurement-Liquid Level Measurement-Flow Measurement-Displacement to pressure transducers. [09]

Passive Electrical Transducer

Resistive Transducers, Resistance thermometers, Hot wire resistance transducer, Resistive displacement transducers, Resistive strain transducers-Inductive Transducer, Inductive thickness transducer, Displacement

transducer, Moveable core type inductive transducer, Eddy current type inductive transducer-Capacitive Transducers-Thickness, Displacement, Moisture [09]

Active Electric Transducer

Thermo electric transducers-Piezo Electric Transducers-Magnetostrictive Transducers-Hall-Effect Transducers-Photoelectric Transducers-Ionization Transducers-Digital transducers-electrochemical transducers. [09]

Recent Trends and Applications

Film sensors – Micro-scale sensors – Particle measuring systems – Applications and case studies- Automobile Engineering, Aeronautics, Machine tools and Manufacturing processes. [09]

Total Hours: 45

Text book(s) :

1	Patranabis D,"Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., 2017
2.	Renganathan S., "Transducer Engineering", Allied Publishers (P) Ltd., 2015

Reference(s) :

1.	Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., NewDelhi, 2010.
2.	Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.
3.	J. P. Bentley, Principles of Measurement Systems, Addison Wesley Longman Ltd., UK, 2010
4.	K. Sawhney and P. Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 503 & Sensors and Instrumentation	CO1	3	3	3	3				3		2	3	1		3
	CO2	3	3	3	3			1	2	2	2	2	1		3
	CO3	3	3	2	2	2		2	2	1	2	1	1	3	3
	CO4	3	3	3		3	2	2		2		2	2	3	2
	CO5	3	3	3		3	2	2		2		2	2	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 504 – Machine Design

B.E. Mechatronics Engineering

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

Objectives

- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data.
- To learn to use catalogues and standard machine components
- To design the various machine components as per standards.

Course Outcomes

At the end of the course, the students will be able to

1. Analyze stresses and dimensions in machine elements at various loads.
2. Understand the design of shaft, couplings, keys and knuckle joint for different applications.
3. Design and analyze the springs and gears.
4. Exhibit the design of bearings and connecting rod.
5. Understand the threaded fasteners and ability to design of welded joints.

Variable Stresses in Machine Members

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – Impact and shock loading – eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations. [09]

Shafts and Couplings

Design of solid shaft based on strength, rigidity and critical speed – Design of keys – Types - keyways - Design of rigid and flexible couplings - design of knuckle joints. [09]

Springs and Gears

Springs –Types of Springs, Design of helical, leaf and torsional springs under constant loads and varying loads – Concentric torsion springs – Gears, types, Terminologies-Design of spur and helical gears. [09]

Bearings and Connecting Rod

Study of bearings, Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of connecting rod. [09]

Fasteners and Welded Joints

Threaded fasteners - Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures - theory of bonded joints**.** [09]

Total Hours: 45 + 15(Tutorial) = 60

Text book(s) :

1	Juvinall R.C, and Marshek K.M, "Fundamentals of Machine Component Design", John Wiley & Sons, Seventh Edition, 2019.
2.	J.K Gupta and R.S..Khurmi, "A Textbook of Machine Design" ,Eurasia Publishing House, 2018.

Reference(s) :

1.	Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co, 2008
2.	Norton R.L, "Design of Machinery", Tata McGraw-Hill Book Co, 2004.
3.	Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
4.	Spotts M.F., Shoup T.E, "Design and Machine Elements" Pearson Education, 2004.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 504 & Machine Design	CO1	1	3	1	1	1	2		2		2	3	2	2	3
	CO2	2	2	2	3	3		2		3		2		2	2
	CO3	2	3	1	3	2	1		1		1		3	3	3
	CO4	1	3	3	2	1		2	3		2	1	2	2	2
	CO5	2	1	1	1	2	2	3				1	2	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 5P1 – Microprocessors and Microcontrollers Laboratory

B.E. Mechatronics Engineering

Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	0	0	4	60	2	60	40	100

Objectives

- To familiarize the architecture of 8085, 8086 Microprocessor and 8051 microcontrollers.
- To explore a basic knowledge of microprocessors and microcontrollers.
- To learn programming of microprocessors and microcontrollers.
- To design and develop interfacing concepts of microprocessors and microcontrollers.
- Ability to develop microprocessor and microcontroller based small applications.

Course Outcomes

At the end of the course, the students will be able to

1. Perform the basic arithmetic operations using 8085 microprocessors by developing assembly language programs.
2. Develop an assembly language program to convert hexadecimal to decimal and decimal to hexadecimal and also perform sorting using 8085
3. Perform the basic programming operations using 8086 microprocessors.
4. Perform the basic arithmetic operations using 8051 microcontrollers by developing assembly language programs
5. Demonstrate the interfacing of stepper motor and traffic light controller using 8051

List of Experiments

Programming with 8085 Microprocessors

1. Arithmetic operations (addition, subtraction, multiplication, division) using 8085
2. Logical operations programs using 8085
3. Sorting numbers in ascending and descending order of 8085
4. 8-bit decimal to hexadecimal conversion of 8085
5. Hexadecimal number to decimal number conversion of 8085

Programming with 8086 Microprocessors

6. Basic Programming with 8086 Assembler

Programming with 8051 Microcontrollers

7. Arithmetic operations (addition, subtraction, multiplication, division) using 8051
8. Stepper motor interface using 8051
9. Interface Traffic light controller using 8051
10. ADC and DAC Interface.

	Total Hours: 60
Text book(s) :	
1	R.S. Goankar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2013.
2.	Ajay V. Deshmukh, "Microcontrollers Theory and Applications, "Tata McGraw Hill Publishing company Ltd, New Delhi 2011.
Reference(s) :	
1.	Krishna Kant, "Microprocessors and Microcontrollers Architecture, Programming and system Design 8085, 8086, 8051, 8096", Prentice Hall of India, New Delhi, 8th Edition , 2011.
2.	Mathur S, Panda J, "Microprocessor and Microcontrollers", PHI Learning, 2018.
3.	Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, 2015.
4.	A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals" ,Tata McGraw- Hill Publishing company Ltd, Second Edition, 2010.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 5P1 & Microprocessors and Microcontrollers Laboratory	CO1	2	1	2	3	2	1	2		3	2		3	2	3
	CO2	1	2	3	2	3	2	3		3	2	2	1	2	3
	CO3	2		1	2	2			2	2		2	2		3
	CO4	2	1		2	1	2	1	2	2	2			2	2
	CO5	1		1	3	3				1		2	1	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MC 5P2 – Metrology and Dynamics Laboratory							
B.E. Mechatronics Engineering							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
V	0	0	4	60	2	60	40	100

Objectives	• To be familiar with different measurement equipment's and quality inspection for industrial applications. • Identify and use reference materials to ensure good quality, accurate, traceable measurement results. • To study the principles of gyroscope, Cam and measurement of surface finish. • To calculate the moment of inertia of connecting rod. • To analyze the natural frequency of different types of vibrations.
Course Outcomes	**At the end of the course, the students will be able to** 1. Describe the basic concepts of Metrology and classify different measuring tools related to experiments. 2. Discriminate between various screws by measuring their taper angle and pitch. 3. Measure the diameter of the screw thread. 4. Verify the laws of gyroscope and plot the profile of cam. 5. Evaluate the natural frequency of spring mass system and moment of inertia of connecting rod.

Introduction to metrology and measurement.

1. Calibration of micrometer using slip gauges.
2. a) Study of Tool Makers Microscope.
   b) Measurement of taper angle and pitch by using tool maker's microscope.
3. a) Study of Gear Terminology.
   b) Measurement of various dimensions of the given component using profile projector.
4. Measurement of taper angle using sine bar.
5. a) Study of Screw thread terminology.
   b) Measurement of major and effective diameter of screw thread using 2 wire methods.
6. a) Study of various surface finish measurement techniques.
   b) Measurement of surface flatness by using autocollimator.
7. Determination of gyroscopic couple using Motorized Gyroscope.
8. Plot the profile of cam and study of jump phenomenon.
9. Determination of natural frequency and critical speed of given shaft.
10. Determination of natural frequency of given spring mass system.
11. Determination of Torsional frequency of a single rotor system.
12. Calculate the moment of inertia of connecting rod by oscillation method.

		Total Hours: 60
Text book(s) : :		
1	Jain R.K., "Engineering Metrology", 21st Revised Edition, Khanna publishers, New Delhi, 2015	
2	R.K.Bansal and J.S.Brar., "A Textbook of theory of machines" 5th edition laxmi publication(P) LTD, New Delhi, 2015.	
Reference(s) :		
1.	S. S. Rattan, "Theory of Machines" ,McGraw-Hill Education (India) Private, 2014.	
2.	Khurmi R.S., and Gupta J.K., "Theory of machines", S.Chand & Company Ltd., New Delhi, 14th Edition, 2014.	
3.	Amitabh Ghosh and Malik, A.K., "Theory of Mechanisms and Machines", Reprint, Affiliated East West Press Pvt. Ltd., 3rd Edition, 2011.	
4.	Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2018.	

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 5P2 & Metrology and Dynamics Laboratory	CO1	1	1	1	1	1	1	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	2	1
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
Semester V								
Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
50TP0P3	CAREER COMPETENCY DEVELOPMENT III	0	0	2	0	100	00	100

Course Objectives	• To help the learners to enrich the written and oral communication skills in the academic and professional contexts • To help the learners to enrich their verbal and logical reasoning ability to meet out the employability requirements of the companies • To help the learners to comprehend the Intermediate level of aptitude skills required to attend placement and competitive online exams • To help the learners to enhance their knowledge in the quantitative aptitude skills in algebraic and linear equations. • To help the learners to augment the core technical and coding skills of their respective domains to compete in coding contests
Course Outcomes	**At the end of the course, the student will be able to** 1. Examine the written and oral communication skills in the academic and professional contexts 2. Interpret the concepts of verbal reasoning and relate for the concepts to the requirements of the competitive exams and employability 3. Infer the concepts of intermediate level of aptitude skills pertaining to competitive exams and company recruitments. 4. Assess their comprehension in the quantitative aptitude skills in algebraic and linear equations. 5. Review the core technical and coding skills of their respective domains to compete in coding contests

Unit–1	Written and Oral Communication– Part1	Hrs
Reading Comprehension Level 3 - Self Introduction - News Paper Review - Self Marketing - Debate- Structure and Unstructured GDs Psychometric Assessment – Types & Strategies to answer the questions **Practices:** Sentence Completion - Sentence Correction - Jumbled Sentences - Synonyms & Antonyms - Using the Same Word as Different Parts of Speech-Interpretation of Pictorial Representations-Editing-GD-Debate. **Materials:** Instructor Manual, Word power Made Easy Book, Newspapers		6
Unit–2	Verbal & Logical Reasoning–Part1	
Syllogism - Assertion and Reasons - Statements and Assumptions - Identifying Valid Inferences - identifyingStrongArgumentsandWeakArguments-StatementsandConclusions-CauseandEffect- Deriving Conclusions from Passages - Seating Arrangements. **Practices:** Analogies - Blood Relations -Statement & Conclusions.		8

Materials: Instructor Manual, Verbal Reasoning by R.S.Aggarwal		
Unit–3	Quantitative Aptitude–Part3	6
Probability-Calendar-Clocks-Logarithms –Permutations and Combinations **Materials:** Instructor Manual Aptitude Book		
Unit–4	Quantitative Aptitude–Part4	6
Algebra-Linear Equations-Quadratic Equations –Polynomials. **Practices:** Problem on Numbers -Ages-Train-Time and Work -Sudoku–Puzzles. **Materials:** Instructor Manual, Aptitude Book		
Unit–5	Technical & Programming Skills–Part1	4
Core Subject–1,23 **Practices:** Questions from Gate Material. **Materials:** Textbook, Gate Material		
	Total	30

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation 1 Written Test	50Questions–30 Questions from Unit 1 &2 , 20 Questions from Unit3, (External Evaluation)	50
2	Evaluation2 Oral Communication 1	Self-Introduction, Role Play & Picture Talk from Unit-4 (External Evaluation by English and MBA Dept.)	30
3	Evaluation3 Oral Communication 2	Book Review & Prepared Speech from Unit-5(External Evaluation by English and MBA Dept.)	20
		Total	**100**

Reference Books

1. Aggarwal, R.S. "A Modern Approach to Verbal and Non-verbal Reasoning", Revised Edition 2008,Reprint 2009,S.Chand&CoLtd.,NewDelhi.
2. Word power Made Easy by Norman Lewis W.R.GOYAL Publications

Note:

- InstructorcancoverthesyllabusbyClassroomactivitiesandAssignments (5Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough workpages
- Each Assignment has 20questionsfromUnit1,2andUnit5and5questionsfromUnit3and4
- Evaluation has to be conducted as like Lab Examination.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50TP0P3 & Career Competency Development III	CO1	1	1	1	1	1	1	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	2	1
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC 601 – Programmable Automation Controllers								
B.E. Mechatronics Engineering								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
VI	3	1	0	60	4	40	60	100
Objectives	• To gain the knowledge of various skills necessary for industrial applications of PLC. • To provide the basic programming concepts and various logical instructions used in PLC. • To familiarize the learners in data handling of PLC. • To impart the knowledge on advanced functions of PLC. • To enable the students to troubleshoot and maintain the controller operation in industries.							
Course Outcomes	**At the end of the course, Students will be able to** 1. Describe the main functional units in a PLC and its elements. 2. Develop ladder logic programming for industrial applications. 3. Use PLC data handling instructions for industrial automation. 4. Analyze the advanced functions in control of drives and interfacing techniques with PLC. 5. Outline different industrial automation applications and troubleshooting procedure.							

Automation Fundamentals and PLC

Introduction – Requirement, Architecture of Industrial Automation system – History & Architecture of PLC – Principle operation – PLC Input & Output modules –Selection criteria – PLCs versus computers – Programming devices – PLC programming: Ladder diagram, STL, Functional block diagram, Sequential flow chart, Instruction List. [09]

PLC Programming

Symbols in ladder diagram – Boolean logic & relay logic– input and output field devices – Bit logic instructions – ladder diagram examples, interlocking, latching, inter dependency and logical functions – PLC Timer & Counter functions: ON-delay timer, OFF-delay timers, retentive timers, pulse timers, up-counter, down-counter and up-down counter, industrial process examples using timer & counters. [09]

Data Handling Functions

Data move instructions– FIFO & LIFO, FAL, ONS, CLR, SWEEP functions – Math instructions – Data manipulation &conversion functions – Program control and interrupts: SKIP and MCR functions, jumps, subroutine, and sequence control relay – Simple programs. [09]

Advanced PLC Functions

Sink and Source concept – Analog PLC operation– PID functions – networking of PLC – Drives Control: AC Motor starter, DC motor controller, Variable Frequency Drive – Introduction to IEC61131 international standard for PLC. [09]

PLC Maintenance and Case Studies

PLC maintenance – internal & external PLC faults – programmed error – watch dogs – hardware safety circuits –troubleshooting. Case Studies:Robot controller – FMS – Factory automation – Process control –Materials handling applications – Automatic control of power plant – Simple programs. [09]

Total Hours: 45 + 15(Tutorial) = 60 hours

Text book(s) :

1. Frank D. Petruzella “Programmable Logic Controller”, Tata McGraw-Hill Publication, 5th Edition, 2016.
2. John W. Webb and Ronald A. Reis “Programmable Logic Controllers: Principles and Applications” Prentice – Hall India Publication, 5th Edition, 2013.

Reference(s) :

1. W. Bolton, “Programmable Logic Controllers”, Elsevier Publication, 5th Edition, 2009.
2. E.A.Parr “Programmable Controllers An Engineer’s Guide”, Elsevier Publication, 3rd Edition, 2014.
3. Stuart A Boyer, “SCADA Supervisory Control and Data Acquisition”, ISA, 4th Revised Edition, 2016.
4. Krishnakant, “Computer based Industrial Control”, PHI, New Delhi,5thEdition, 2017.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 601 &Programmable Automation Controllers	CO1	3	3	3	3		1		3		2	3	1		3
	CO2	3	3	3	3			1	2	2	2	2	1		3
	CO3	2	3	2	2	2		2	2	1	2	1	1	3	3
	CO4	2	3	3		3	2	2		2		2	2	3	2
	CO5	3	3	3		3	2	2		2		2	2	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 602 - Computer Aided Design and Manufacturing

B.E. Mechatronics Engineering

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

Objectives

- To provide an overview of how computers are being used in component design.
- To educate concept of computer graphics and graphics standards.
- To impart the fundamentals of geometric modeling and its application in machine design.
- To provide knowledge on CNC machines and train the students in CNC part programming.
- To understand the application of computers in various aspects of Manufacturing.

Course Outcomes	**At the end of the course, the student will be able to** 1. Acquire knowledge about the steps involved in product cycle and fundamentals of CAD/CAM. 2. Recognize and explain the 2D and 3D transformations and different Standards in CAD. 3. Explain the fundamentals of parametric curves, Surfaces and Solids. 4. Apply NC programming concepts to develop part programme for Lathe & Milling Machines. 5. Recite the role of computers in GT and FMS.

Introduction to CAD/CAM

Product cycle, Design process (Shigley model), Sequential and Concurrent Engineering. Computer Aided Design - Applications of Computer in Design, Benefits of CAD. Computer Aided Manufacturing, CAD/CAM concept - Automation and CAD/CAM, Role of CAD/CAM in industry 4.0. [09]

Computer Graphics

Introduction to Computer Graphics - Input and Output devices. Graphical input techniques - Output primitives - 2D and 3D transformations. Visibility techniques: Windowing and Clipping, Hidden line removal, Brightness modulation and Shading. Graphics standards, Standards for exchange images - Open Graphics Library (OpenGL) - Data exchange standards – IGES and STEP. [09]

Geometric Modeling

Introduction to Geometric Modeling - Wireframe modeling - Representation of curves- Hermite curve- Bezier curve- B-spline curves. Techniques for surface modeling - surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques - CSG and B-rep. [09]

Fundamentals of CNC machines and Part Programming

Introduction to NC and CNC systems - Machine axis and Co-ordinate system - Functions and Constructional features of CNC - Classification of CNC machines - DNC concepts and types - Adoptive control. Fundamentals of part programming - Manual Part Programming. Computer assisted part programming - NC programming using CAD/CAM. [09]

Group Technology and Flexible Manufacturing System

Group Technology (GT), Part Families - Parts Classification and coding systems - Simple Problems in OPITZ Coding system - Production flow Analysis - Group technology machine cells - Guidelines for implementing GT. Flexible Manufacturing System (FMS) - FMS Components and its types - Flexibility in FMS - FMS Control - FMS layout configuration - FMS Application & Benefits. [09]

Total Hours: 45

Text book(s) :

1	K Lalit Narayan, K Mallikarjuna Rao and M M M Sarcar, “Computer Aided Design and Manufacturing”, PHI Learning (P) Ltd, 2015.
2	P Radhakrishnan, S Subramanyan and V Raju, “CAD/CAM/CIM”, New Age International (P) Ltd., 2010.

Reference(s) :

1	Chris McMahon and Jimmie Browne, “ CAD/CAM Principles, Practice and Manufacturing Management”, Addison Wesley Longman England, 2000
2	Donald Hearn and M Pauline Baker, “ Computer Graphics”, PHI Pvt Ltd., New Delhi, 2006
3	Ibrahim Zeld and R Sivasubramanian, “CAD/CAM: Theory and Practice”, Tata McGraw Hill Company, 2007.
4	Sadhu Singh, “Computer Aided Design and Manufacturing”, Khanna Publishers, New Delhi, 2011.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 602 & Computer Aided Design and Manufacturing	CO1	1	2	3	3	3				1	2		1	1	2
	CO2	2	2	2	3	3							1	1	2
	CO3	2	2	2	3	3							1	1	2
	CO4	2	2	2	3	3							1	1	2
	CO5	1	2	2	3	3							1	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
51 MC 603 – Robotics Engineering								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Objectives	• To develop the student's knowledge in various robot structures and their workspace. • To develop student's skills in perform kinematics analysis of robot systems • To provide the student with knowledge of the singularity issues associated with the operation of robotic systems • To provide the student with some knowledge and analysis skills associated with robotic sensors • To provide the student with some knowledge and skills associated with Machine vision system
Course Outcomes	**At the end of the course, the student will be able to:** 1. Express the basic concepts, laws, components and parameters of robots. 2. Explain the types of grippers and its functions. 3. Know the basic robot kinematic and acquaintance of homogeneous transformation for various types of robots. 4. Understand the sensors principles for different environmental condition. 5. Know the basis of machine vision and describing the various programming techniques used in industrial robots.

Introduction and Robot Components

Introduction – basic components of robot – laws of robotics – classification of robot – robot motions work space – precision of movement – power transmission system – gear transmission - belt drives – rotary to linear motion conversion, rack and pinion drives, stepper motors and servo motors. [09]

End Effectors

Robot End Effectors – Introduction-Types of end effectors – Mechanical gripper – types of gripper mechanism – gripper force analysis – other types of gripper – special purpose grippers. [09]

Robot Mechanics

Introduction- Matrix representation - rigid motion - homogeneous transformation matrices - forward & inverse kinematics of robot – degeneracy and dexterity- Introduction to USARSim simulation of Robot Kinematics kinematics using USARSim [09]

Sensors

Introduction – Characteristics of sensor - types of sensors – Potentiometers – LVDT – Encoders – Velocity and acceleration sensors – pressure sensor – touch and tactile sensor - proximity sensor – range & sniff sensor.[09]

Machine Vision System and Programming

Introduction - Image acquisition - Sampling and quantization - Image Processing Techniques - Noise reduction methods - Edge detection – Segmentation - thresholding – binary morphology and gray morphology. Introduction - Procedures and Functions - Control Statements-On-line programming - Manual input, lead through programming [09]

Total Hours: 45

Text book(s) :

1	Saeed B. Niku, " Introduction to Robotics: Analysis, systems, Application", 2nd Edition, Pearson Education India, 2017.
2	Mikell P. Groover, "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.

Reference(s) :

1	John.J.Craig, " Introduction to Robotics: Mechanics & control" , Pearson Publication, 4th Edition, 2018.
2	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2nd Edition, 2016.
3	Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, "Introduction to autonomous mobile robots", 2nd Edition, MIT Press, 2011.
4	Ramesh Jain, Rangachari Kasturi, Brain G.Schunck," Machine Vision", Tata McGraw Hill, USA., 2ndEdition (India), 2012.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 MC 603 & Robotics Engineering	CO1	1	1	3	1	2	3	2		3			2	1	2
	CO2	2	2	2	2	1	2		2	2		2	3	1	3
	CO3	3	2	3	2	2	2	1					2	3	3
	CO4	2	1	2	3	1	2		2	1		3	3	2	3
	CO5	2	2	1	1	3		2	3	2			1	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC 6P1 – Robotics and Machine Vision Laboratory								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total

VI	0	0	4	60	2	60	40	100

Objectives	• To introduce different types of robotics and demonstrate them to identify different parts and components. • To write programming for simple operations. • The students will learn to design, build, program, control robotic devices and think of ways in machine vision system. • To educate recent robotics concepts. • To conduct advanced fundamental and applied research in robotics
Course Outcomes	**At the end of the course, the students will be able to** 1. Describe the different types of links, drives, joints and end effectors used inrobots. 2. Analyze the Signal conversion of sensing and digitizing the images using sampling and quantization 3. Analyze the Threshold, connectivity, noise reduction and edge detection of the image. 4. Inspect the color to differentiate the components while doing the pick and place operation of the desired components. 5. Develop the various methods of inspection and maintenance

1. Study of different types of links and joints used in robots, components of robots with drive system and end effectors, classification of robots based on configuration and application.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system.
3. Robot programming exercises (Point-to-point and continuous path programming)
4. Signal conversion of sensing and digitizing the images using sampling and quantization analysis.
5. Windowing and digital conversion techniques of the captured component image for data reduction process.
6. Threshold, connectivity, noise reduction and edge detection of the component image for further segmentation analysis of the component.
7. Texture analysis of the captured image for feature extraction process.
8. Depth and volume analysis of the component in feature extraction techniques to pick the component.
9. Analysis of color inspection to differentiate the components while doing the pick and place operation of the desired component.
10. Template matching such as pattern matching and geometric matching exercises for the component recognition to pick the component using grippers.

Total Hours: 60

Text book(s) :

1	Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, Second Edition, Pearson Education India, PHI 2013 (ISBN 81-7808-677-8)
2.	Ramesh Jain, Rangachari Kasturi, Brain G. Schunck, “Machine Vision”, Tata McGraw Hill, 2012

Reference(s) :

1.	M.P.Groover, “Industrial Robotics-Technology, Programming and Applications”, McGraw Hill, USA. 2012.
2.	John.J.Craig, " Introduction to Robotics: Mechanics & control” , Pearson Publication, 4th Edition, 2018
3.	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2nd Edition, 2016.
4.	Damian M Lyons,Cluster Computing for Robotics and Computer Vision, World Scientific, Singapore, 2011.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 6P1 **&** Robotics and Machine Vision Laboratory	CO1	1	3	1	1	1	2		2			3	2	2	3
	CO2	2	2	2	2	2		2		3	2	2		3	2
	CO3	2	3	2	3	2	1		2				3	3	3
	CO4	1	2	3	2	1		2	3		1	1	2	3	2
	CO5	2	1	1	2	2	2	3			2	2	2	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							R2018
50 MC 6P2 - Computer Aided Manufacturing Laboratory							
B.E. Mechatronics Engineering							
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**	
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**

VI	0	0	4	60	2	60	40	100

Objectives	• To provide knowledge on construction and working of Computer Numerical Control (CNC) Machines • To be familiar with on interfacing, communicating and control of CNC machine tools. • To impart the knowledge on CNC manual part programming basics. • To provide skill on programming of CNC turning center and CNC machining center. • To gain practical experience computer assisted part programming
Course Outcomes	**At the end of the course, the student will be able to:** 1. Explain the construction and working of CNC machine tools. 2. Understand the various concepts in CNC programming. 3. Prepare the programs to manufacture components in CNC turning center. 4. Prepare the programs to manufacture prismatic components using CNC machining centers. 5. Understand the NC code generation through CAD models in CAM Software.

CNC Turning

1. NC manual part program generation on step turning.
2. NC manual part program generation on taper turning.
3. NC manual part program generation on grooving cycle.
4. NC manual part program generation on thread cutting.
5. NC manual part program generation on drilling and boring cycle.

CNC Milling

6. NC manual part program generation on linear interpolation.
7. NC manual part program generation on circular interpolation.
8. NC manual part program generation on contour milling.
9. NC manual part program generation on drilling and peck drilling.
10. NC manual part program generation on Mirror imaging in CNC Milling.

Computer Aided Part Programming

11. CL Data Generation for the given component by using CAM Software.

Total Hours: 60

Text book(s) :

1	Lalit Narayan. K, Mallikarjuna Rao. K and Sarcar. M. M. M, "Computer Aided Design and Manufacturing", PHI Learning (P) Ltd, 2015.
2	Radhakrishnan. P., "Computer Numerical Control Machines", New Central Book Agency, 2001.

Reference(s) :

1	NIIT., "Fundamentals of Computer Numerical Control", PHI learning private limited, New Delhi, 2009
2	Sadhu Singh, "Computer Aided Design and Manufacturing", Khanna Publishers, New Delhi, 2011.
3	Ibrahim Zeld and R Sivasubramanian, "CAD/CAM: Theory and Practice", Tata McGraw Hill Company, 2007.
4	Chris McMahon and Jimmie Browne, "CAD/CAM: Principles, Practice, and Manufacturing Management" ,Pearson Education Asia, 2001.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 6P2 & Computer Aided Manufacturing Laboratory	CO1	3	1	3	1	2	2	1	2	1		3	3	2	3
	CO2	2	2	2	2	2	3	2		3	2	2	2	3	3
	CO3	2	1	2	3	2	1		2			1	3	3	3
	CO4	3	2	3	2	2	3	2	3		1	1	2	3	2
	CO5	2	1	1	2	2	2	3		1	2	2	2	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
Semester VI								
Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
50 TP 0P4	CAREER COMPETENCY DEVELOPMENT IV	0	0	2	0	100	00	100

Course Objectives	• To help the learners to enrich the advanced written and oral communication skills in the academic and professional contexts • To help the learners to augment their advanced verbal and logical reasoning ability to meet out the employability requirements of the companies • To help the learners to comprehend the advanced level of aptitude skills in the concepts of Geometry • To help the learners to enhance the data interpretation and analytical skills in variedmethods. • To help the learners to enrich the technical and programming skills to be focused on better employability, codeathons and hackathons
Course Outcomes	**At the end of the course, the student will be able to** 1. Examine and correlate the written and oral communication skills in the academic and professional contexts 2. Predict and discriminate advanced verbal and logical reasoning ability to meet out the employability requirements of the companies 3. Infer the concepts of advanced level of aptitude skills on Geometry pertaining to competitive exams and company recruitments. 4. Illustrate the data interpretation and analytical skills in varied methods. 5. Formulate the technical and programming skills to be focused on better employability, codeathons and hackathons

Unit–1	Written and Oral Communication– Part2	Hrs
Self-Introduction–GD–Personal Interview Skills **Practices** on Reading Comprehension Level 2 – Paragraph Writing – Newspaper and Book Review Writing–SkimmingandScanning–InterpretationofPictorialRepresentations–SentenceCompletion- Sentence Correction–Jumbled Sentences–Synonyms & Antonyms– Using the Same Word as Different Parts of Speech–Editing.**Materials:**InstructorManual,WordpowerMadeEasyBook,NewsPapers		4
Unit–2	Verbal & Logical Reasoning –Part2	8
Analogies – Blood Relations – Seating Arrangements – Syllogism – Statements and Conclusions, Cause and Effect – Deriving Conclusions from Passages – Series Completion (Numbers, Alphabets & Figures) – AnalyticalReasoning–Classification–CriticalReasoning**Practices**:Analogies–BloodRelations– Statement &Conclusions.**Materials:**Instructor Manual, Verbal Reasoning by R.S.Aggarwal		
Unit–3	Quantitative Aptitude– Part–5	6
Geometry–StraightLine–Triangles–Quadrilaterals–Circles–Co-ordinateGeometry–Cube–Cone –Sphere. **Materials:** Instructor Manual, Aptitude book		
Unit–4	Data Interpretation and Analysis	6
Data Interpretation based onText–DataInterpretationbasedonGraphsandTables.GraphscanbeColumnGraphs, Bar graphs, Line Charts, Pie Chart, Graphs representing Area, Venn Diagram & Flow Charts. **Materials:** Instructor Manual, Aptitude Book		
Unit–5	Technical & Programming Skills–Part2	6
Core Subject– 4, 5, 6 **Practices:** Questions from Gate Material. **Materials:** Text Book, Gate Material		
	Total	30

Evaluation Criteria

S.No.	Particular	Test Portion	**Marks**
1	Evaluation1 Written Test	15 Questions each from Unit1,2,3,4&5(External Evaluation)	50
2	Evaluation2– Oral Communication	GD and HR Interview (External Evaluation by English, MBA Dept.)	30
3	Evaluation 3 – Technical Interview	Internal Evaluation by the Dept.–3CoreSubjects	20
		Total	100

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non- verbal Reasoning”, Revised Edition2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Abhijit Guha, “QuantitativeAptitude”, TMH,3rd edition
3. Objective Instant Arithmetic by M.B.Lal & Goswami Upkar Publications.
4. Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

Note:

- Instructor can cover the syllabus by Class room activities and Assignments(5Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough Workpages
- Each Assignment has 20 questions from Unit 1,2,3,4,5 and 5 questions from Unit 1(OralCommunication) & Unit 5(Programs)
- Evaluation has to be conducted as like Lab Examination.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 TP 0P4 – Career Competency Development IV	CO1	1	1	1	1	1	2	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	1	1
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	2	2	2	2	1	1	1	2	3	3	3	2	2
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MC 701 – Industrial Automation Protocols							
B.E. Mechatronics Engineering							
Semester	**Hours / Week**			**Total Hrs**	**Credit**	**Maximum Marks**	
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
VII	3	0	0	45	3	40	60	100

Objectives(s)	• To impart the knowledge of Supervisory Control and Data Acquisition (SCADA) System. • To make the students understand role of Distributed Control System in industrial automation. • To familiarize the learners in industrial communication with its protocol. • To provide an importance of Internet of Things (IoT) and it's envisioned deployment domains. • To enable the students to understand the various cyber security technologies used in industries.
Course Outcomes	**At the end of the course, Students will be able to** 1. Implement the Supervisory Control and Data Acquisition systems for particular applications. 2. Integrate the distributed control system and to differentiate the DCS over other automation systems. 3. Select the proper communication buses and its protocol for industrial applications. 4. Adopt the concepts of Internet of Things (IoT) industrial automation. 5. Utilize the new tools and technologies to enhance the cyber security industrial communication.

Supervisory Control and Data Acquisition System:

Elements of SCADA-Functionalities of SCADA-Architecture: Hardware, Software: Development, Runtime mode Functions-Tools: Tag Database-Recipe database- Alarm Logging-Trends: Real Time, Historical Trends-Security and User Access Management-Management Information System-Report Function. Different Communication Protocols, SCADA systems in operation and control of manufacturing Plant, Trends in SCADA. [09]

Distributed Control Systems:

Distributed Control System (DCS) - Introduction, Flow sheet symbols, Architecture, Specifications, Supervisory computer functions and Algorithm, Computer displays, Control Techniques and Strategies, Computer interface with DCS, System integration with PLCs, Computer – HMI, DCS programming. [09]

Role of Networking in Automation

Different Network protocols - ASI, CAN, Device net, Industrial Ethernet, Profibus – PA / DP / FMS, Fieldbus, HART, Physical layer and wiring rules, Safety Instrumented System (SIS) - Need for safety instrumentation- risk and risk reduction methods, hazards analysis, Process control systems and SIS, Safety Integrity Levels (SIL) and availability, Introduction to the international functional safety standard IEC61508. [09]

Industrial Internet of Things

Introduction to Internet of Things-Overview of Internet of Things-the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (IIoT -Industry 4.0), Quality Assurance, Predictive Maintenance, Real Time Diagnostics, Design and Development for IoT, Understanding System Design for IoT, Design Model for IoT. IoT Specific Challenges and Opportunities. [09]

Cyber Security in Industrial Automation

Emerging Approaches to Industrial Automation Security-Internet of Things, Open platform communications unified architecture, Security and privacy, Big data analytics and the industrial Internet of Things, The National Institute of Standards Technology (NIST) Cyber-Physical Systems (CPS) Framework, CPS and Cyber security, Critical Infrastructure security, Software-defined elements. [09]

Total Hours: 45

Text book(s) :

1	M. P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Fourth Edition, Pearson Education, UK, 2016.

2	Stuart A.Boyer, "SCADA: 'Supervisory control and Data Acquisition', 4th Edition, ISA, 2010.
Reference(s) :	
1.	Natalia Olifer, Victor Olifer, "Computer Networks: Principles, Technologies and protocols for Network design", John Wiley & Sons, 2010.
2.	Robert Radvanovsky, Jacob Brodsky, "Handbook of SCADA/Control Systems Security", 2nd Edition, CRC press, 2016.
3.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress 1st Edition, 2017.
4.	Lucas M.P, Distributed Control Systems, Van Nostrand Reinhold Company, Newyork, 1986.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 701 & Industrial Automation Protocols	CO1	1	1	1	1	1	1	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	1	1
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 702 – Embedded System

B.E. Mechatronics Engineering

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

Objectives(s)

- To impart knowledge on the Building Blocks of Embedded System, Various Embedded development Strategies.
- To endow with an overview of ARM architecture and Memory organization.
- To bring out the various networks and buses, interfacing protocols with embedded system and scheduling algorithms.
- To equip students with the knowledge of scheduling and multitasking strategies of RTOS.
- To illustrate the different embedded processors and their application in practice.

Course Outcomes

At the end of the course, the students will be able to

1. Describe the function and operation of software and hardware components of embedded systems
2. Design ARM based systems and study about memory organization.
3. Design and discriminate various communication networks and their interfaces
4. Outline the features of RTOS and Configure the RTOS for operations involved in embedded applications.
5. Develop the hardware for embedded system application based on the processors.

Introduction to Embedded Systems

The build process for embedded Systems-Structural units in Embedded processor, selection of processor &memory Devices-Timer and Counting devices, Watchdog Timer, Real Time Clock-Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging need for Hardware-Software Partitioning, Co-Design. [09]

ARM Architecture and Memory Organization

ARM architecture–ARM programming's Model-Registers– Pipelining architecture–-Interrupts and Exceptions handlings–ARM Instruction sets–THUMB instruction sets. ARM Programming-DMA–Memory Management-Cache mapping techniques, dynamic allocation–Fragmentation. [09]

Embedded networking and communication

Sockets, ports, UDP, TCP/IP, client server model, socket programming, 802.11, Bluetooth, ZigBee, firewalls, network security and I2C. Wireless sensor networks – Introduction – Applications – Network Topology – Localization –Time Synchronization - Energy efficient MAC protocols.

Types of Interrupt-Programmed I/O Busy wait approach without ISM–ISR Concept–Interrupt Handling Mechanism–Context Switching-Interrupt latency–Interrupt Service Deadline-preventing Interrupt overrun, disability interrupts-interrupt driven I/O-writing interrupt service routine in C & assembly languages. [09]

Real Time Operating System(RTOS)

Introduction to RTOS –Advantage and Disadvantage of Using RTOS – Multitasking – Tasks and task states - Real Time Kernels – Scheduler - Non-Preemptive Kernels - Preemptive Kernels – Round Robin Scheduling - Task Priorities -Static Priorities – Mutual Exclusion – Deadlock – Clock ticks. [09]

Case Studies Embedded System in Automobile–Adaptive Cruise Control Systems in a car– Case study of coding for a Digital Camera -Elevator control –ATM Machine-Mobile Phone-Robotic ARM control. [09]	
Total hours 45	
Text book:	
1	P.Rajkamal,"Embedded System–Architecture, Programming and Design" ,3rd Edition ,Tata McGraw Hill Publishing Co.Ltd,2015.
2.	Steve Furber,"ARM System on chip Architecture",2nd Edition ,Addison Wesley, 2013.
Reference(s):	
1.	Frank Vahid, 'Embedded System Design – A Unified Hardware & Software Introduction', John Wiley, 2002.
2.	Sriram V. Iyer, Pankaj Gupta, 'Embedded Real Time Systems Programming', Tata McGraw Hill, 2004.
3.	Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", 2nd Edition, Morgan Kaufman Publishers, 2013.
4.	Dominic Symes , Chris Wright , Andrew N.sloss, "ARM Systems Developer's Guides-Designing&Optimizing System Software", 2008, Elsevier.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 702 &Embedded System	CO1	1	1	1	1	1	1	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	2	2
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous R2018

50 MC 703 – Autonomous Vehicle

B.E. Mechatronics Engineering

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

Objectives(s)	• To introduce the basic concepts and communication protocols of autonomous vehicle system. • To familiar and explain about driver assistance techniques and troubleshooting methods. • To enlighten the learners about the basics of unmanned aerial vehicle and its navigation concepts. • To expertise in the autonomous vehicle architectures and path planning system. • To gain knowledge about autonomous vehicle projects and data acquisition system.
Course Outcomes	**At the end of the course, the students will be able to** 1. Understand the basic working principles of autonomous vehicle system. 2. Get expertise in advanced driver assistance and maintenance system. 3. Acquire knowledge in basic design concept and control aspects of UAVs. 4. Understand the autonomous vehicle architectures concepts and obstacle avoidance methods. 5. Enhance knowledge in the successful autonomous vehicle case studies in different fields.

Introduction to Autonomous Vehicle System (AVS)

AVS - Missions, capabilities, types and configurations - Basic control system theory applied to automobiles - Overview of Electronic Control Unit (ECU) - Basic Cyber Physical System (CPS) theory and autonomous vehicles - Role of surroundings sensing systems - Telemetry and communications, wireless data networks and autonomy. [09]

Advanced Driver Assistance System Technology

Driverless car technology - Moral, legal, roadblock issues, technical issues and security issues - Troubleshooting and maintenance of advanced driver assistance systems, failure modes - Self calibration - Sensor testing and calibration - Standard manufacturing principles - Redundant systems. [09]

Concepts of Unmanned Aerial Vehicle (UAV)

History of UAVs – Ground, surface water and underwater UAVs - Remotely Operated Vehicle (ROV) - Levels of autonomy - Coordinate systems - Equations of motion and transformation for payloads - Sensors and actuators

- Internal measurements and navigation, Global Positioning System (GPS) - Proportional Integral Derivative (PID) automatic control – Guidance – Navigation - Vision based guidance for ground vehicles. [09]

Architectures for Autonomous Vehicle

Control architectures and motion autonomy - Deliberative, reactive, hybrid architectures - Overview of sharp architecture, models of vehicles, concepts of sensor based maneuver, reactive trajectory - Parallel parking- Platooning, main approaches to trajectory planning - Non-Holonomic path planning [09].

Autonomous Vehicle and Case Studies

Defense Advanced Research Projects Agency (DARPA) Challenges case study, ARGO prototype vehicle, The Generic Obstacle for Lane Detection (GOLD) system - The inverse perspective mapping, lane detection, obstacle detection, vehicle detection, pedestrian detection - Software systems architecture, Computational performances, ARGO prototype vehicle hardware – Functionalities, Data Acquisition System (DAS), processing system and control system. [09]

Total hours 45

Text book:

1	Nicu Bison, Lucian D Ascalescu and Naser Mahdavit Abatabaei "Autonomous Vehicles Intelligent, Transport Systems and Smart Technologies", Nova Publishers, 2014.
2.	Reg Austin, 'Unmanned Aircraft Systems: UAVs Design, Development, and Deployment', First Edition, John Wiley and Sons Ltd., 2011.

Reference(s):

1.	James M. Anderson, Nidhi Kalra, Karlyn D. Stanley, Paul Sorensen, Constantine Samaras, Oluwatobi A. Oluwatola, "Autonomous Vehicle Technology" Published by Rand Corporation, 2016.
2.	Anthony Finn and Steve Scheding, "Developments and Challenges for Autonomous Unmanned Vehicles", Springer, 2010.
3.	Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011.
4.	Thomas Gleason and Paul Fahlstrom, 'Introduction to UAV Systems', Fourth Edition, John Wiley and Sons Ltd., 2012.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 703 & Autonomous Vehicle	CO1	2	2	3	3	3	2	2	3	3	3	3	1	2	3
	CO2	3	2	3	2	2	3	2	3	2		1		3	3
	CO3	2	2	2	2	2	3	2	2	2	1		1	2	2
	CO4	2	2	3	2	2	2	3	3	2	1		3	2	3
	CO5	3	3	2	3	3	3	2	2	3	2	3	1	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous R2018

50 AC 001 - Research Skill Development -I

Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	1	0	0	10	0	100	0	100

Objective(s)

- To learn about the effective usage of power point presentation
- To prepare presentation with various effects
- To visualize the data in the presentation
- To acquire knowledge about data sources
- To investigate the research articles based on various applications

Course Outcomes

At the end of the course, the students will be able to

1. Develop presentation with visual effects
2. Prepare a presentation with supporting data
3. Attain the importance of research and data collection
4. Analyze the various sources of research articles
5. Interpret the tools and methods in preparing manuscript

Note: Hours notified against each unit in the syllabus are only indicative but are not decisive. Faculty may decide the number of hours for each unit depending upon the concepts and depth. Questions need not be asked based on the number of hours notified against each unit in the syllabus**.**

Preparing a Presentation (03)

Presenting data using Power Point- Power Point preparation and presentation, Design principles for creating effective PowerPoint slides with visuals displaying data. - Profile, -Problem, and a set of basic Excel charts, use to create a presentation.

Creating effective slides using PowerPoint (02)

Create effective slides using PowerPoint. Tools within PowerPoint, structure story line, create story boards, identify primary elements of slide design, display data and finalize slide presentation.

Research Designs and Data Sources (03)

Overview of the topics: process of data collection and analysis. Starting with a research question - Review of existing data sources- Survey data collection techniques- Importance of data collection- Basic features affect data analysis when dealing with sample data. Issues of data access and resources for access.

Measurements and Analysis Plan (02)

Importance of well-specified research question and analysis plan: various data collection strategies - Variety of available modes for data collection – review of literature - Tools at hand for simple analysis and interpretation.

Total Hours: 10

Text Book(s):

1. Judy Jones Tisdale. Effective Business Presentations. Gulf Coast Books LLC. ISBN-13: 978-0130977359, 2004.
2. Frauke Kreuter. Framework for Data Collection and Analysis,2018. https://www.coursera.org/learn/data-collection-framework

Reference(s)

1. Kothari, C.R. and Gaurav Garg, “Research Methodology: Methods and Techniques”, New Age International Publishers, 2013
2. Srivastava, T.N. and Rego, S., "Business Research Methodology", Tata Mc GrawHill Education Pvt. Ltd., Delhi, 2019.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 AC 001 **&**Research Skill Development -I	CO1	3	3	3	2	1	3	3	2	3	1	2	1	2	3
	CO2	3	2	2	1	1	2	1	1	3	2	3	2	2	2
	CO3	3	1	3	1	1	3	3	1	1	3	2	1	3	3
	CO4	3	2	3	3	2	2	1	1	2	1	3	2	3	2
	CO5	2	1	3	1	1	3	2	1	2	1	3	1	1	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 7P1 – Industrial Automation and Control Laboratory

B.E. Mechatronics Engineering

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	0	0	4	60	2	60	40	100

Objectives(s)

- To train the students to be familiar with the software and hardware of PLC using ladder logic codes.
- To familiarize the student to develop PLC programs for different applications.
- To facilitate knowledge on PLC Control Principles and Applications with Field Devices.
- To train the students to create ladder diagrams for process control descriptions.
- To impart knowledge on Configure communication between the PLC and PC.

Course Outcomes

At the end of the course, Students will be able to

1. Write a PLC program for various industrial applications.
2. Control the speed of AC motors using VFD.
3. Interface the sensors for flow, pressure and level monitoring and control in process industries.
4. Design the of closed loop temperature controller.
5. Explore the concept of real-time monitoring and control using HMI.

Programming the PLC using ladder logic for:

1 Basic operations (Mathematical and Boolean).
2 Gray painting system.
3 Control the lamp by timer.
4 Material handling system.
5 Lift elevator control.
6 Traffic light control

Program and Interface the PLC using ladder logic for:

7 Bottle filling and stamping system
8 Water level control.
9 Speed control of AC motor.
10 Flow measurement
11 Pressure measurement.
12 Temperature control.
13 Human machine interface

Total Hours: 60

Text book(s) :

1.	M. P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Fourth Edition, Pearson Education, UK, 2016.
2.	Stuart A.Boyer, "SCADA: 'Supervisory Control and Data Acquisition', 4th Edition, ISA, 2010.

Reference(s) :

1.	Natalia Olifer, Victor Olifer, "Computer networks: Principles, Technologies and protocols for Network design", John Wiley & Sons, 2010.
2.	Robert Radvanovsky, Jacob Brodsky, "Handbook of SCADA/Control Systems Security", 2nd edition, CRC press, 2016.
3.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress 1st Edition, 2017.
4.	Lucas M.P, Distributed Control Systems, Van Nostrand Reinhold Company, Newyork, 1986.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 7P1 **&** Industrial Automation and Control Laboratory	CO1	3	3	3	3	3	1	1	1	3	3	3	1	3	3
	CO2	3	3	3	3	3		1		2	2	2	1	3	2
	CO3	3	3	3	3	3	2	1	1	3	3	3	1	3	3
	CO4	3	3	3	3	3	2	1	1	3	3	3	1	3	3
	CO5	3	3	3	3	1	1	1		2	1	2	1	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 7P2 – Embedded System Laboratory

B.E. Mechatronics Engineering

Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	0	0	4	60	2	60	40	100

Objectives(s)

- Understand the programming concepts of Embedded Systems.
- Using Embedded C / Assembly Language using Keil IDE or Equivalent. Learn the working of Arm architecture in Atmel processor.
- To explore a basic knowledge of AT89X51ED2 Development board.
- To train the students for creating embedded control process for variety of applications.
- To conduct advanced fundamental and applied research in embedded systems.

Course Outcomes

At the end of the course, the students will be able to

1. Acquire the knowledge of basics of embedded system and Perform arithmetic operations in an embedded system with a combination of C and assemble language.
2. Test the serial data communication of internal UART using Atmel processor.
3. Demonstrate the dual slope ADC and 8 channel 12-bit ADC using Atmel processor.
4. Demonstrate the concept of 7 segment display and real time clock.
5. Interface the traffic light signal, stepper motor and position control of DC motor using ARM processor.

1. Real time operating system solutions with KEIL tools – Introduction
2. Program to perform 8bit and 16bit Arithmetic operation using KEIL IDE.
3. Program to perform search and replacement a number using KEIL IDE.
4. Program to transmit a message from Microcontroller to PC serially using UART communication
5. Program to check the status of PORT1 (8051) signal using LEDs.
6. Interfacing and programming of 8 Channel 12 Bit ADC
7. Interfacing and programming of Dual Slope ADC
8. Interfacing and Programming of Seven Segment Display
9. Interfacing real time clock and serial port
10. Program to interface Traffic Light Controller
11. Program to interface Stepper Motor to rotate the motor in clockwise and anticlockwise directions
12. DC motor speed and position control using ARM Processor

Total Hours: 60

Text book:

1	P.Rajkamal, "Embedded System – Architecture, Programming and Design", 3rd Edition, TataMcGraw Hill Publishing Co. Ltd, 2015.
2.	David E. Simon, "An Embedded Software Primer", 3rd Edition, Pearson Education, 2014.

Reference(s):

1.	Steve Furber, "ARM System on chip Architecture", 2nd Edition, Addision Wesley, 2013.
2.	Dr K.V.K.K..Prasad, "Embedded /Real-Time systems: Concepts, Design & Programming", New Edition, Dream Tech Press, 2013.
3.	Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier Publications, 2013.
4.	Dominic Symes, Chris Wright, Andrew N.sloss , "ARM Systems Developer's Guides-Designing & Optimizing System Software" , 2008,Elsevier.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 7P2 &Embedded System Laboratory	CO1	3	3	2	3	1	2	2	1	1	1	1	1	2	2
	CO2	1	1	2	1	1	2	2	1	1	1	1	1	2	2
	CO3	2	2	2	2	1	2	2	1	1	1	1	1	2	2
	CO4	3	3	2	3	1	2	2	1	1	1	1	1	2	2
	CO5	3	3	2	3	1	2	2	1	1	1	1	1	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC 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

Objective(s)	• To apply the knowledge/concepts acquired in the Previous semesters to create/design/implement project relevant to the field of Electrical/Electronics/Robotics/Automation/ Mechanical domains. • To acquire collaborative skills through working in a team to achieve common goals. • To search for related area in which the students are going to do their project. • To identify suitable project work, acquiring knowledge on that area, making preliminary works towards project phase II. • To acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.
Course Outcomes	**At the end of the course, the students will be able to** 1. Survey the literature and market for availability of resources 2. Select the title and collect relevant information related with selected title. 3. Collect the literature based on survey and do the partially design of the system. 4. Carryout partial design of the system 5. Prepare and present the project report

Methodology	• Three reviews have to be conducted by the committee of minimum of three members one of which must be the guide. • Problem should be selected. • Students have to collect around 25 papers related to their work. • Report has to be prepared by the students as per the format available in CTCMS. • Preliminary implementation can be done if possible. • Evaluation has to be done for 100 marks.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 7P3 & Project Work - Phase I	CO1	2	2									2	2	2	1
	CO2	2	3									2	1	2	
	CO3	2	2	3	1								1	3	2
	CO4	3		1	3	2				2			1	1	2
	CO5			1		2					2	2	2		2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
Semester VII								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
50 TP 0P5	**CAREER COMPETENCY DEVELOPMENT-V**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Course Objectives	• To help the learners to practice the written and oral communication skills in the academic andprofessional contexts • To help the learners to practice the verbal and logical reasoning ability to meet out the requirementsof both competitive exams and companies • To help the learners to practice effectively the aptitude modules for company based recruitments andcompetitive exams • To help the learners to practice effectively the data interpretation and analysis modules for companybased recruitments and competitive exams • To help the learners to hone the technical and programming skills for better employability							
Course Outcomes	**At the end of the course, the student will be able to** 1. Reinforce the written and oral communication skills in the academic and professional contexts 2. Discriminate and assess the verbal and logical reasoning ability to meet out the employabilityrequirements of the companies 3. Relate the aptitude modules for company based recruitments and competitive exams effectively 4. Compare and illustrate the data interpretation and analysis modules effectively for company basedrecruitments and competitive exams 5. Formulate and integrate the technical and programming skills to be focused on better employabilityand code contests.							
Unit–1	**Written and Oral Communication**							Hrs
Self-Introduction–GD–HR Interview Skills–Corporate Profile Review-Practices on Company Based Questions andCompetitive Exams **Materials:** Instructor Manual								6
Unit–2	**Verbal &Logical Reasoning**							6
Practices on Company Based Questions and Competitive Exams **Materials:** Instructor Manual								
Unit–3	**Quantitative Aptitude**							6
Practices on Company Based Questions and Competitive Exams **Materials** Instructor Manual								
Unit–4	**Data Interpretation and Analysis**							6
Practices on Company Based Questions and Competitive Exams **Materials :**Instructor Manual								
Unit–5	**Programming & Technical Skills–Part3**							

Data Structure- Arrays–Linked List–Stack–Queues –Tree–Graph. Practices on Algorithms and Objective TypeQuestions. **Materials :**Instructor Manual	6
Total	30

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation1 – Written Test	15 Questions each from Unit1,2,3,4&5 (External Evaluation)	50
2	Evaluation2- Oral Communication	GD and HR Interview (External Evaluation by English ,MBA Dept.)	30
3	Evaluation3– Technical interview	Internal Evaluation by the Dept.–3 Core Subjects	20
		Total	**100**

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non- verbal Reasoning”, Revised Edition2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Abhijit Guha, “QuantitativeAptitude”,TMH,3rd edition
3. Objective Instant Arithmetic by M.B.Lal & Goswami Upkar Publications.
4. Word Power Made Easy by Norman Lewis W.R.GOYAL Publications

Note:

- Instructor can cover the syllabus by Class room activities and Assignments(5Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough Workpages
- Each Assignment has 20 questions from Unit 1,2,3,4,5 and 5 questions from Unit 1(OralCommunication) & Unit 5(Programs)
- Evaluation has to be conducted as like Lab Examination.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 TP 0P5 & Career Competency Development V	CO1	1	1	1	1	1	2	1	1	2	3	2	3	1	1
	CO2	2	1	2	2	1	2	1	1	2	3	3	3	1	1
	CO3	2	1	2	2	1	1	1	1	2	3	2	3	2	2
	CO4	2	2	2	2	2	1	1	1	2	3	3	3	2	2
	CO5	2	2	2	2	2	2	2	2	2	3	2	3	3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 HS 003- Total Quality Management

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)	• To facilitate the understanding of total quality management principles, tools and techniques. • To equip the students to apply the TQM principles, tools and techniques in manufacturing sectors. • To equip the students to apply the TQM principles, tools and techniques in service sectors. • To impart knowledge on quality management principles, tools, techniques and quality standards for real life applications • To make the students understand the importance of standards in the quality assurance process and their impact on the final product.
Course Outcomes	**At the end of the course, the students will be able to** 1. Recognise the need for quality concepts and its application in organizations. 2. Apply the TQM principles for survival and growth in world class competition 3. Apply the traditional tools and new tools for quality improvement. 4. Apply the tools and techniques like quality circle, QFD, TPM and FMEA for quality improvement. 5. Apply QMS and EMS in organizations.

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Introduction

Introduction, definitions of quality, need for quality, evolution of quality, dimensions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer satisfaction, customer complaints, customer retention; costs to quality. [09]

TQM Principles

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; continuous process improvement; PDSA cycle, Kaizen, 5S & 7S; Supplier partnership, Partnering, Supplier rating and selection. [09]

TQM Tools and Techniques I

The seven traditional tools of quality; New management tools - applications to manufacturing, service sector,Statistical Fundamentals, Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, control charts, process capability, concepts of six sigma's, Bench marking - Reasons to benchmark, Benchmarking process. [09]

TQM Tools and Techniques II

Quality circles, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance, measures. FMEA- stages, Types-Design FMEA and Process FMEA. [09]

Quality Management System

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001, ISO 9001:2008 Requirements-Implementation-Documentation-Internal Audits-Registration-Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS. [09]

Total Hours: 45

Text Book(s):

1.	Dale H. Bester field .,et. al, "Total Quality Management", 3rd Edition., Pearson Education South Asia, 2013.
2.	Janakiraman, B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd. 2006.

Reference(s)

1.	Joel.E. Ross, "Total Quality Management – Text and Cases", 3rd Edition, Routledge, 2017.
2.	James R. Evans, James Robert Evans, William M. Lindsay, "The Management and Control of Quality", 8th Edition, South-Western, 2010.
3.	Kiran.D.R, "Total Quality Management", Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
4.	Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 HS 003 &Total Quality Management	CO1	3	3	3	2	1	3	3	2	3	1	2	1	2	3
	CO2	3	2	2	1	1	2	1	1	3	2	3	2	2	2
	CO3	3	1	3	1	1	3	3	1	1	3	2	1	3	3
	CO4	3	2	3	3	2	2	1	1	2	1	3	2	3	2
	CO5	2	1	3	1	1	3	2	1	2	1	3	1	1	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 AC 002 - Research Skill Development -II							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
VIII	1	0	0	15	0	100	--	100
Objective(s)	• To identify the ethics in preparing research paper • To organize manuscript for submission • To attain knowledge for filing Patent • To apply for copy right • To develop and deploy Mobile App. in play store						

Course Outcomes	**At the end of the course, the students will be able to** 1. Prepare a manuscript for journal publication. 2. Apply the manuscript for publication 3. Interpret the process of obtaining copyright and patent 4. Analyze the various provisions to share the application 5. Create and publish the mobile application in the digital store

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Preparation of Manuscript

Data necessary before writing a paper: the context in which the scientist is publishing. Learning and identification of research community - advantages of scientific journal publication and manuscript preparation - ethical values in publishing. [03]

Writing the paper

Writing research paper - structure of the paper - usage of bibliographical tools - abstract preparation and to do a peer review for the abstract of the others, as in real academic life. Plagiarism of the prepared manuscript.

Copyright [02]

Copyright law in India-Meaning of copyright-Classes of works for copyright protection -Ownership of Copyright-Assignment of copyright-Intellectual Property Rights (IPR) of Computer Software-Copyright Infringements-Procedure for registration. [02]

Patents

Patent System In India -Types of Patent Applications-patentable invention - Not patentable-Appropriate office for filing -Documents required Publication and Examination of Patent Applications -Grant of Patent-Infringement of Patents -E-filing of Patent applications. [03]

Deploying Mobile App. in play store

Introduction to Application Stores – Play Store, App Store, Microsoft Store, Creating App – Android, iOS, UWP, Defining Manifest, Certifying App, Create Store Listing, Sharing Screenshots, Sharing App Credentials for testing.

Total Hours: 15

Text Book(s):

1	Mathis Plapp. How to Write and Publish a Scientific Paper (Project-Centered Course). https://www.coursera.org /learn/how-to-write-a-scientific-paper #instructors
2	Rajkumar S. Adukia ,Handbook On Intellectual Property Rights In India,2007
3	Dr. M. Kantha Babu ,"Text book on Intellectual Property Rights",2019.

Reference(s):

1	Kothari, C.R. and Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International Publishers, 2013
2	Srivastava, T.N. and Rego, S., "Business Research Methodology", Tata McGrawHill Education Pvt. Ltd., Delhi, 2019.
3	https://support.google.com/googleplay/android-developer/answer/9859152
4	https://developer.apple.com/ios/submit/
5	https://docs.microsoft.com/en-us/windows/uwp/publish/app-submissions

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES.

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 AC 002 & Research Skill Development -II	CO1	3	3	3	3				3		2	3	1		3
	CO2	3	3	3	3			1	2	2	2	2	1		3
	CO3	3	3	2	2	2		2	2	1	2	1	1	3	3
	CO4	3	3	3		3	2	2		2		2	2	3	2
	CO5	3	3	3		3	2	2		2		2	2	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MC 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	50	50	100

Objective(s)	• To enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. • To have guidance for an every project team, by the faculty member of the concerned department. • To receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide. • To present in periodical seminars on the progress made in the project • To produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.
Course Outcomes	**At the end of the course, the students will be able to** 1. Make links across different areas of knowledge and to generate, develop and evaluate ideas and information 2. Apply these skills to the project 3. Design the project work. 4. Model and fabricate the project work 5. Prepare and present the project work along with report.
Methodology	• Three reviews have to be conducted by the committee of minimum of three members one of which should be their project guide. • Progress of project has to be monitored by the project guide and committee regularly. • Each review has to be evaluated for 100 marks. • Attendance is compulsory for all reviews. If a student fails to attend review for some valid reasons, one more chance may be given. • Final review will be carried out by the committee that consists of minimum of three members one of which should be their project guide (if possible include one external expert examiner within the college). • The project report should be submitted by the students around at the first week of April.

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC 8P1&Project Work - Phase II	CO1	3	2									2	2	2	
	CO2	2	3										1	2	
	CO3	2	2	3	1								1	3	2
	CO4	2		1	3	2				2		2	1	1	2
	CO5			1		2					2	2	2		2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MC E11 – Wireless Sensor Networks							
B.E. Mechatronics Engineering							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100
Objectives	• To introduce the basic concepts in Wireless sensor networks. • To illustrate architecture and protocols in wireless sensor. • To provide an insight into different layers and their design considerations. • To identify the trends and latest development of the technologies in the area. • To provide a broad coverage of challenges and latest research results related to the design and management of wireless sensor networks.						
Course Outcomes	**At the end of the course, the students will be able to** 1. Learn the components of wireless sensor networks. 2. Explore the different layers in wireless networks. 3. Understand the different routing protocols in Wireless networks. 4. Have an in-depth knowledge on sensor timing synchronization and localization. 5. Produce safe and secure wireless communication networks.						

Introduction

Introduction to wireless sensor networks, Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs), Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts. [09]

Networking Sensors

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy- Efficient Routing, Geographic Routing. [09]

Network Layer

Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols Node and Network Management: Power Management, Local Power Management aspects, Dynamic Power Management, Conceptual Architecture. [09]

Time Synchronization

Clocks and the Synchronization Problem, Time Synchronization in Wireless Sensor Networks, Basics of Time Synchronization, Time Synchronization Protocols Localization: Ranging Techniques, Range-Based Localization, Range-Free Localization, Event Driven Localization. [09]

Security

Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and Zig Bee Security. [09]

Total Hours: 45

Text book(s) :

1	Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley 2010.
2.	Mohammad S. Obaidat, SudipMisra, "Principles of Wireless Sensor Networks", Cambridge, 2014.

Reference(s) :

1.	Fei Hu, Xiaojun Cao, "Wireless Sensor Networks", CRC Press,2013.
2.	Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", Wiley, 2009.
3.	C S Raghavendra, K M Sivalingam, TaiebZnati, "Wireless Sensor Networks", Springer, 2010.
4.	Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks",Wiley, 2010

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E11 & Wireless Sensor Networks	CO1	3	3	1	1	2			3	2			1	1	1
	CO2	3	3	1	1	2			2	2			1	1	1
	CO3	3	3	2	1	2			2	2			1	1	1
	CO4	3	3	3	2	2	3	2	2	1			1	2	2
	CO5	3	3	3	2	2	3	2	3	2			1	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC E12– Automobile Technology

B.E. Mechatronics Engineering

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

Objectives

- To impart knowledge on the constructional details and principle of operation of various automobile components.
- To provide knowledge on the working of fuel supply and electrical system in various automobiles.
- To learn the function of various components in transmission and drive lines of a vehicle.
- To study the concept and working of steering, brakes and suspension systems in automobiles.
- To acquire knowledge on technologies related to various alternative energy sources for the automobiles.

Course Outcomes	**At the end of the course, the students will be able to** 1. Demonstrate the various automobile components and engine parts. 2. Explain the function of fuel supply and electrical systems. 3. Explain the function of various components in transmission and drive lines of a vehicle. 4. Identify and explain the types of steering system, suspension system and braking system. 5. Discuss the usage of various alternate energy sources in automobiles.

Vehicle Structure and Engines

Types of Automobiles - vehicle construction, chassis, frame and body. Vehicle aerodynamics (various resistances and moments involved). Engine -Types and Construction. Lubrication system - Types and construction. Cooling system -Types and construction. Engine emission control by 3 Way Catalytic Controller. [09]

Fuel Supply and Electrical Systems

Spark ignition engine- Electronic fuel injection system, mono-point and multi Point injection systems. Compression ignition engine-Inline fuel injection system, Common rail direct fuel injection system.Supercharger and turbo charger. General layout of electrical system. Construction and operation of Lead Acid battery -Lighting system –Starting motor and drives. [09]

Power Transmission Systems

Clutch- Types- single plate clutch, multi plate clutch. Gearbox - Types- synchromesh gearbox, sliding mesh gear box, constant mesh gearbox. Automatic transmission system. Fluid flywheel, torque convertors, propeller shaft, slip joint, universal joints. Differential and rear axle drives - Hotchkiss drive and torque tube drive.[09]

Wheel, Steering, Brakes and Suspension

Wheels and Tyre Construction. Steering geometry and types of steering - rack and pinion steering gear, recirculating ball type steering gear and Power steering - construction and working principle. Suspension systems - Types - rear suspension and front suspension. Braking systems-types- disc brake, drum brake, hydraulic brake and air brake. [09]

Alternate Energy Sources

Use of Natural Gas, LPG, Bio diesel, Gasohol and Hydrogen in Automobiles. Electric and Hybrid Vehicles - layout of electric and hybrid vehicles, components, transmission requirements, advantages and limitations. FuelCells – classification, working principle, components and applications. [09]

Total Hours: 45

Text book(s) :

1. Kirpal Singh, “Automobile Engineering, Volume I & II”, 13th Edition, Standard Publishers, New Delhi, 2013.
2. Rajput R.K.,“Automobile Engineering”, 2nd Edition, Laxmi Publication, New Delhi, 2014.

Reference(s) :

1. Gupta S. K. “Automobile Engineering”, S Chand Publishing Company, New Delhi, 2020.
2. Sethi H. M. “Automobile Technology”, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2007.
3. Jain K.K. and Asthana R.B., “Automobile Engineering”, 1st Edition, Tata McGraw Hill Publishers, New Delhi, 2002.
4. I. Hussain, “Electric & Hybrid Vehicles - Design Fundamentals”, Boca Raton: CRC Press, 2011.

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E12 & Automobile Technology	CO1	1			1		3	2	1		2		1	2	1
	CO2	2	2		1	3	2	1	1		2		1	2	3
	CO3	2			1		3	2	1		2		3	2	1
	CO4	1			1		3	2	1		2		1	2	1
	CO5	1	2		1	3	2	1	1		2		1	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E15 – Modern Vehicle System								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100
Objectives	• To enlighten the learners about the concepts of basic vehicle safety features. • To explain latest advancement in hybrid engine technology. • To understand the design concepts of body for safety. • To familiar with advanced features in comfort vehicle technology. • To broaden the advanced technologies in modern vehicle systems.							

Course Outcomes	**At the end of the course, the students will be able to** 1. Understand various systems that enhance vehicle safety, passenger Comfort, recent technologies in automobile industries. 2. Analyze the various advanced equipment's in Hybrid vehicle. 3. Know about the acceleration and deceleration impact with obstacles. 4. identify the comfort system and convenient system in a vehicle. 5. Know about the features of the vehicle and analyze the working systems.

Vehicle Safety Concepts

Active safety - Driving safety, Conditional safety, Perceptibility safety, Operating safety, Passive safety - Exterior safety, Interior safety, Deformation behavior of vehicle body, Speed and acceleration characteristics of vehicle body, Velocity and time graph. [09]

Advancement in Engine and Related Components.

Introduction & types of hybrid vehicle, Hybrid drives systems, Compressed air car, Solar Cars, Hydrogen operated Engine, Basic concepts of Blue Motion Technologies like DSG, TSI, TDI, GDI variable valve timing system.[09]

Collision Avoidance Systems

Collision warning system, Causes of rear end collision, Front and rear vehicle object detection system, Automatic braking system, Lane departure warnings system, Electronic brake force distribution systems, Emergency brake assist system. [09]

Comfort and Convenience System

Steering and mirror adjustment, Central locking, Remote control system, Tyre pressure monitoring system, Rain sensor system, Garage door opening system, Environment infotainment system, Vehicle seating positions and height adjustments, Laminated windshield protection and transparency. [09]

Modern Intelligence Vehicle System

Introduction - Basic structure-vision based autonomous road vehicles-architecture for dynamic vision system - features - Applications- A visual control system using image processing and fuzzy theory- An application of mobile robot vision to vehicle information system-object detection. [09]

Total hours 45

Text book:

1. Gilbert Held "Inter and Intra Vehicle Communications", Auerbach Publications, 2008.
2. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.

Reference(s):

1. Vivek D.Bhise "Ergonomics in the Automotive Design Process" Bhise publisher Crc press, Taylor and Francis Group, 2012.
2. Tao Zhang, Luca Delgrossi, "Vehicle Safety CommunicationsProtocols, Security and privacy", Information Communication Technology Series, 2012.
3. Jullian Happian, Smith, "An Introduction to Modern Vehicle Design", SAE, 2002.
4. Richard Bishop, "Intelligent Vehicle Technology and Trends" Artech House, Inc,2005.

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E15 &Modern Vehicle System	CO1		1	3	1	3		1	3		1		1		2
	CO2	3					2			2		3		2	1
	CO3		2		2			1	2				3	3	
	CO4	3		3	1	2	2	3		2	3				2
	CO5	1	3		1			2	2	1		1	2	3	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E14 – Composite Materials								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Objectives

- Give an exposure on composite materials, fibers and matrices.
- To identify the properties of fiber and matrix materials used in composite materials.
- Provides a platform to acquire knowledge on manufacturing methods.
- Imparts specifics on micromechanics and the performance based on the properties of micromechanics.
- The course communicates about advanced composites focusing on nanocomposites.

Course Outcomes	**At the end of the course, the students will be able to** 1. Recognize the need and characteristics of the composite materials. 2. Describe the properties and applications of metal, ceramic and polymer matrix composite materials. 3. Portray the various manufacturing processes involved in the fabrication of composite materials. 4. Gain knowledge on the mechanics and performance of composite materials. 5. Describe the processing, properties and applications of advanced nanocomposites.

Introduction to Composites

Definition of composite material – need for composites – general characteristics of composites – classification of composites. Fibers – Types of fibers, Glass, Carbon, Aramid, Kevlar and natural fibers – Matrices: polymer, metal ceramic matrices – polymer matrix composites – thermo set polymers – coupling agents, fillers and additives. [09]

Types of Composite Materials

Properties of metal matrix composites (MMC)- inter metallic and alloys used for MMC and their properties – characteristics and applications of MMC – Classification of ceramics and their potential role as matrices – properties and application ceramic matrix composites (CMC) using fine ceramics, carbon, glass, cement and gypsum as matrices, polymer matrix composites(PMC)- characteristics and applications of PMC. [09]

Manufacturing Methods

Fundamentals – hand layup & spray layup – bag moulding – compression moulding – injection moulding – resin injection – pultrusion – filament winding – other manufacturing processes for CMC & MMC – quality inspection and non-destructive testing. [09]

Mechanics and Performance

Introduction to micro-mechanics – unidirectional lamina – bi directional lamina – laminates – types of laminates, symmetric laminate, anti-symmetric laminate, balanced laminate, quasi-isotropic laminates, cross ply laminates, angle ply laminate – inter-laminar stresses – static mechanical properties – fatigue properties – impact properties – environmental effects – fracture mechanics and toughening mechanisms, damage prediction, failure modes. [09]

Advanced Composites

Carbon-Carbon composites-processing, properties and applications-sandwich-structured composites – hybrid composites – Biodegradable green composites – Polymer nano composites – nano clay – carbon nanofibers – carbon nanotubes (CNTs) – production and properties of CNTs – applications of nano composites. [09]

Total Hours: 45

Text book(s) :

1	Mallick, P. K, “Fiber-reinforced composite: Materials, Manufacturing and Design”, 3rd Edition, CRC press, 2010.
2.	Krishan K. Chawla, “Composite Materials- Science and Engineering”, Third Edition, Springer Science & Business Media,2014.

Reference(s) :

1.	Michael W Hyer, “Stress Analysis of Fiber – Reinforced Composite Materials”, DEStech Publications, Inc. 2008, ISBN: 193207886X
2.	Bhagwan.D. Agarwal, Lawrence.J.Broutman and K.Chandrasekara , “Analysis and Performance of Fiber Composites”, John Wiley and Sons,3rd Edition, 2006, ISBN: 0471268917
3.	F.Matthews & R.Rawlings, “Composite Materials, Engineering and Science”, Woodhead Publishing, New edition, 1999, ISBN:1855734737
4.	Ronald F Gibson, “Principles of Composite Material Mechanics”, second edition, CRC press, Taylor & Francis group, 2015.

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E14 & Composite Materials	CO1	3	2	3	3		2	2					3	3	3
	CO2	2	2		2		2	2					2	3	2
	CO3	3	2	2	2		2	2					3	3	3
	CO4	2	2	2	2		2	2					2	3	2
	CO5	2	2	2	2		2	2					2	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 HS 004 - Principles of Management								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Objectives	• The objective of this course is to make the students to understand Evolution of Management. • To provide them knowledge on planning process • To make them differentiate between formal and informal organization • To provide them knowledge on leadership, motivation and communication • To enable them to learn different controlling techniques
Course Outcomes	**At the end of the course, the student will be able to** 1. Aware of the role of managers 2. Know about Planning, forecasting and decision making 3. Acquire knowledge on decentralization, delegation and departmentation 4. Know the types of leadership, motivation techniques and process of communication 5. Apply suitable controlling techniques

Historical Development

Definition of Management - Role of managers - Evolution of Management thought –Contribution of Taylor and Fayal- Functions of Management –Types of Business Organization [09]

Planning

Nature and Purpose- Types of plans-Steps involved in planning- Objectives – Setting Objectives –process of Management by Objectives (MBO)-Strategies, Policies, Planning Premises- Forecasting – Decision Making [09]

Organizing

Nature and Purpose- Formal and Informal-Organization Chart- Structure and Process-Departmentation –Line and Staff authority- benefits and limitations-Decentralization and Delegation of Authority-Staffing –Selection Process - Techniques-Human Resource Development-Managerial Effectiveness [09]

Directing

Scope-Human Factors-Leadership-Types of Leadership- Motivation-Hierarchy of Needs-Motivation Theories-Motivation Techniques-Job enrichment-Communication-Process of Communication-Barriers and Breakdown-Effective Communication-Electronic Media in Communication [09]

Controlling

System and Process of Controlling- Requirements for effective control-the Budget as control technique-Information Technology in Controlling- Use of Computers in handling the information-Productivity- Problems and Management-Control of overall performance – Direct and preventive control-Reporting- the Global environment-Globalization and Liberalization- International Management and global theory of Management [09]

Total Hours: 45

Text book(s) :

1. Stephen P. Robbins & Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6th Edition, 2004.

Reference(s) :

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008
3. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 HS 004 & Principles of Management	CO1			2		1	3	3	2	3	2	3	2	3	1
	CO2			1		2	2	2	1	3	2	3	2	1	3
	CO3			2		1	3	3	2	3	3	3	3	1	2
	CO4			1		1	2	2	1	3	1	3	2	2	1
	CO5			1		1	3	3	1	3	3	3	3	1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E27 - Industry 4.0								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Objectives	• The objective of this course is to make the students to understand Evolution of Management. • To provide them knowledge on planning process • To make them differentiate between formal and informal organization • To provide them knowledge on leadership, motivation and communication • To enable them to learn different controlling techniques
Course Outcomes	**At the end of the course, the student will be able to** 1. Understand the drivers and enablers of Industry 4.0 2. Demonstrate conceptual framework and road map of Industry 4.0 3. Acquire knowledge about smartness in Smart Factories, Smart cities, smart products and smart services 4. Describe Robotic technology and Augmented reality for Industry 4.0 5. Realize the various application of Industry 4.0 and understand the opportunities, challenges brought about by Industry 4.0.

Introduction to Industry4.0:
Introduction, core idea of Industry 4.0,origin concept of industry 4.0 - Industry 4.0 production system – current state of industry4.0 – Technologies – How is India preparing for Industry4.0 [09]

A Conceptual Framework for Industry 4.0
Introduction – Main Concepts and Components of Industry4.0 - State of Art, Supportive Technologies - Proposed Framework for Industry4.0. [09]

Technology Roadmap for Industry 4.0
Introduction – Proposed Framework for Technology Roadmap – Strategy Phase – Strategy Phase - New Product and Process Development Phase. [09]

Advances in Robotics in the Era of Industry 4.0
Introduction – Recent Technological Components of Robots - Advanced Sensor Technologies – Internet of Robotic Things – Cloud Robotics – Cognitive Architecture for Cyber-Physical Robotics - Industrial Robotic Applications-Manufacturing, Maintenance and Assembly. [09]

Obstacles and Framework Conditions for Industry4.0
Lack of A Digital Strategy alongside Resource Scarcity – Lack of standards and poor data security – Financing conditions – availability of skilled workers – comprehensive broadband infra-structure – state support – legal framework – protection of corporate data – liability – handling personal data. [09]

Total Hours: 45

Text book(s) :

1. Sudip Misra , Chandana Roy , Anandarup Mukherjee,“ Introduction to Industrial Internet of Things andIndustry 4.0 Paperback – 1 ,Apress 2020.
2. Alp Ustundag and Emre Cevikcan,”Industry 4.0: Managing the Digital Transformation”, Springer Technologyand Engineering,2017.

Reference(s) :

1. Christian Schröder ,”The Challenges of Industry 4.0 for Small and Medium-sized Enterprises”.
2. Bartodziej, Christoph Jan,”The Concept Industry 4.0”,Springer,2017.
3. André, Jean-Claude,” Industry 4.0: Paradoxes and Conflicts”,Wiley,2019.
4. http://www.nptel.ac.in/Industry4.0

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E27 & Industry 4.0	CO1	2	2		1	3	2		3	2		2		1	
	CO2	2	1		1	2	2		3	2		1			1
	CO3	2	2		2	3	2		3	2		2			
	CO4	1	1		2	2	1		2	3		1		1	
	CO5	1	1		2	1	1		2	3		3		1	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E26 – Non-Conventional Machining Processes								
B.E. Mechatronics Engineering								
Semester	**Hours / Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
VI	3	0	0	45	3	40	60	100

Objectives	• Give an exposure about various unconventional machining processes. • Recognize the role of mechanical energy in unconventional machining processes. • Gain the knowledge on machining the electrically conductive material through electrical energy in unconventional machining processes • Impart specifies the concept of machining the hard material using chemical energy and electrochemical energy. • Familiarity with various thermal energy based unconventional machining processes.
Course Outcomes	**At the end of the course, the student will be able to** 1. Describe the classification of non-traditional machining methods and process selection. 2. Understand the Mechanical energy based unconventional machining processes. 3. Understand the Electrical energy based unconventional machining processes. 4. Recognize the Chemical and Electrochemical energy based unconventional machining processes. 5. Understand the Thermal energy based unconventional machining processes

Introduction

Introduction - Need of non-traditional machining Methods - Classification of modern machining processes, Process selection, Materials Applications. Ultrasonic machining: Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development. [09]

Mechanical Energy Based Processes

Abrasive Jet Machining, Water Jet Machining and Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of material removal (MRR)-application and limitations. [09]

Electrical Energy Based Processes

Electric Discharge Machining (EDM): Basic principle, equipment, Process Parameters, Surface Finish and MRR, electrode/Tool, Power and control Circuits, Tool Wear, Dielectric, Flushing. Wire cut EDM, Applications. [09]

Chemical and Electro-Chemical Energy Based Processes

Chemical machining: Etchants, Maskant, techniques of applying mask ants, Process Parameters, Surface finish and MRR, Applications. Electro-Chemical machining: Basic principle, equipment, Surface Roughness and MRR Electrical Circuit, Process Parameters, Electrochemical grinding and Electrochemical Honing Applications. [09]

Thermal Energy Based Processes

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications. **[09]**

Total Hours: 45

Text book:

1	K K Singh, "Unconventional Manufacturing Process", Dhanpat Rai & Company, New Delhi, 2012.
2	P C Pandey and H S Shan, "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2017.

Reference(s):

1	Paul De Garmo, J.T. Black, and Ronald.A. Kohser, Material and Processes in Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
2	Serope Kalpakjian and Steven Schmid, "Manufacturing Engineering and Technology", 7th Edition, Pearson education India Ltd, New Delhi, 2013.
3	P. K. Mishra, Non-Conventional Machining, Narosa Publishing House, New Delhi, 2010.
4	Gary F Benedict, 'Nontraditional Manufacturing processes", CRC press, 2011

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E51 **&** Non-Conventional Machining Processes	CO1	2	1	1	1	1	1	2	1		1			2	1
	CO2	3	2	1	2		1	2			2			1	1
	CO3	2	3			1	1		2		1			1	1
	CO4	2	1	2		1	1	1			1			1	3
	CO5	1	2	1	2	3	1	2			1			3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E23 – Design of Transmission Systems								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Objectives	• To gain knowledge on the types of power Transmission systems. • To gain knowledge about the working principles of power transmission systems. • To understand the procedure used to design the power transmission elements. • To learn to use standard practices and standard data. • To learn to use catalogues and standard machine transmission elements
Course Outcomes	**At the end of the course, the students will be able to** 1. Apply the concepts of design for belts, chains and rope drives. 2. Design of spur and helical gears with different applications. 3. Design of bevel, worm gears based on Lewis and Buckingham equations. 4. Design and analyze the various types of gear box. 5. Apply the concepts of design for clutches and brakes.

Design of Flexible Elements

Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprocket-recirculating ball design. [09]

Spur Gears and Helical Gears

Speed ratios and number of teeth-Force analysis -Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears- helix angles -Cross helical: Terminology- - Estimating the size of the pair of cross helical gears. herringbone gears. [09]

Bevel, Worm Gears

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. [09]

Design of Gear Boxes

Geometric progression – Standard step ratio – Ray diagram, kinematics layout -Design of sliding mesh gear box – Design of multi speed gear box for machine tool applications – Constant mesh gear box – Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications [09]

Design of Clutches and Brakes

Role of clutches - positive and gradually engaged clutches, toothed claw clutches, design of clutches- single plate and multiple plate, variable speed drives, types and selection. Design of Brakes, Role of brakes-types of brakes-self energizing and de-energizing brakes. [09]

Total Hours: 45

Text book(s) :

1	Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design",8th Edition, Tata McGraw-Hill, 2008.

Reference(s) :

1.	Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003
2.	Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
3.	C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd., 2003
4.	Gitin Maitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E23 & Design of Transmission Systems	CO1	3	2	3		2			3	2		3		2	3
	CO2		2				2	1				3		2	3
	CO3	2	2	1		1		2	2		1			2	3
	CO4		3	1		3				2		3		2	3
	CO5	3	2		2	3		2						2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E24 – Industrial Design and Applied Ergonomics								
B.E. Mechatronics Engineering								
Semester	**Hours / Week**			**Total**	**Credit**	**Maximum Marks**		
	L	**T**	**P**	**hrs**	**C**	**CA**	**ES**	**Total**
VI	3	0	0	45	3	40	60	100

Objectives	• Course imparts students to possess essential knowledge on ergonomics. • Insights on psychological and anthropometrical development leads student into a good designer. • Emphasis given on industrial worker's health and safety pertaining to industrial design. • Course deals with Viable Ergonomic principles and their application. • Concentrates on Ergonomic design in terms of social and legal aspects.
Course Outcomes	**At the end of the course, the students will be able to** 1. Apply ergonomic principles and tools for a safer and effective work atmosphere. 2. Assess ergonomic risk and mitigate ergonomic hazards. 3. Formulate control measures for ergo risk areas. 4. Explain work related causes of musculoskeletal disorders. 5. Design a workplace complying with suitable ergonomic principles.

Introduction to Ergonomics and Industrial Design

Ergonomics – The focus of ergonomics and its area of application in the work system- anatomy: human body-structure and function – posture and health.

Industrial Design: An approach to industrial design- workplace design and assessment -elements of design structure for industrial design in engineering application in modern manufacturing system – Industrial design and human factors- human machine interface- health and safety legislation and ergonomics. [09]

Human Behavior and Perception

Human characteristics and limitations-human error-team work and ageing- fitting the job to the person and the person to the job-psychology – communication and cognitive issues -perception of risk-motivation and behavior-memory-signal detection theory and vigilance- stress – cause, preventive and protective measures- organization – shift working and overtime. [09]

Human Physical Dimension on Design Concern

Anthropometrics- body growth and somato types- static and dynamic anthropometry performance support – ergonomics approach and design intervention to work station - standing – anthropometry landmarks- sitting postures- anthropometry - squatting and cross-legged postures- measuring techniques- data and percentile calculation – work station design- vertical and horizontal work surface-movement – work counter-risk factors for musculoskeletal disorder in the workplace - environmental factors influencing worker comfort ability-Posture Evaluation Tools- Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA) – NIOSH Lifting Equation-Hand Activity Level. [09]

Application of Ergonomics

Principles- human skill & performance and display, control and virtual environments-cognitive ergonomics, human information processing-memory; reading-perception-navigation-problem solving- decision making, human – computer interaction, input/output technology, usability- evaluation- health problems, research techniques in ergonomic data generation, interpretation and application of stastiscal methods, ergonomic design process-ergonomic design methodology- ergonomics criteria/check- design process involving-checklist for task easiness. [09]

Macro ergonomics and Case Studies

Macro ergonomic methods- participatory ergonomics-parallel suggestion involvement, job involvement, implementing issues- design for physically challenged -design ergonomics in India- scope for exploration -case studies. [09]

Total Hours: 45

Text book(s) :

1	Mark S Sanders,Ernest J Mccormick, "Human Factors in Engineering & Design", McGraw-Hill Education Private Limited,7th Edition,2016.
2	Knoz,Stephan A,Johnson,Steven ,Holcomb Hathaway,Scottsdale, "Work Design: Industrial Ergonomics" , 7th Edition, 2007.

Reference(s) :

1	Bridger R.S., "Introduction to Ergonomics",CRC Press,3rd Edition,2008.
2	Khan M I, "Industrial Ergonomics", PHI Learning Private Limited, New Delhi,2013.
3	Mayall W H, "Industrial Design for Engineers", London Hiffee Books Limited,1988.
4	"Introduction to Work Study" , ILO,Oxford and IBH Publishing Company,Bombay,3rd Edition,2008.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E24 **&** Industrial Design and Applied Ergonomics	CO1	3	2	3		2			3	2		3		2	3
	CO2		2				2	1				3		2	3
	CO3	2	2	1		1		2	2		1			2	3
	CO4		3	1		3				2		3		2	3
	CO5	3	2		2	3		2						2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								**R2018**
51 MC E25-Virtual Reality and Augmented Reality								
B.E. Mechatronics Engineering								
Semester	**Hours / Week**			**Total**	**Credit**	**Maximum Marks**		
	L	**T**	**P**	**hrs**	**C**	**CA**	**ES**	**Total**
VI	3	0	0	45	3	40	60	100

Objectives	• Explore the potential of a virtual world for delivering application. • Determine possible instructional designs. • Understand the limitations. • Understand the barriers, solutions, and costs associated, including required training. • Understand the various applications of virtual reality technique.
Course Outcomes	**At the end of the course, the student will be able to:** 1. Demonstrate an understanding of fundamental techniques, processes, technologies and equipment used in immersive virtual reality. 2. Function as a member of an engineering design team. 3. Understand the human interferences in VR. 4. Develop the VR Programming. 5. Understand the various application of VR in real time.

Introduction to Virtual Reality

The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. [09]

Hardware Technologies for 3D user Interfaces

Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces. [09]

Human Factors

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment. [09]

VR Programming

Introducing Java 3D-loading and manipulating external models using a lathe to make shapes. 3D Sprites-animated 3D sprites-particle systems. [09]

Applications

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications-games, movies, simulations, therapy. [09]

Total Hours: 45

Text book(s) :

1	C. Burdea & Philippe Coiffet, “Virtual Reality Technology”, Second Edition, Gregory, John Wiley & Sons, Inc.,2014.
2	Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2015.

Reference(s) :

1	Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2016.
2	Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2014.
3.	Alan B. Craig, “Understanding Augmented Reality, Concepts and Applications”, Morgan Kaufmann, 2013.
4	Matjaz Mihelj and Janez Podobnik, “Haptics for Virtual Reality and Teleportation”, Springer Publishing Company, 2012.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E25 **&** Virtual Reality and Haptics	CO1	2	2	3	3	3	2	2	3	3	3	3	1	2	3
	CO2	3	2	3	2	2	3	2	3	2		1		3	3
	CO3	2	2	2	2	2	3	2	2	2	1		1	2	2
	CO4	2	2	3	2	2	2	3	3	2	1		3	2	3
	CO5	3	3	2	3	3	3	2	2	3	2	3	1	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 ME E31 – Operations Research							
Semester	Hours / Week			Total	Credit	Maximum Marks	
	L	T	P	Hrs	C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Objectives	• To impart knowledge about Operations Research techniques and enable students to take effective engineering and managerial decisions. • To train students to apply Operations Research techniques for the effective utilization of available resources in engineering and business. • To equip students to find the optimum solution for transportation problems and assignment problems. • To impart knowledge a-bout network models and train students to apply these concepts to solve the real world problems. • To train students to apply simulation techniques to solve Inventory and queuing problems.
Course Outcomes	**At the end of the course the students will be able to** 1. Form Linear Programming models and solve them. 2. Apply transportation models and Assignment models to solve real world problems. 3. Construct Networks and find optimum solution. 4. Apply Inventory models to solve inventory problems. 5. Apply Queuing models to solve problems and analyze them using simulation techniques.

Linear Programming Problems

OR-definition – Phases of OR - Models, Concept of linear programming model-Development of LP models – Graphical solution - Simplex method - Big M method - Two phase method, Introduction to duality theory. [09]

Transportation Problems0

Transportation problems- Balanced and Unbalanced TP- Basic feasible solution, Optimal solution by MODI method - Degeneracy, Production problems. Assignment problems - Hungarian method – Balanced and Unbalanced assignment problems - Problem with assignment restrictions-, Travelling salesman problem. [09]

Network Models and Project Management

Shortest route model- Minimal spanning tree model - Maximum flow model – Project network construction – Network logic - Fulkerson's rule - Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) – Probability of completing a project in a scheduled date - Crashing of project networks. [09]

Inventory Models

Types of inventory models - Inventory cost - Deterministic Inventory models - Economic Order Quantity (EOQ) - Purchase and Production models with and without shortages - Determination of buffer stock and re-order levels - EOQ with price breaks - Multi product EOQ models – ABC, VED & SDE analysis in inventory - Introduction to Stochastic inventory problems –discrete case and continuous case. [09]

Queuing Theory and Simulation

Queuing system - terminologies of queuing problem - applications of queuing model - Poisson distribution and exponential distribution –Single server queuing models – Simulation - Need for simulation – Advantages, disadvantages and applications of simulation - Random number generation – Monte Carlo technique- Inventory and Queuing problems in simulation. [09]

Total Hours: 45

Text book(s) :

1. Hamdy A. Taha, "Operation Research - An Introduction", 9th Edition, Pearson India Education Services Pvt.Ltd., New Delhi, 2014.
2. Panneerselvam, R., "Operations Research" 2nd Edition, Prentice Hall of India Private Ltd, New Delhi, 2006.

Reference(s) :

1. Wayne L. Winston, "Operations Research – Applications and Algorithms", 4th Edition, Cengage Learning India Private Limited, New Delhi, 2011.

2.	Frederick S. Hillier And Gerald J. Lieberman, "Introduction To Operations Research", 9th Edition, McGraw Hill Publishing Co., New Delhi, 2011.
3.	Perm Kumar Gupta, D.S. Hira, "Operations Research", S.Chand and Company Ltd., 2008.
4.	Srinivasan G, "Operations Research Principles and Applications", 3rd Edition EEE PHI, 2017.
5.	Sharma J K, "Operations Research Theory and Applications", 5th Edition, Macmillan India, 2013.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E31 & Operations Research	CO1	3	2		2	2						3	2		3
	CO2	2	3	3	2	2						2	3	1	2
	CO3	3	2	2	2	2						1	2		3
	CO4	3	3	2	2	2						1	3	2	
	CO5	3	2	2	2	2						2	2		2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC E32– Design of Material Handling Equipments

B.E. Mechatronics Engineering

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

Objectives	• To enlighten the learners about the concepts of basic operational features of materialhandling equipment. • To impart the fundamental knowledge design flexible hoisting appliances, pulleys,sprockets, drums arresting gear and brakes. • To understand the motor rating and determination of torque during transient motion inhoisting gears. • To endow with an overview of specific requirements of conveyors systems and their applications. • To gain adequate knowledge in the area of designing cage elevators, fork lift truck and escalators.
Course Outcomes	**At the end of the course, the students will be able to** 1. Describe the importance of material handling equipment and select proper material handling equipment for specific applications. 2. Design flexible hoisting appliances, pulleys, sprockets, drums, load handling attachments, arresting gear and brakes 3. Design the drives used in hoisting equipment and determination of torque during transient motion in hoisting gears. 4. Understand the specific requirements of conveyors systems design and their applications. 5. Design the bucket elevators, cage elevators, fork lift truck and escalators.

Materials Handling Equipment

Introduction - Interplant transporting facilities - Types - Principle groups of material, handling equipment - Choice of material handling equipment – types of material handling equipment – General characteristics of Hoisting machines, surface and overhead equipment- application- AGVs- ASRs. [09]

Design of Hoist

Designing of hoisting elements: Welded and roller chains - Hemp and steel wire ropes - pulleys, pulley systems, sprockets and drums - Load handling attachments - Forged hooks and eye hooks - Crane grabs – Electric lifting magnets - Grabbing attachments – Ladles - Arresting gear and Brakes. [09]

Hoisting Gear

Drives of Hoisting gear - Hand and power drives – Traveling gear - Rail traveling mechanism - Cantilever and monorail cranes – Trackless travelling mechanisms - Slewing, jib and luffing gear - Selecting the motor ratings Cogwheel drive. [09]

Conveyors

Conveyor types - Belt conveyor - Pneumatic conveyor - Screw conveyor - Apron conveyor - Vibratory conveyor – Design and applications. [09]

Elevators

Bucket elevators - design - Loading and bucket arrangements - Cage elevators - Shaft way, guides, counter weights, hoisting machine, safety devices – Fork lift truck – Escalators. [09]

Total Hours: 45

Text book(s) :	
1	Rudenko, N., “Materials Handling Equipment”, Peace Publications, Mascow, 2014.
2.	Spivakovsy, A.O and Dyachkov, V.K., “Conveying Machines”, Volumes I and II, MIR Publishers, 2012.
Reference(s) :	
1.	Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 2010.
2.	Arora,.K.C and Vikas V. Shinde., “Aspects of Material handling”, First Edition, Laxmi Publications (P). Ltd, 2008.
3.	Fayed,.M.E and Thomas S.Skoair, “Mechanical Conveyors", Selection and operation”, First Edition, CRC press,2010.
4.	P.S.G. Tech, “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2011.

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E32 & Design of Material Handling Equipments	CO1	3	3	2	2	1	1	1	1	1	1	2	3	3	3
	CO2	3	2	3	2	1	2	2	1	1	1	2	3	3	3
	CO3	3	2	3	2	1	2	2	1	1	1	2	3	3	3
	CO4	3	2	2	2	1	2	1	1	1	1	1	3	2	3
	CO5	3	3	3	2	1	1	1	1	1	1	1	3	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							R2018
51 PT T01 – Creo for Design							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
VII	2	0	2	45	3	50	50	100

Objective(s)

- To provide the fundamental concepts of drawing and elaborating on how to concretize the idea of new structure such as a machine element.
- Study the conventions and rules to be followed by engineers for making accurate drawings.
- Understand the basic dimensioning practices that have to be followed in the preparation of drawings.
- To provide hands on exposure of mechanism design and simulation using Creo.
- To acquire design knowledge on the sheet metal design and advanced surfacing modeling.

Course Outcomes

At the end of the course, the student will be able to

1. Creating knowledge about the various practices with regard to the dimensioning, sectioning and development of views.
2. Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings
3. Interpretation of machine drawings that in turn help the students in the preparation of the production drawings
4. Crafting knowledge about the various practices with regard to the dimensioning, sectioning and development of views in sheet metal.
5. Developing knowledge about the various practices with regard to the dimensioning, sectioning and development of views in surface model.

Advance Part Modeling

Advanced Selection Techniques - Advanced Datum Features - Advanced Sketching Techniques - Create advanced holes - Create advanced drafts and ribs - Create advanced shells - Create advanced rounds and chamfers - Use relations and parameters - Create advanced blends - Create sweeps with variable sections - Create helical sweeps - Create swept blends - Advanced Layer Techniques - Advanced reference management techniques - Create family tables - Reuse features - Advanced copy techniques - Create advanced patterns. [11]

Advance Assembly Design

Use advanced component selection - Use advanced assembly constraints - Create and use component interfaces - Utilize intelligent fasteners Extension (IFX) - Create and use flexible components - Restructure and mirror assemblies - Use assembly features and shrink wrap – Replace components in an assembly - Understand the basics of simplified reps - Create cross-sections, display styles, and combined views - Substitute components by reps, envelopes, and simplified reps - Understand advanced simplified rep functionality - Create and use assembly structure and skeletons - Utilize design exploration, extension (DEX). [12]

Sheet Metal Design

Sheet metal Model Fundamentals - Creating Primary Sheet metal Wall Features - Creating Secondary Sheet metal Wall Features - Bending and Unbending Sheet metal Models - Sheet metal Form Features - Modifying Sheet metal Models - Sheet metal Setup and Tools - Detail sheet metal designs. [11]

Advanced Surfacing

Describe surface modeling and its terminology - Create various boundary surfaces - Utilize surface analysis tools - Additional Surface Analysis Tools - Extend and trim surfaces - Manipulate surfaces - Create and edit solid models using surface quilts - Utilize the master model technique - Style Surfacing. [11]

Total hours 45

Text Book(s):

1.	Sham Tickoo, "PTC Creo Parametric 7.0 for Engineers and Designers", Revised and updated edition (MISL-DT), Dreamtech Press, 2018.
2.	Kelly D.S, Pro / Engineer 3.0 for Engineers and Designers, Mcgraw Hill, 2014.

Reference(s):

1.	Creo Work Book, Dysmech Consultancy Servicers Private Limited, Pune, 2016.
2	David S. Kelley, Pro/Engineer wildfire 5.0 instructor, McGraw-Hill, 2016.
3	Sham Tickoo, Designing with Pro Engineer, Dreamtech Press, 2001.
4	Creo Work Book, Dysmech Consultancy Servicers Private Limited, Pune, 2016.

Pre-requisite: **Engineering Drawing**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 PT T01 **&**Creo for Design	CO1	2					1		2		2			2	2
	CO2	2					2		2		2			2	2
	CO3	2					2		2		1			3	2
	CO4	3					3		3		1			3	3
	CO5	3					3		3		1			3	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC E34 – MEMS and NEMS

B.E. Mechatronics Engineering

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

Objectives

- To develop the basic knowledge about the MEMS system
- To practice the concepts and principles of MEMS
- To gain adequate knowledge micro fabrication and manufacturing techniques.
- To equip students to Nano electronics
- To Realizing the various application of NEMS and MEMS

Course Outcomes

At the end of the course, the student will be able to:

1. Understand the Fundamentals and working principles of microsystems and microelectronics
2. Practice the concept on both micro fabrication and manufacturing techniques.
3. Acquire knowledge about micro system design and its various applications
4. Study about the basic concepts of Nano electronics with various devices and also discusses with its applications
5. Realize the various application of NEMS and Architecture of MEMS

Introduction

Fundamentals – Micro systems and microelectronics - working principle of microsystems – Micro sensors, acoustic sensor, Bio sensor, chemical sensor, pressure sensor, Temperature sensor - micro actuation techniques – Actuation using thermal forces, actuation using SMA, Actuation using piezo electric effect, Actuation using electro static forces – micro gripper – micro motors – micro valves – micro pumps, types – micro heat pipes. [09]

Micro Fabrication And Manufacturing Techniques

Materials for micro systems – Substrates and wafer- Silicon, Quartz, Piezoelectric crystals, polymers - Photo Lithography – Diffusion- Oxidation – CVD- PVD, Etching, types - Bulk micro manufacturing – Surface micro machining - Micro system packaging-materials, die level, device level, system level - Packaging techniques – die preparation - Surface bonding-wire bonding - sealing. [09]

Mechanics For Micro System Design And Applications

Basic concepts – Bending of thin plates – Mechanical vibration – Thermo mechanics - Fracture mechanics –

Fluid mechanics at micro systems- Design considerations - Process design-mask layout design – Mechanical design-Applications of micro system in automotive industry, bio medical, aerospace and telecommunication. [09]

Nano Electronics

Basics of nano electronics – Nano electronics with tunneling devices – Nano electronics with super conducting devices - Molecular nano technology – Applications of MNT - Direct self-assembly-device assembly - electrostatic self-assembly-nano tubes – Nano wire and carbon-60 - Dielectrophoretic nano assembly. [09]

Architecture And Applications

Architecture of MEMS – Requirements of nano systems - Development of nano electronics and structuring – Application of NEMS – Deposition of coatings – Three dimensional materials – Dewatering. [09]

Total Hours: 45

Text book(s) :

1. Goser.K , Dienstuhl .J , " Nano Electronics & Nanosystems '' , Springer International Edition, 2010.
2. Tai – Ran Hsu,"MEMS & Microsystems: Design and Manufacture ", Second Edition Tata McGraw Hill, 2008.

Reference(s) :

1. Michael Pycraft Inrushes , "Nano Electro Mechanics in Engineering & Biology '' ,CRC Press New York, 2002.
2. Charles P.Poojlejr Fran K J.Owners , " Introduction to Nano Technology '', Willey Student Edition 2008.
3. Gregory Timp, " Nano Technology '',Spinger International Edition , 1999.
4. Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim, "Microsensors MEMS and Smart Devices", John Wiby & Sons Ltd.,2001

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E34 & MEMS and NEMS	CO1	3	2	3		2			3	2		3	1	2	3
	CO2		2				2	1				3	2	2	3
	CO3	2	2	1		1		2	2		1		1	2	3
	CO4		3	1		3				2		3	3	2	3
	CO5	3	2		2	3		2					1	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC E35 – Product Design and Costing

B.E. Mechatronics Engineering

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

Objectives

- To enable the student to understand the various aspects of the product design and development.
- To educate the concept of customer need and product architecture.
- To train the student in the concept of product development economics in product design.
- To impart knowledge on various types of costs associated with production of components.
- To educate the concept of work study and ergonomics and its influence in production.

Course Outcomes

At the end of the course, the student will be able to

1. Understand the fundamentals of product design, planning, development and product life cycle.
2. Understand the significance of customer satisfaction and issues associated with it.
3. Learn the economic analysis process, factors affecting it and trade-offs.
4. Estimate various types of costs for producing components by turning, drilling, shaping, planning, milling, grinding, welding and forging.
5. Learn the process of work study, method study, tools and techniques used for it and able to calculate the standard time.

Product Design and Development

Principles of creativity in design - Product development planning - Planning process - Product analysis – Criteria for product design - Market research - Design for customer and design for manufacture - Product life cycle. [09]

Customer Needs and Product Architecture

Customer satisfaction - Voice of customer, Types of customer needs, customer need model - Organizingand

prioritizing customer needs. Product architecture – Architecture types - Implication - Establishing product modularity – types. [09]

Product Development Economics

Elements of economic analysis - Quantitative analysis- Qualitative analysis. Economic Analysis Process - builda base- Case financial model - Sensitivity analysis - Understand the project trade-offs - Influence of the qualitative factors on project success. [09]

Cost Estimation of Manufactured Jobs

Cost estimation to find out labor and total costs for simple machining works such as Turning, Drilling, Shaping Planning, Milling, Grinding, Cast, Welded and forged components. [09]

Work Study and Ergonomics

Method study - definition - objectives - Motion economy principles - Tools and techniques – applications. Work and Measurement - purpose - use - procedure techniques - Standard time. Ergonomics - tools - principles - applications. [09]

Total Hours: 45

Text book(s) :

1	Karl T. Ulrich, Steven D. Eppinger, "Product Design and Development", Tata Mc Graw-Hill edition, 4th Edition, 2012.
2	Kevin Otto, Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", Pearson education, 2012.

Reference(s) :

1	George E Dieter, " Engineering Design: A Materials and Processing Approach", McGraw Hill Publishing Company, London, 2000.
2	Stanley Walker Jones, "Product Design and Process Selection", Butterworth Publications, 1973.
3	Sameul Eilon, "Elements of Production Planning and Control", McMillan and Company, 1962.
4	R Kesavan, C Elanchezhian and B Vijaya Ramnath, "Process Planning and Cost Estimation", New Age International (P) Ltd., Publishers, 2015.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E35 & Product Design and Costing	CO1	2	2	3	2	3							1		2
	CO2	2	2	3									1		3
	CO3	1	2	3	1								2		2
	CO4	2	2	3	2								2		2
	CO5	2	2	2	2			2					1		1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								**R2018**
50 MC E45- Drone Technology								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Objectives	• The main aim of this course is to understand the basics of Drones and its components. • To introduce the various types, functions of UAV, and Rules and Regulation of Aerial vehicles**.** • To make the students understand the basic working principle and different Sensors used in UAV. • To enable the students to identify and understand various navigation guidance systems. • To understand the method of operating unmanned vehicles and payloads
Course Outcomes	**At the end of the course, the students will be able to** 1. Explain the fundamental ideology about unmanned and micro air vehicles. 2. Classification of unmanned systems, Parts and function of UAVs, UGV, UWV. 3. Demonstrate the design process of UAVs fixed wing multi copter and electronic components used in Drones and its specification. 4. Apply guidance and trajectory control algorithm to navigate the unmanned system. 5. Describe the applications and payloads of aeriavehicles.

Introduction to Drone

Basic Drone terminology- Historical development-Types of drones- Components for UAV Prototypes-Functional Operations and Advantages of UAVs. [09]

Unmanned Systems

Unmanned Aerial Vehicle - Basics of UAV piloting - Unmanned ground vehicle-, Unmanned Water vehicle – Classification of UGV and UWV- Parts and function of UGV and UWV- Launching and Recovery of US – Electronics components of US- Amphibious Vehicle- Lighter Than-Air Systems- Rules and Regulation of Aerial vehicles**.** [09]

Integration of Aerial Robots and Sensors

Fixed wing UAVs- Multi copter UAV- Flapping wing UAV- Swarm Robot, Integration of Aerial robot- IOT based Aerial robot- Safety procedure of Aerial Robot- Material for Aerial Robot. Introduction to sensors – types of sensors – accelerometer-barometer-Gyro sensor and magneto sensor- other sensors – distance sensor-thermal sensor and chemical sensor. [09]

Navigation and Guidance System of Aerial Vehicles

Flight Control System –Path planning- Way point Navigation system - Obstacle's avoidance Techniques – functional block of lateral and longitudinal guidance- GPS – GCS-Telemetry –Transmitter & Receiver. [09]

Applications and Payloads of Aerial Vehicles

Applications of Aerial Vehicles - Remote sensing, Aerial mapping, Disaster response, Surveillance Search and rescue, Transportation Payload delivery, Image acquisition for cinematography, Aerial Observations Military Operations, Civilian and Private Applications-of Payload -Classification of payloads -Camera and sensors.[09]

Total hours 45

Text book:

1	Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha Ph.D., 2016
2.	Reg Austin, "Unmanned Air Systems: UAV Design, Development and Deployment "First Edition, Wiley Publishers, 2015.

Reference(s):

1.	Handbook of Unmanned Aerial Vehicles- Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014
2.	Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011
3.	Mirosaw Adamski, "Power units and power supply systems in UAV", New Edition, Taylor and Francis Group publishers, 2014.
4.	Droneprep, "Unmanned Aircraft Systems Logbook for Drone Pilots & Operators", Create Space Independent Publishing Platform, Latest Edition, 2015.

Pre-requisite:

Sensors and Instrumentation, Autonomous Vehicle, Robotics Engineering

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
50 MC E45- Drone Technology	CO1	2	3	3	3	1		2					2	3	2	
	CO2	2	2	3	2	1		2					2	3	1	
	CO3	2	3	3	1	1		2					2	3	3	
	CO4	2	2	3	1	-		2					3	3	2	
	CO5	2	3	3	1	1		2					2	3	1	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E47 – Non Destructive Testing								
B.E. Mechatronics 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
Objectives	• To learn the fundamentals of NDT Techniques • To understand the basic principles of various NDT methods • To be aware of applications and limitations of the NDT techniques • To know the different type of service and process defects. • To learn the NDT method(s) best suited to evaluate the manufactured products.							

Course Outcomes	At the end of the course, the student will be able to: 1. Understand the fundamentals of NDT techniques and testing equipment. 2. Understand the eddy current testing procedures for nondestructive testing 3. Apply principles of magnetism to investigate the service and processing defects\ 4. Select appropriate radiographic techniques and X-Rays for evaluation 5. Utilize ultrasonic testing as an NDT technique to investigate defects.

Visual Inspection and Liquid Penetrant Testing

Introduction to NDT, scope and advantages of NDT, Comparison of NDT and DT, classifications of NDT. Equipment used for visual inspection -Magnifying Glass, Magnifying Mirror, Microscope, Borescope and Endoscope.

Liquid Penetration Testing: Introduction, Principle, Procedures, Hazards Precautions, Advantages, Limitations and Applications. [09]

Eddy Current Testing

Principle of Eddy Current Testing, Advantages, Disadvantages, Factors affecting Eddy Current Response-Material Conductivity, Permeability, Frequency, Geometry and Proximity (Lift off)-Faraday's Law - Lenz's law - Types of Probes. [09]

Magnetic Particle Testing

Principle of Magnetic Particle Testing-Different methods to generate magnetic fields -Magnetic Particle Testing Equipment and Testing Procedures - Methods of De-Magnetization- Magnetic Particle Medium-Evaluation of test indications and Acceptance Standards. [09]

Radiographic Testing

Radiography Principle-Electromagnetic Radiation Sources- X-ray films, exposure- Penetrometer radiographic imaging-inspection standards and techniques – Neutron radiography – Radiography applications, limitations and safety. [09]

Ultrasonic Testing

Principle of operation, Types of Ultrasonic Propagation- Ultrasonic probes - Ultrasonic Transducers -Ultrasonic Testing Techniques. Method for Evaluating Discontinuities - Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. [09]

Total Hours: 45

Text book(s):

1	J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata McGraw Hill Education Private Limited, 2017.
2	Prakash Ravi, "Nondestructive Testing Techniques", New Age International publishers, 1st Revised Edition, 2010.

Reference(s):

1	Baldev Raj, Jayakumar.T, Thavasimuthu.M, "Practical Non Destructive Testing", Narosa Publishing House, New Delhi,3rd Edition, 2009.
2	American Society for Metals, "Non-Destructive Evaluation and Quality Control" : Metals Hand Book, Vol. 17, 9th Edition, Metals Park, 1992.
3	Paul E Mix, Wiley, "Introduction to Nondestructive Testing: A Training Guide", 2nd Edition New Jersey, 2005.
4	Y. Kong, C.J. Bennett, C.J. Hyde, "A Review of Non-Destructive Testing Techniques for the in-situ investigation of fretting fatigue cracks ", Materials and Design, Vol. 196, Elsevier, 2020.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E47**&** Non Destructive Testing	CO1	2	1	1	1		1	2			1			2	3
	CO2	3	2	1	2		1	2			1			3	2
	CO3	2	1	2		1	1		2		1	2		1	1
	CO4	3	1				1	1			1			1	1
	CO5	1	2	1	2	3	1	2			1			1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E43 - New and Renewable Energy Sources								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Objectives	• The students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources. • Create awareness about sources of energy and able to estimate how long the available conventional fuel reserves will last. • Learn the fundamental concepts about solar energy systems and devices. • Design wind turbine blades and know about applications of wind energy for water pumping and electricity generation. • Understand the working of OTEC system and different possible ways of extracting energy from ocean, know about Biomass energy, mini-micro hydro systems and geothermal energy system.
Course outcomes	**At the end of the course, the student will be able to** 1. Gain knowledge about working principle of various solar energy systems 2. Provide importance of Wind Energy. 3. Understand the role of ocean energy in the Energy Generation. 4. Get the utilization of Biogas plants and geothermal energy 5. Understand the concept of energy Conservation.

Solar Energy

Solar radiation - Availability- Measurement and estimation- Isotropic and an isotropic model - Introduction to solar collectors (liquid flat- Plate collector - Air heater and concentrating collector) and thermal storage - Steady state transient analysis - Photovoltaic solar cell - Hybrid systems - Thermal storage- Solar array and their characteristics evaluation – Solar distillation – Solar drying. [09]

Wind Energy

Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine - Vertical axis wind turbine - Rotor selection - Design considerations - Number of blades - Blade profile - Power regulation - Yaw system - Choice of power plant - Wind mapping and selection of location - Cost analysis and economics of systems utilizing renewable sources of energy. [09]

Ocean Thermal Energy Conversion

Wave and Tidal energy - Availability - Geographical distribution - Power generation using OTEC - Wave and Tidal energy - Scope and economics - Geothermal energy - Availability - Limitations. [09]

Hydrogen Energy

Electrolytic and thermo chemical hydrogen production – Metal hydrides and storage of hydrogen – Hydrogen energy conversion systems hybrid systems – Economics and technical feasibility- Applications of fuel cells. [09]

New Energy Sources

Bio fuels classification – Biomass production for energy forming – Energy through fermentation – Pyrolysis – Gasification and combustion - Aerobic and Anaerobic bio conversion process - Feed stock - Properties of bio- gas composition - Biogas plant design and operation - Alcoholic fermentation – Phase change materials. [09]

Text book:

1. G. S. Sawhney, " Non-Conventional Resources of Energy", PHI Learning Pvt. Ltd.. 2012
2. Rai G.D, "Non-conventional Energy sources", Khanna Publishers, New Delhi, 2010.

Reference(s):

1. Bent Sorensen., "Renewable Energy", Academic Press, Elsevier, New Delhi, 2011.
2. Kothari.D.P, Singal.K.C and Rakeshranjan., "Renewable energy sources and emerging technologies", PHI learning Pvt Ltd, New Delhi,2011.
3. Tasneem abbasi and Abbasi.S.A, "Renewable energy sources", PHI learning Pvt Ltd, New Delhi, 2011.
4. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modeling & Applications", Narosa Publishing House, New Delhi, 2002.

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E43 & New and Renewable Energy Sources	CO1	2	3	1					1	1	2		2	3	3
	CO2	2	3	3	2	2			2	1	2		2	2	2
	CO3	2	3	3	2	2			2	1	2		2	2	3
	CO4	2	3	3	2				1	1	2		2	3	2
	CO5	2	3	3	1	2			1	1	2		2	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC E44 - Machine Learning and Condition Monitoring

B.E. Mechatronics Engineering

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

Objectives

- To understand the machine from data without human intervention.
- To know the principle methods of machines by simulating the human ability to understand machine language.
- To understand different types of condition monitoring techniques.
- To be familiar with the Wavelet Transform and vibration monitoring.
- To know the different applications of non-destructive testing techniques in fault diagnosis**.**

Course Outcomes

At the end of the course, the students will be able to

1. Familiarize the different machine learning techniques.
2. Understand the Natural Language Processing (NLP) and deep Learning withindustrial applications.
3. Familiarize with different signal processing techniques and its advantages inindustries.
4. Understand the role of Wavelet Transform and vibration monitoring.
5. Understand the significance of fault diagnosis and non-destructive testing techniques.

Introduction to Machine Learning

Linear Regression-Linear Regression Assignment-Logistic Regression-Naive Bayes-Model Selection-Advanced Regression-Tree Models-Model Selection - Practical Considerations-Boosting-Unsupervised Learning: Clustering, Principal Component Analysis - Investment Case Study -Telecom Churn Case Study. [09]

Natural Language Processing, Deep and Reinforcement Learning

Lexical Processing-Syntactic Processing-Semantic Processing-Deep Learning: Introduction to Neural Networks-Convolution Neural Networks -Industrial Applications. Classical Reinforcement Learning-Deep- Reinforcement Learning. [09]

Introduction to condition monitoring and Basic signal processing techniques

Basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring. Basic signal processing techniques-Probability distribution and density, Fourier analysis, Digital filtering. [09]

Wavelet Transform and Vibration Monitoring

Introduction to Wavelets, Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT), Wavelet Packet Transform (WPT), types of wavelets – Haarwavelets, Shannon wavelets, Meyer wavelets, Daubechies wavelets, Coifmann wavelets and applications of wavelets. Introduction to Vibration Monitoring, vibration data collection, techniques, instruments, transducers, selection, measurement location, time domain analysis. [09]

Mechanical fault diagnosis and Nondestructive testing techniques

Wear monitoring and lubricant analysis - sources of contamination, Spectrometric Oil Analysis Procedure (SOAP) and ferrography. NDT-Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection. [09]

Total hours 45

Text book:

1. Robert Bond Randall – Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications, John Wiley & Sons Ltd.,2011.
2. R A Collacot – Mechanical Fault Diagnosis – Chapman and Hall Ltd.,2007.

Reference(s):	
1.	Dr.K.Balaveera Reddy, ISTE Summer School on Machinery Diagnostics and Preventive Maintenance, KREC, Surathkal, June 19-25,2005.
2.	Dr.A.Ramachandra, ISTE-STTP on Maintenance of Machinery, SJCE, Mysore, June 18-31,2000.
3.	P Baldi, and S Brunak, Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press,2002.
4.	C Bishop, Pattern Recognition and Machine Learning, Berlin: Springer-Verlag, 2006.

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E44 & Machine Learning and Condition Monitoring	CO1	1	2		2			3		1	2		2	1	2
	CO2			2	3	1		2		2				1	2
	CO3			1		2	1					2		1	2
	CO4			2		2						1		1	2
	CO5	1	2		2	2	2			2				1	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 MC E46 – Finite Element Method								
B.E. Mechatronics Engineering								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Objectives	• To explore the mathematical theory keystones in finite element analysis. • To practice the various steps involved in the finite element analysis of a problem. • To learn to use standard practices and standard data. • To apply the finite element method by solving the problems in solid and structural mechanics, heat transfer. • To learn the usage of catalogues and standards for machine transmission elements.
Course Outcomes	**At the end of the course, the students will be able to** 1. Apply the Variational methods of approximation for solving continuum structural problems. 2. Formulate the one dimensional bar element and apply it for solving solid mechanics problems. 3. Estimate the steady state heat transfer through composite wall and thin fins. 4. Solve the structural problems with plane stress, plane strain assumptions and axis symmetric problems using triangular element. 5. Formulate the Quadrilateral element for iso parametric conditions and Implement the Gauss-Legendre quadrature technique for numerical.

Fundamentals

Mathematical models of physical systems – Analytical solutions - Variational methods of approximation – Ritz method – Weighted residual method: Galerkin, Least squares and Collocation methods. Piecewise approximation – Finite element method (FEM) – Basic features - steps of FEM – Numerical solution of finite element equations – Gauss elimination method. [09]

One Dimensional Problems

One dimensional elements – Interpolation and Shape functions - Principle of minimum potential energy - Derivation of element equations – Connectivity of elements – Imposition of boundary conditions – Solution of equations - Application to Bars and Plane Trusses. [09]

One Dimensional Beam and Heat Transfer Problems

One dimensional beam element – formulation – hermite shape function - Element equations - Load vector and boundary conditions – Solution - Application to analysis of beams. One dimensional heat transfer - Conduction and Convection – Application to steady state heat transfer in composite walls and thin fins. [09]

Two Dimensional Problems

Triangular element – Interpolation and Shape functions – Strain-Displacement relations - Stress-Strain relations – Plane stress and Plane strain assumptions - Element equations – Axis symmetric problems - Application to Structural and heat transfer problems. [09]

Isoparametric Formulations

Natural co-ordinate systems - Legrangian and Serendipity Rectangular elements - Isoparametric formulations - Quadrilateral elements – Coordinate transformations – Jacobian transformation matrix -Shape functions - Element equations - Application to plane stress problems - Numerical integration – Gauss-Legendre quadrature. [09]

Total Hours: 45

Text book(s) :	
1	Chandrupatla T.R and Belegundu A.D., “Introduction to Finite Elements in Engineering”, 4th Edition, Pearson Education, New Delhi, 2011.
2	SingiresuS.Rao, “The Finite Element Method in Engineering”, 5th Edition, Butterworth-Heinemann, New Delhi, 2011.
Reference(s) :	
1.	Reddy J.N., “An Introduction to Finite Element Method”, 3rdedition, McGraw Hill Education Ltd, New Delhi, 2006
2.	Daryl L.Logan,“A First course in the Finite Element Method”, 5th Edition, Cengage Learning, 2011.
3.	Zeinkiewicz.O.C, “The Finite Element Method: Its Basis and Fundamentals”, 7th Edition, Elsevier, 2013.
4.	Cook R D, Malkus D S,Plesha M E, “Concepts and Applications of Finite Element Analysis”, Fourth Edition, John Wiley and Sons, New Delhi, 2011.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC E46& Finite Element Method	CO1	2	3	2	2	1	1	1	1	1	1	2	3	3	3
	CO2	3	3	3	2	1	2	2	3	2	1	2	3	3	3
	CO3	2	2	3	2	1	2	2	1	1	1	2	3	3	2
	CO4	3	2	2	2	1	2	1	1	1	1	1	3	2	3
	CO5	1	3	3	2	1	1	1	1	2	1	1	3	2	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

51 PT T02 – Creo for Production Engineering

Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	2	0	2	45	3	50	50	100

Objective(s)	• To enable the students with various concepts in mold design using Creo software. • To understand the basic operations of CAM and automation of manufacturing industries. • To ensure that the error rate is decreased, uniformity of the product is high and the precessionin the process can achieved. • To impart the mathematical formatting and documentation related to manufacturing process in order to become professionally efficient. • To create an ability to make a design and production model using rapid prototyping methods respectively.
Course Outcomes	**At the end of the course, the student will be able to** 1. Create, modify and analyze mold components and assemblies. 2. Create geometries, tool paths and generate NC codes for turning using Creo software. 3. Create geometries, tool paths and generate NC codes for milling using Creo software 4. Ability to retrieve the mathematical functions during design process. 5. Relate the concepts of rapid prototyping to create real time products.

Mold design

Basic Mold Process - Prepare design models for the mold process - Design Model Analysis - Mold Models – Shrinkage – Work pieces - Mold Volume Creation - Parting Lines - Skirt Surfaces – Parting Surface Creation - Splitting Mold Volumes - Mold Component Extraction - Mold Features Creation - Filling and Opening the Mold. [15]

Manufacturing Process

Manufacturing Process Overview - Creating Manufacturing Models – Configuring Operations - Using Reference Models - Using Work piece Models - Creating and Using NC Model Assemblies - Creating and Configuring a Work Center - Creating and Configuring Tools - Using Manufacturing Parameters - Creating Face Milling Sequences - Creating Volume Milling Sequences - Creating Profile Milling Sequences - Creating Straight Cut Surface Milling Sequences - Creating From Surface Isolines Surface Milling Sequences - Creating Cut Line Surface Milling Sequences - Advanced Surface Milling Options - Creating Roughing and Re-roughing Sequences - Creating Finishing Sequences -Creating Trajectory Milling Sequences – Creating Hole making Sequences - Creating Engraving Sequences - Using the Process Manager - Creating and Post- Processing CL Data Files. [20]

Rapid Prototyping: Introduction to RPT - Data Preparation - RPT Data Processing - Data Post Processing - RPT assignment. [10]

Total hours 45

Text Book(s):	
1.	Sham Tickoo, “Pro / Engineer PTC Creo Parametric 3.0 for Engineers and Designers”, Revised and updated edition (MISL-DT), Dream tech Press, 2015.
2	Chua C.K., Leong K.F. and Lim C.S., “Rapid Prototyping: Principles and Applications”, 3rd Edition, World Scientific, New Jersey, 2010.
Reference(s):	
1.	Chee Kai Chua, “Rapid Prototyping: Principles and Applications”, World Scientific publications, 3rd Edition, Singapore, 2010.
2.	Philip. J. Pritchard, “Mathcad: a Tool for Engineers and Scientists”, Wiley publications, Indiana, 2013.
3.	Jacobs P.F., “Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography”, McGraw-Hill, New York, 2010
4.	David S. Kelley, Pro/Engineer wildfire 5.0 instructor, McGraw-Hill,2016

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 PT T02 & Creo for Production Engineering	CO1	2		3										2	2
	CO2	2												2	2
	CO3	2												2	2
	CO4	2		3										2	2
	CO5	2												2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							R2018
51 MC E55 – Rapid Prototyping							
B.E. Mechatronics Engineering							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
VII	2	0	2	45	3	50	50	100

Objectives	• To understand the various rapid prototyping, process and its applications. • To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies. • To understand different types of tooling in additive manufacturing. • To be familiar with the characteristics of the different materials those are used in Bio-Additive Manufacturing. • To know the different applications additive manufacturing role in the medical field.
Course Outcomes	**At the end of the course, the students will be able to** 1. Understand the need, history, growth and classification of RP system. 2. Understand the Principle, process parameters, applications of SLA, FDM and LOM. 3. Learn the Principle, process parameters, applications of SLS, 3DP and LENS. 4. Initiate a continuous improvement in medical and bio additive manufacturing. 5. Understand the different types of rapid tooling and applications.

Introduction to Additive Manufacturing

Overview – History - Need for the time compression in product development- Classification -Additive Manufacturing Technology in product Development-Materials for Additive Manufacturing Technology – Applications. [09]

Liquid Based and Solid Based Additive Manufacturing Systems

Classification – Liquid based system – Stereo Lithography Apparatus (SLA) - Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling(FDM) - Principle, process, advantages and applications, Laminated Object Manufacturing (LOM)- Principle, process, advantages and applications. [09]

Powder Based Additive Manufacturing Systems

Classification – Powder based system, Selective Laser Sintering(SLS) – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS)- Principle, process, advantages and applications. [09]

Medical and Bio-Additive Manufacturing

Customized implants and prosthesis: Design and production, Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE)-Applications. [09]

Software& Tools

DesigningforAdditiveManufacturing(DAM)-SoftwareToolsvs.Requirements-Pre-&Post-processing-3DScanning & the Scanning Process –Modifying &Repairing Data-AM File Formats-STEP File Format-More Detail on NURBS - Model Validation-Working with DICOM Files for 3DPrinting Medical Imagery. [09]

Hands on Session:

1. Design and develop the geometrical shapes using any one additive manufacturing machine.
2. Design and develop the 3D components using any one additive manufacturing machine.

Design and produce an own simple model using design software, and make the product using 3D printing machine

Total Hours: 45

Text book(s) :

1	Hari Prasad I and A.V. Suresh, "Additive Manufacturing Technology", 1st Edition, Cengage Publishers,2019.
2.	Subramanian Senthilkannan Muthu and Monica Mahesh Savalani, " Handbook of Sustainability in Additive Manufacturing", 1st Edition, Springer, 2016.

Reference(s) :

1.	Jing Zhang and Yeon-Gil Jung, "Additive Manufacturing: Materials, Processes, Quantifications and Applications", 1st Edition, Butterworth-Heinemann, 2018.
2.	David Ian Wimpenny, Pulak M.Pandey and L.Jyothish Kumar, " Advances in 3D Printing & Additive Manufacturing Technologies", 1st Edition, Springer, 2017.
3.	Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press, 2015.
4.	Ian Gibson,David Rosen and Brent Stucker ,"Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing",Springer Nature,2nd Edition, 2015.

Pre-requisite**: Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 MC E55**&**Rapid Manufacturing	CO1	3	3			1				2			2	2	
	CO2	3	2			1				2			2	2	1
	CO3	2	3			1				-			2	2	
	CO4	3	2			-				-			3	3	
	CO5	3	3			1				2			2	2	

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

51 MC E56 – PC Based Instrumentation

B.E. Mechatronics Engineering

Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	2	0	2	45	3	50	50	100

Objectives

- To understand the fundamentals of virtual instrumentation and basic concept of Graphical programming with their functions in Lab VIEW.
- To impart the fundamental knowledge on the software tools in virtual instrumentation.
- To develop programming through Lab VIEW graphical programming environment.
- To know about the data acquisition and various types Interfaces used in VI.
- To familiarize students with various applications of VI.

Course Outcomes

At the end of the course, the students will be able to

1. Understand the basic concepts about virtual instrumentation.
2. Interpret the software tools in virtual instrumentation.
3. Develop programming through Lab VIEW graphical programming environment.
4. Describe the functions and the interface requirements in Data acquisition system.
5. Understand the different applications and advanced concept of VI.

Introduction to VI

Historical perspective and Traditional bench-top instruments – General functional description of a digital instrument – Block diagram of a Virtual Instrument – Physical quantities and analog interfaces – Hardware and Software – Advantages of Virtual Instruments over conventional instruments – Architecture of a Virtual Instrument and its relation to the operating system. [09]

VI Software Tools

Graphical user interfaces – Controls and Indicators – Modular programming – Data types – Data flow programming – Editing, Debugging and Running a Virtual Instrument – Graphical programming palettes and tools – Function and Libraries – VI and sub-VI, Structures: FOR Loops, WHILE loops, Shift Registers, CASE

structure, Formula nodes, Sequence structures, Timed looped structures. [09]

VI Programming Techniques

Arrays and Clusters: Array operation – Bundle/Unbundle and Bundle/Unbundle by name – Plotting data: graphs and charts – String and File I/O: High level and Low level file I/O's – Attribute nodes – Local and global variables. [09]

Data Acquisition and Interface System

Introduction to data acquisition on PC, Sampling fundamentals. Concepts of Data Acquisition and terminology – Installing Hardware and drivers – Configuring and addressing the hardware – Digital and Analog I/O function – Real time Data Acquisition – USB based DAQ. Common Instrument Interfaces: Current loop – RS 232C – RS485 and Bus Interfaces. [09]

VI Applications

Advantages and Applications – Advanced concepts – TCP/IP VI's – PXI – Instrument Control – Imageacquisition – Motion Control – Signal processing – Signal analysis: Power spectral analysis – Control design and simulation. [09]

Hands on Sessions:

1) Debugging a VI, sub VI's using Lab VIEW.
2) Programming structure, arrays, clusters, and File I/O using Lab VIEW.
3) Control of temperature using data acquisition card.
4) Model and simulate a LED interface unit using DAQ.

Total Hours: 45

Text book(s) :

1	Jeffrey Travis, Jim Kring, "Lab VIEW for Everyone: Graphical Programming Made Easy and Fun" (3rd Edition), Prentice Hall, 2012.
2.	Sanjeev Gupta, "Virtual Instrumentation using Lab VIEW", TMH, 2013.

Reference(s) :

1.	Jovitha Jerome, "Virtual Instrumentation using Lab View", PHI Learning Pvt. Ltd, New Delhi, 2010.
2.	Gary W. Johnson, Richard Jennings, "Lab-view Graphical Programming", McGraw Hill Professional Publishing, 2011.
3.	Robert H. Bishop, "Learning with Lab VIEW", Prentice Hall, 2013.
4.	Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newness, 2010.

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 MC E56 & PC Based Instrumentation	CO1	1	1	2	1	3	1	1	1	1	2	2	3	2	2
	CO2	3	2	1	1	2	1	1	1	1	1	1	1	1	1
	CO3	2	3	2	1	1	1	3	1	1	2	1	2	2	2
	CO4	2	2	2	1	1	2	2	1	1	1	2	1	1	1
	CO5	3	2	3	1	2	1	1	1	1	2	1	2	1	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

51 MC E57 – Medical Mechatronics

B.E. Mechatronics Engineering

Semester	Hours / Week			Total	Credit	Maximum Marks		
	L	T	P	Hrs	C	CA	ES	Total
VII	2	0	2	45	3	50	50	100

Objectives	• To understand the different types of electrodes and its placement for various recording. • To discuss the latest ideas on devices used for the measurement of physical and modern methods of imaging techniques • To summarize different biochemical measurements. • To learn the biotelemetry principles and human assist devices. • To create the awareness of electrical safety of medical equipments.
Course Outcomes	**At the end of the course, the student will be able to:** 1. Understand the concepts of bio amplifier for various physiological recordings and illustrate the different electrodes. 2. Analyze the procedures involved in the physical recording systems medical imaging techniques. 3. Demonstrate different biochemical measurement techniques. 4. Discuss the functions and importance of Bio-telemetry and human assist devices.

	5. Study the importance of the electrical safety of medical equipments.

Bio-Instrumentation System

Introduction – Block diagram of bio-medical system – Role of Instrumentation in Medicine - Review of sensors and transducers: ultrasonic, electro chemical and electro-mechanical-selection criteria. Review of Amplifier: Instrumentation Amplifier, Isolated DC amplifier and AC carrier amplifier. Electrodes: Electrode Theory – Limb electrodes – floating electrodes – pre-gelled disposable electrodes - Micro, needle and surface electrodes- textile electrodes. [09]

Physical and Medical Imaging Measurements

X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Gamma camera – Thermography – Different types of biotelemetry system and patient monitoring. ECG – EEG – EMG – ERG – EOG- Lead systems and recording methods – Typical waveforms. [09]

Biochemical Measurement and Biosensors

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field Effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers -colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Biosensors – Principles – amperometric and voltometric techniques, Electrophoretic techniques. [09]

Bio-Telemetry and Human Assist Devices

Medical Stimulator, Telemetry principles, frequency selection, Bio-telemetry, tele-stimulation and tele-medicine, electrical safety. Cardiac pacemakers, DC Debrillators, Heart Lung Machine and Anesthetic Machine. [09]

Electrical Safety of Medical Equipment

Physiological Effects of Electricity - Leakage Currents and Methods of Accident Prevention - Micro shocks and Macro Shocks Hazards - Special Safety Measures for Electrical Susceptible Patients - Power Distribution and Protection System of the Hospital - Electrical Safety Codes and Standards. [09]

Hands on Session

1. ECG wave analysis using simulator
2. Heart sound measurement using PCG
3. Blood Pressure Measurement

Total Hours: 45

Text book(s) :

1	Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Pearson Education, New Delhi, 2015.
2.	Arumugam.M, ‘’ Bio Medical instrumentation”, Anuradha Agencies Pub., 2013.

Reference(s) :

1.	JohnG.Webster, “Medical Instrumentation Application and Design”,5th Edition, WileyIndia Pvt Ltd,New Delhi,2020.
2.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd Edition, Tata McGraw-Hill New Delhi,2014.
3.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education,2004.
4.	Anandanatarajan.R., “Biomedical Instrumentation and Measurements”, PHI Learning Private Limited, New Delhi, 2011.

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 MC E57 **&** Medical Mechatronics	CO1	3	1	2	1	3	1	1	1	1	2	2	3	2	2
	CO2	3	2	1	1	2	1	1	1	1	1	1	1	1	1
	CO3	2	3	2	1	1	1	3	1	1	2	1	2	2	2
	CO4	2	2	2	1	1	2	2	1	1	1	2	1	1	1
	CO5	1	2	3	1	2	1	1	1	1	2	1	2	1	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
51 MC E53 – Fundamentals of Arduino							
B.E. Mechatronics Engineering							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
VII	2	0	2	45	3	50	50	100

Objectives	• To provide knowledge of different processor and controllers • To understand concepts of Arduino system • To familiarize students with Arduino as IDE, programming language& platform. • To provide knowledge of Arduino boards and basic components. • To Develop skills to design and implement various smart system sensors
Course Outcomes	**At the end of the course, the students will be able to** 1. Learn the basics of electronics, including reading schematics 2. Learn how to prototype circuits with a breadboard. 3. Program the Arduino microcontroller to make the circuits work 4. Connect the Arduino microcontroller to a serial terminal to understand communication and stand-alone use 5. Explore the provided example code and online resources for extending knowledge about the capabilities of the Arduino microcontroller

Introduction

Introduction to embedded system - Understanding Embedded System - Overview of basic electronics anddigital electronics- Microcontroller vs. Microprocessor - Common features of Microcontroller. - Different types of microcontrollers- ATmega328 Microcontroller. [09]

Arduino i/o Functions

Pins Configured as INPUT -Pull-up Resistors - Pins Configured as OUTPUT – pin Mode Function – digital Write Function – analog Read function - Arduino Interrupts. [09]

Arduino Sensors

Arduino Humidity Sensor - Arduino Temperature Sensor - Arduino Water Detector / Sensor- Arduino PIR Sensor -Arduino Ultrasonic Sensor - Arduino Connecting Switch (Magnetic relay switches). [09]

Input to the controller& Communications

Using serial input. -Controlling LEDs with keys. - Keys as toggle switch. - Interfacing a piezo Buzzer - Using a buzzer as an alarm unit.

Parallel Communication - Serial Communication Modules - Types of Serial Communications - Arduino UART - GSM/GPRS Arduino Interfacing [09]

Applications (Arduino case studies)

Intelligent home locking system- Intelligent water level management system- Home automation using RFID- Real time clock-based home automation- Intelligent Automatic Irrigation System [09]

Experiments:

1. Study about basic interfacing various actuators
2. General hardware interfacing(LED, switch, seven segment display, Relay, LCD, buzzer)

Interfacing arduino with different sensor (Touch sensor, Temperature sensor, LDR, Humidity sensor,Moisture sensor, Accelerometer, IR sensor, Proximity sensors)

Total hours= 45

Text book:

1	Rajesh Singh, Anita Gehlot, Bhupendra Singh, and SushabhanChoudhur ”Arduino-Based Embedded Systems, Boca Raton, 2017 first edition
2	Andrew N Sloss, Dominic Symes, Chris Wright ,”ARM System Developer's Guide -Designing and Optimizing System Software”, 2004, Elseiver .

Reference(s):

1.	ARM System -On -Chip Architecture, Furber, Steve.
2.	J. M. Hughes,”Arduino: A Technical Reference: A Handbook for Technicians, Engineers, and Makers”,O'Reilly Media, Inc.", 16-May-2016
3.	Jeremy Blum,”Exploring Arduino: Tools and Techniques for Engineering Wizardry”1st Edition, NovellaBargains ,2017
4.	Simon Monk" Programming Arduino: Getting Started with Sketches (Tab) 2nd Edition, Kindle Edition,2016

Pre-requisite: **NIL**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
51 MC E53 **&** Fundamentals of Arduino	CO1	2	2	3	2	3							1		2
	CO2	2	2	3									1		3
	CO3	1	2	3	1								2		2
	CO4	2	2	3	2								2		2
	CO5	2	2	2	2			2					1		1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

General Elective

K.S.Rangasamy College of Technology – Autonomous							R2018
50 GE 001 – National Cadet Corps(Air Wing)							
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
IV	2	0	2	60	3	50	50	100

Objective(s)	• 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 thecadets.
Course Outcomes	**At the end of the course, the students will be able to** 1. Display sense of patriotism, secular values and shall be transformed into motivated youth whowill carry out nation building through national unity and social cohesion. 2. Demonstrate the sense of discipline with smartness and have basic knowledge of weaponsand their use and handling 3. Illustrate various forces and moments acting on aircraft 4. Outline the concepts of aircraft engine and rocket propulsion 5. Design, build and fly chuck gliders/model airplanes and display static models

Note: Hours notified against each unit in the syllabus are only indicative but are not decisive. Faculty may decide the number of hours for each unit depending upon the concepts and depth. Questions need not be asked based on thenumber of hours notified against each unit in the syllabus**.**

NCC Organization & National Integration [09]

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-Pak War-1971-Operation Safed Sagar. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.

Drill & Weapon Training [09]

Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march andwheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION). Main Parts of a 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)

Principles of Flight [09]

Laws of motion-Forces acting on aircraft–Bernoulli's theorem-Stalling-Primary control surfaces – secondary controlsurfaces-Aircraft recognition.

Aero Engines [09]

Introduction of Aero engine-Types of engine-piston engine-jet engines-Turboprop engines-Basic Flight Instruments-Modern trends.

Aero Modeling [09]

History of aero modeling-Materials used in Aero-modeling-Types of Aero-models – Static Models-Gliders-Control linemodels-Radio Control Models-Building and Flying of Aero-models.

Total Hours: 45

Text Book(s):

1.	"National Cadet Corps- A Concise handbook of NCC Cadets" by Ramesh Publishing House, New Delhi,2014.
2.	"NCC OTA Precise" by DGNCC, 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

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 GE 001 & National Cadet Corps (Air Wing)	CO1						3	3	3	3	3		3		
	CO2					3						3	2		
	CO3	3	2	1	1									3	2
	CO4	3	2	1	1									3	2
	CO5	3	2	1	1									3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous								R2018
50 GE 002 – National Cadet Corps (Army Wing)								
Semester	Hours / Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	2	0	2	60	3	50	50	100

Objective(s)	• 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.
Course Outcomes	**At the end of the course, the students will be able to** 1. 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. 2. Demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders. 3. Basic knowledge of weapons and their use and handling. 4. Aware about social evils and shall inculcate sense of whistle blowing against such evilsand ways to eradicate such evils 5. Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles

Note: Hours notified against each unit in the syllabus are only indicative but are not decisive. Faculty may decide the number of hours for each unit depending upon the concepts and depth. Questions need not be asked based on the number of hours notified against each unit in the syllabus**.**

NCC Organization & National Integration [09]

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.

Basic Physical Training & Drill [09]

Basic physical Training – various exercises for fitness (with Demonstration)-Food – Hygiene and Cleaniness Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning onthe 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)

Weapon Training [09]

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.

Social Awareness and Community Development [09**]**

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-SGSY-JGSY-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

Specialized Subject (ARMY) [09]

Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews.

Total Hours: 45

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

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO											
		1	2	3	4	5	6	7	8	9	10	11	12
50 GE 002 – National Cadet Crops- Army Wing	CO1						1		3				
	CO2								2				
	CO3						1		3				
	CO4								2				
	CO5								3				

K.S.Rangasamy College of Technology – Autonomous							R2018
50 MC L05–Robotics and Automation							
B.E. Mechatronics Engineering							
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**	
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
Open Elective	3	0	0	45	3	40	60	100

Objectives	• To develop the student's knowledge in various robot structures and their workspace. • To develop student's skills in perform kinematics analysis of robot system. • To provide the student with knowledge of the singularity issues associated with the operation ofrobotic systems. • To provide the student with some knowledge and analysis skills associated with automated inspection and testing. • To provide the student with some knowledge and skills associated with robot control.
Course Outcomes	**At the end of the course, the student will be able to:** 1. Explain the basic concepts of working of robot. 2. Analyze the function of sensors in the robot. 3. Equip students to write programs for automatic functioning of a robot. 4. Solve the problems related to robot design and control. 5. Select and employ suitable robots for a specific application.

Basic Concepts

Definition and origin of robotics – Different types of robotics – Various generations of robots – Degrees offreedom– Laws of robotics – Dynamic stabilization of robots. [09]

Power Sources and Sensors

Hydraulic, Pneumatic and Electric drives – Determination of HP of motor and gearing ratio – Variable speed arrangements – Path determination – Micro machines in robotics – Machine vision – Ranging – Laser – Acoustic – Magnetic, Fiber optic and tactile sensors. [09]

Automated Materials Handling

The material handling function, Types of material handling equipment, Analysis for material handling systems, Design of the system, Conveyor systems, Automated guided vehicle systems**.** [09]

Automated Inspection and Testing

Inspection and testing, Statistical quality control, Automated inspection principles and methods, Sensor technologies for automated inspection, Coordinate measuring machines, Other contact inspection methods, Machine vision, Other optical inspection methods. [09]

Applications

Multiple robots–Machine interface–Robots in manufacturing and not-manufacturing application–Robot cell Design–Selection of a robot –PUMA 560 & SCARA robots-Automatic inspection- Computer integrated manufacture– CNC(Computer Numerical Control). [09]

Hands-on Session(s)

1. Study of different types of links and joints used in robots, components of robots with drive system andend effectors, classification of robots based on configuration and application.
2. Robot programming exercises for pick and place (Point-to-point and continuous path programming).
3. Signal conversion of sensing and digitizing the images using sampling and quantization analysis.

Total Hours:45

Text book:

1	Saeed B.Niku,"Introduction to Robotics Analysis, Systems, Applications", Wiley India Private limited, Second Edition, 2011.
2	MikellP.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications ", McGraw Hill Book Company, 2016.

Reference(s):

1	Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia, 2015.

2	Deb. S.R.,"Robotics Technology and Flexible Automation", John Wiley, USA 2010.
3	Vokissw. Anadham and Y.Narahari, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Pvt. Ltd, 2015.
4.	John.J.Craig, " Introduction to Robotics: Mechanics & Control" , Pearson Publication, Fourth Edition, 2018

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC L05 & Robotics and Automation	CO1	3	3	3	2	1	2	2		2	1	2	3	3	2
	CO2	3	3	3	2	1	2	3		2	1	2	3	2	1
	CO3	3	3	3	2	1	2	3		2	1	2	3	3	2
	CO4	3	3	3	2	1	2	3		2	1	2	3	2	1
	CO5	3	3	3	2	1	2	3		2	1	2	3	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R 2018**

50 MC L06–Applied Ergonomics

MC: B.E. Mechatronics Engineering

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

Objective(s)	• Course imparts basic knowledge on ergonomics anatomy and biomechanics. • Insights on importance of organization ergonomics. • Emphasis on the factors affecting ergonomic design. • Course deals with Physical and cognitive ergonomics. • Course provides an idea about man-workplace interface in regard with ergonomics.
Course Outcomes	**At the end of the course, the student will be able to** 1. Understand the basic concept of ergonomics and human anatomy. 2. Analyze the factors contributing to human error. 3. Correlate the parameters involved in designing ergo workplace. 4. Determine the factors influencing physical ergonomics. 5. Interface between man machine and work environment pertaining to ergonomics

Introduction toErgonomics Definition, domains and Applications of Ergonomics- Basics of Human anatomy and Biomechanics – application of biomechanics-overview of human body- Musculoskeletal system- metabolism-cardiovascular system-respiratory system - structure and function-posture and health. [09]

Organization Ergonomics Job Factors - fitting person to job and fitting a job to a person(FPJ & FJP) -Human errors-brief descriptions of taxonomy of human error, job factors, environmental conditions Organization ergonomics – responsibility and authority-types of decision-line organization and staff functions matrix organization motivation of work-Maslow gratification theory- workers motivation -Job evaluation in organizational ergonomics –job satisfaction-signs of job satisfaction-job rotation-job specialization-job enlargement –Job enrichment work organization. [10]

Ergonomics for design Human oriented design –anthropometry –anthropometry data – anthropometric design process – anthropometric data – measurements- how to use anthropometric data – statistical essentials - Ergo tools – measuring tools – software tools- designing for static and dynamic work- Human –machine system- human components-machine components-environmental components Tools. [10]

Physical ergonomics: Physiology - work physiology –energy expenditure of the body and oxygen debt- muscle strength and endurance- heat balance – thermo regulations – climate of work place-heat stress-cold stress-ABC's of Material handling- power zone-Lifting and mechanical handling guidelines-lift plans and risk assessment. [08]

Cognitive ergonomics Workplace ergonomics - Human sensory system-human cognitive system - human vision -–hearing sense and importance of auditory performance. –Long term memory and its importance in cognitive ergonomics - Common cognitive tasks – decision making –planning- problem solving. Guidelines for cognitive work sensory reception and perception – Visual environment and lighting –physics of light-visibility-lighting system-auditory environment – effect of noise. [09]

Total Hours 45

Text Book(s):

1.	R.S.Bridger,"Introduction to Ergonomics",CRC Press,3rd edition,2008.

2.	Mark S Sanders,Ernest J Mccormick," Human Factors in Engineering & Design", Mcgraw-Hill education Private Limited,7th edition,2016.
Reference(s) :	
1.	M.I.Khan,"Industrial Ergonomics", PHI Learning Private Limited,New Delhi,2013.
2.	Christoper D Wickens, Sallie E.Gordon-Becker, Yili Liu ,John D.Lee "An introduction to Human Factors Engineering", Pearson-Prentie Hall, 2nd edition,2004
3.	Mikell P Groover, " Work systems and the Methods,Measurement and Management of Work",Pearson-Prentice Hall,New Delhi,2nd edition,2006
4.	Knoz,Stephan A,Johnson,Steven,Holcomb Ergonomics",7th edition, 2007 Hathaway, Scottsdale, "Work Design:Industrial

Pre-requisite: **Nil**

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC L06 & Applied Ergonomics	CO1	3	3	3	2	1	2	2		2	2	2	3	3	2
	CO2	3	3	3	2	1	2	3		2	1	2	3	2	1
	CO3	3	2	2	2	1	2	3		2	1	2	3	3	2
	CO4	3	3	3	2	1	2	3		2	2	2	3	2	2
	CO5	3	3	3	2	1	3	3		2	1	2	3	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC L01 - Industrial Safety Engineering

B.E.Mechatronics Engineering

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

Objectives	• To impart knowledge on fundamentals of safety engineering. • To forefront the safety management practices. • To stress the importance of safe operating practices in industries. • To give deep insight into occupational health and safety practices followed in industries. • To relate the legislations pertaining to industrial safety.
Course outcomes	At the end of the course the student will be able to 1. Comprehend the history, safety organization and functions of safety organization. 2. Investigate accidents and document accident reports. 3. Follow safety norms adhering to engineering industry including fire fighting and first aid. 4. Identify occupational health and hygiene issues at industries. 5. Summarize the legislations and standards pertaining to occupational safety, health and environment.

Safety Management

Introduction-Key concepts, terminologies of safety-History and development of industrial safety-Formation of factories act and safety council-safety and productivity- safety and reliability-safety policy-safety organization, safety committee, safety budget- safety training. Role of management and government in industrial safety. [09]

Accident Prevention

Definition and theories-accident-injury- -near miss-theories and principles of accident causation-principle of accident prevention- unsafe act and conditions – Human error analysis and safety-cost of accidents-accident reporting and investigation – reportable and non reportable accidents- accident indices. [09]

Safety in Engineering Industries

Hazard, risk, general safety rules- Hazard identification Techniques - Housekeeping – standard operatingprocedures - machine guarding - types and its application- benefits of good guarding systems.

Safety in welding and gas cutting - general safety consideration in material handling - manual handling - mechanical handling - Ergonomic consideration in material handling. Safety in use of electricity- Fire triangle -Classes of fire - Fire fighting equipments – First aid. [09]

Occupational Health and Industrial Hygiene

Toxicity, exposure limits and levels, Lethal Dose and Concentration -LD50,LC50- MSDS - types of hazards- exposure, acute effect, chronic effect- routes of entry: dose- response relationship- occupational diseases, - control measures - Industrial hygiene -functional units and activities of occupational health services, pre- employment and post-employment medical examinations –exposure monitoring - stress, fatigue. [09]

Safety Regulation and Certifications

Overview of Factories Act 1948 and Tamil Nadu Factories Rules 1950 – ISO 9001, ISO 14001, OHSAS 18001and Integrated Management System – ISO 45001. [09]

	Total Hours: 45
Text books(s):	
1.	John V Grimaldi and Rollin H Simonds, “Safety Management”, All India Traveller Book Seller, 5th Edition, New Delhi , 2001.
2.	Roger L Brauer, “Safety and Health for Engineers”, Wiley, Third Edition, 2016
Reference(s) :	
1.	Deshmukh. L M , “Industrial Safety Management: Hazard Identification and Risk control”, 6th Edition, Tata Mcgraw Hill,New Delhi, 2010
2.	Phillip E Hagan, John F.Montgometry,James T.O’Reilly “Accident Prevention Manual for business and Industry”, 13thEdition, National Safety Council,Chicago, 2009.
3.	“The Factories Act 1948”, Madras Book Agency,Chennai,28th Edition, 2017
4.	Heinrich, H.W., “Industrial Accident Prevention”, 5th Edition,McGraw-Hill,California, 1980.

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC L01 & Industrial Safety Engineering	CO1	2	2	3		3	3	3		2	3	2	1	2	3
	CO2	1	2	3		3	3	3		2	3	1	1	2	2
	CO3	1	1	2		2	2	2		2	2	2	1	3	2
	CO4	3	3	3	1	2	2	2	1	2	3	2	1	3	1
	CO5	1	1	3	2	2	3	3		3	3	1	1	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MC L08 – Fire Safety							
Open Elective – Common to All Branches							
Semester	**Hours/Week**			**Total hours**	**Credit**	**Maximum Marks**	
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
V / VII	3	0	0	45	3	40	60	100

Objectives

- Help learners know about the formation of fire and fire hazards.
- Ability to extinguish different classes of fire.
- Conduct mock drill and suggest fire extinguishing agents.
- Have knowledge about firefighting suit and fire suppression systems.
- Aware about the Industrial and societal fire accidents.

Course Outcomes

At the end of the course the student will be able to

1. Understand the basic science behind fire.
2. Classify the types of fire.
3. Recognize the legal requirements pertaining to fire safety.
4. Devise methodology for fire prevention and protection.
5. Infer from the fire case studies.

Basics Chemistry and Physics of Fire Combustion- types of combustion – fire properties- Products and effects of combustion-Properties of the materials which influences the fire hazard- exothermic reaction and endothermic reaction – transmission of heat– Flash and fire point, Ignition temperature – Auto ignition – fire triangle and fire tetrahedron-fire spread.	[9]
Fire Classification Classes of fire – causes of fire – principles of fire extinguishing-first aid firefighting equipments like fire bucket, hose reel, fire extinguishers- types of fire extinguisher method of operation, maintenance and refilling.	[9]
Statutory norms and Authorities National Building code pertaining to fire safety – Building fire safety - Fire extinguishing agents - Automatic fire extinguishing system - Overview of National Fire protection association (NFPA) life code – TAC – Overview of Indian standards - Provision pertaining to fire in The factories Act 1948 and Tamil Nadu Factories rules 1950 - Fire certificate – directorate General Fire Services, Civil Defense & Home Guards – Overview of Tamil Nadu fire service act & rules -Tamil Nadu Fire & Rescue services – Mock drill – fire report.	[9]
Fire Protection and Prevention Passive fire protection system & Active fire protection system– fire hydrant – firesuppression systems; sprinklers, deluge systems, co2 based suppression systems,inergen, clean agent based suppression system- fire tenders- purpose of fire towers –firefighting suits-– Introduction to Fire detectors and fire alarms.	[9]

Case studies Bombay port fire 1944 – Dabwali fire 1995 – Uphaar Cinema Fire 1997 - Kumbakonam School Fire 2004 - Jaipur oil fire 2009 – AMRI Hospital Fire 2011 - Sivakasi fireworks factory fire 2012- Kollam temple fire 2016 – SURAT Fire 2019.	[9]
Total Hours = 45	

Text Book(s):	
1.	Jain V K, "Fire Safety in Buildings", New Age International (P) Limited Publishers, New Delhi, 2nd Edition, 2015.
2.	Sesha Pakash N, "Manual of Fire Safety", CBS Publishers & Distributors Private Limited, New Delhi
Reference(s):	
1.	Derek James, "Fire Prevention Hand Book", Butterworth-Heinemann, London, 1986.
2.	Gupta R S, "Hand Book of Fire Technology", Orient Longman, Bombay,2nd Edition, 2010
3.	D.D.Purandare, Abhay D.Purandare, P&A publications, Vadodara
4.	Edward D.Hess, "Growing an Entrepreneurial Business: Concepts and Cases",Stanford Business Books, 2011
5.	Howard Love,"The Start-UpJ Curve:The Six Steps to Entrepreneurial Success", Book Group Press,2011

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC L08 – Fire Safety	CO1	2	2	3		3	3	3		2	3	2	1	2	3
	CO2	1	2	3		3	3	3		2	3	1	1	2	2
	CO3	1	1	2		2	2	2		2	2	2	1	3	2
	CO4	3	3	3	1	2	2	2	1	2	3	2	1	3	1
	CO5	1	1	3	2	2	3	3		3	3	1	1	3	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
50 MC L10 Robotics and Control							
Open Elective – Common to All Branches							
Semester	Hours / Week			Total hrs	Credit	Maximum Marks	
	L	T	P		C	CA	ES	Total
V / VII	3	0	0	45	3	40	60	100

Objectives	• To develop student's skills in performing the time response of second order system • To develop student's skills in perform kinematics analysis of robot systems • To develop the student's knowledge in various robot sensors • To provide the student with knowledge skills associated with machine vision system. • To provide the student with knowledge and skills associated with robot control
Course outcomes	At the end of the course the student will be able to 1. Explain the fundamentals of robotics control systems 2. Understand the concepts of Time response of second-order systems 3. illustrate the Kinematics and Dynamics of robotics systems 4. Enlighten the concepts of sensors and instrumentation in robotics **5.** Apply the concepts of machine vision system in robotics

Introduction to control problem Industrial Control examples-Transfer function- System response-Control hardware and their models:- potentiometers- synchro's- LVDT- DC and AC servomotors-Tachogenerators- electro hydraulic valves- hydraulic servomotors- Electro pneumatic valves- pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis. Stability- steady-state accuracy- stability concept- relative stability- Routh stability criterion.	[09]
Time response of second-order systems Steady-state errors and error constants. Performance specifications in time-domain. Lead and lag compensation. Frequency-response analysis-Polar plots- Bode plot- stability in Frequency domain-Nyquist plots. Nyquist stability criterion. Performance Specifications in frequency-domain. Lead and Lag compensation.	[09]
Robot Arm Kinematics Introduction- Direct Kinematics –Inverse Kinematics-Rotation Matrices-Composite Rotation Matrix- Rotation matrixabout an arbitrary axis- Rotation matrix with Euler angle representation- Geometric interpretation of Homogeneous transformation matrices- composite homogeneous transformation matrix- Links joints and their parameters- The Denavit Hartenberg representation- Kinematic Equations for manipulators- Other specifications of the locations of theEnd-Effector- Classification of Manipulators- The inverse Kinematicsproblem- Inverse Transform Technique for Euler Angles Solution.	[09]

Sensor for Robotics Proximity sensing- Inductive sensors- Hall effect sensors- Capacitive Sensors- Ultrasonic sensors- Optical Proximity Sensors- Touch sensors- Binary sensors- Analog sensors- Force and Torque sensing- Elements of a Wrist sensor.	[09]
Machine Vision System Image acquisition- illumination Techniques- imaging geometry- some basic transformations- perspective transformations. Higher-Level Vision: Segmentation- Edge Linking and Boundary detection	[09]
Total Hours	**45**

Text Book(s):	
1.	Robotics control sensing Vision and Intelligence, K.S.Fu,R.C. Gonzalez,C.S.G. Lee, McGraw Hill, 2016
2	Ogata.K, "Modern Control Engineering", Prentice Hall,second edition,2019
Reference(s):	
1.	Introduction to Robotics Mechanics and control,John J. Craig,2nd Edition, Pearson education,2016
2.	Nagrath&Gopal, "Modern Control Engineering", New Age International, NewDelhi,2018
3.	James G.Keramas, "Robot Technology Fundamentals" ,Cengage learning,2017

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC L10 & Robotics and Control	**CO1**	3	3	3	3	3			2	1	1	1	1	**2**	**3**
	CO2	3	3	3	2	2			2	2	1		1	**2**	**2**
	CO3	3	2	3	3	3			3	1	1	1	1	**3**	**2**
	CO4	3	3	3	3	3			1	1		1	1	**3**	**1**
	CO5	3	2	3	2	3			1	1	1	1	1	**3**	**2**

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

50 MC L11 – Digital Transformation in Manufacturing

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

Fundamentals of Smart Manufacturing Revolution

Industry 4.0 - Introduction to the industrial internet - Industry 4.0 components – Industry 4.0 principles - Impact of industry 4.0 - Designing industrial internet systems - Applications in Automotive, Healthcare, Aerospace **[09]**

Frameworks

Reference Architecture - Reference architecture model industry 4.0 - Purdue Enterprise Reference Architecture - IIoT reference architecture – Cloud Manufacturing - Architecture, models, and frameworks **[09]**

Digital Twin Technology

Implementing Manufacturing Execution System - Digital Twin Modeling – Cyber Physical Systems - Digital Twin Shop floor - Digital Twin and Virtual Reality, Augmented Reality and Mixed Reality **[09]**

Network Technology and Security Framework

Access network technology and protocols - Middleware transport protocols – Middleware software patterns - IIoT WAN technologies and protocols - Software design concepts – Middleware industrial internet of things platforms – Securing the industrial internet **[09]**

Future Intelligent Factories

Blockchain in Supply Chain, Smart Logistics and Warehousing, Metaverse, Open AI platforms API and cloud based integration for Industrial Applications - Sustainable and Green Manufacturing - AI applications in manufacturing. **[09]**

Total Hours	**45**

Text Book(s):	
1.	Zindani, Divya., Davim, J. Paulo., Kumar, Kaushik. Industry 4.0: Developments Towards the Fourth Industrial Revolution. Germany: Springer Singapore, 2019
2	Tao, Fei., Nee, A.Y.C.., Zhang, Meng. Digital Twin Driven Smart Manufacturing. United Kingdom: Elsevier Science, 2019
Reference(s):	
1.	Blokdyk, Gerardus. Cloud Manufacturing a Complete Guide – 2020 Edition. N.p.: Emereo Pty Limited, 2020.
2.	Ackerman, Pascal. Industrial Cyber Security: Efficiently Secure Critical Infrastructure Systems. United Kingdom: Packt Publishing, 2017.
3.	Knapp, Eric D.., Langill, Joel. Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control Systems. Netherlands: Elsevier Science, 2014
4.	Macaulay, Tyson, Singer, Bryan L. Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS. United States: CRC Press, 2016

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC L11 & Digital Transformation in Manufacturing	CO1	3	2	3	2	3	2				2		3	2	1
	CO2	2	3	3	2	2	2				3		3	3	2
	CO3	2	2	2	2	3	2				2		2	1	2
	CO4	2	3	2	3	3	2				3		3	2	1
	CO5	2	3	3	2	3	2				2		2	2	1

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K. S. Rangasamy College of Technology

(Autonomous Institution affiliated to Anna University, Chennai)

CURRICULUM AND SYLLABI

of

B.E. Mechatronics Engineering

Honours Degree - Robotics and Automation

R 2018

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.

R8/ w.e.f.27/12/2023
Passed in the BoS Meeting Held on 24/11/2023
Approved in Academic Council Meeting held on 23/12/2023

BoS Chairman

K. S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE – 637 215
DEPARTMENT OF MECHATRONICS ENGINEERING
Honours Degree – Robotics and Automation

S.No	Course Code	Course Name	L	T	P	Credits
1.	50 MC H01	Medical Robotics	03	0	0	03
2.	50 MC H02	AI for Robotics	03	0	0	03
3.	50 MC H03	Robot Kinematics and Dynamics	03	0	0	03
4.	50 MC H04	Applied and Industrial Robotics	03	0	0	03
5.	50 MC H05	Robotic Programming	03	0	0	03
6.	50 MC H06	Sensors and Machine Vision Systems	03	0	0	03
		Total	**18**	**0**	**0**	**18**

K.S.Rangasamy College of Technology – Autonomous **R2018**

Honours Degree

50 MC H01- Medical Robotics

Mechatronics Engineering

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

Objective(s)	• Identify and describe different types of medical robots and their potential applications • Know basic concepts in kinematics, dynamics, and control relevant to surgical manipulators • Develop the analytical and experimental skills necessary to design and implement Motion control and force control in medical robotics • Be familiar with the state of the art in applied medical robotics and Haptic Tele manipulation. • Understand the various roles that robotics can play in Minimally Invasive Surgery.
Course Outcomes	At the end of the course, the students will be able to 1. Classify the different types design of control architectures 2. Identify the function of -assisted minimally invasive surgery. 3. Design of control architectures for robotic-assisted tele-medicine. Evaluation of medical robots 4. Describe the haptic tele manipulation and control strategies 5. Discuss the different techniques minimal invasive surgery

Introduction to Medical Robots Introduction to medical robotics-Assistive technologies - rehabilitation robotics - surgical robotics- robotics for diagnosis - Historical perspective.	**[09]**
Design of Surgical Manipulators Security issues-Manipulators with serial and parallel configurations-European directives-Minimally invasive surgery-Passive and active joints-Remote rotation center-Master-slave mechatronic system - Da Vinci system.	**[09]**
Motion control and force control in medical robotics Motion Control: Joint space control and task space control - Force Control: Indirect force control (compliant control, impedance control) - direct force control (hybrid position/force control, external force control) - Kalman Active Observers - Design of null space / task space controllers for minimally invasive surgery.	**[09]**
Haptic Tele manipulation. Haptic control architectures- Tele presence - stability and robustness analysis - Contact parameter estimation.	**[09]**
Minimally Invasive Surgery Human-machine interfaces - Teleoperation - Cooperative manipulation - Port placement for MIS - Robot design concepts - Video images in MIS - Augmented reality	**[09]**
Total Hours	**45**

Text Book(s):

1.	Khalil, W, Dombre E, Modeling, Identification and Control of Robots, HPS 2022
2.	Ciavicco and Siciliano, Modeling and Control of Robot Manipulators, Springer.2020

Reference(s):

1.	Cortesão, R., Medical Robotics Course, DEEC-FCTUC.(2018)
2.	Anandanatarajan.R., "Biomedical robots", PHI Learning Private Limited, New Delhi ,2011.
3.	Cromwell, Leslie, Weibell. Fred J. and Pfeiffer. Erich A., "Bio-Medical and electronics ", Second Edition, Pearson Education, New Delhi, 2012.
4.	Khandpur R.S., "Handbook of Bio-Medical instrumentation", Tata McGraw-Hill Publishing Co Ltd., New Delhi, 2014.

R8/ w.e.f.27/12/2023
Passed in the BoS Meeting Held on 24/11/2023
Approved in Academic Council Meeting held on 23/12/2023

BoS Chairman

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC H01 & Medical Robotics	CO1	3	2	3	2	3	2	3			2		3	3	3
	CO2	3	3	3	2	2	2	2			3		3	3	2
	CO3	2	3	2	2	3	2			3	2		2	1	2
	CO4	2	3	2	3	3	2	1			3		3	2	2
	CO5	2	3	3	2	3	2	2			2		2	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology–Autonomous **R2018**

Honours Degree

50 MC H02 - AI for Robotics

Mechatronics Engineering

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

Objective(s)	• To impart artificial intelligence principles, techniques and its history. • To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering • To develop intelligent systems by assembling solutions to concrete computational problems • To develop intelligent systems by assembling solutions to concrete computational problems problems • To develop intelligent systems by assembling solutions to concrete computational problems
Course Outcomes	1. Evaluate Artificial Intelligence (AI) methods and describe their foundations. 2. Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning. 3. Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems 4. Analyse and illustrate how search algorithms play a vital role in problem-solving

Introduction Introduction- Evolution of AI, State of Art -Different Types of Artificial Intelligence Applications of AI-Subfields of AI-Intelligent Agents- Structure of Intelligent Agents Environments	**[09]**
Problem Solving based on Searching Introduction to Problem Solving by searching Methods-State Space search, Uninformed Search Methods – Uniform Cost Search, Breadth First Search- Depth First Search-Depth limited search, Iterative deepening depth-first, Informed Search Methods- Best First Search, A* Search	**[09]**
Logic and Reasoning Introduction to Logic and Reasoning -Propositional Logic-First Order Logic-Inference in First Order Logic-Unification, Forward Chaining, Backward Chaining, Resolution.	**[09]**
Planning Classical planning, Planning as State-space search, Forward search, backward search, Planning graphs, Hierarchical Planning, Planning and acting in Nondeterministic domains – Sensor-less Planning, Multiagent planning	**[09]**
Communicating, Perceiving and Acting Communication-Fundamentals of Language -Probabilistic Language Processing -Information Retrieval-Information Extraction-Perception-Image Formation- Object Recognition.	**[09]**
Total Hours	**45**

Text Book(s):

1. Russell, S. and Norvig, P.," Artificial Intelligence - A Modern Approach", 3rd Edition, Prentice Hall,2015.
2. Robin R Murphy, "Artificial Intelligence for Robotics", 2nd Edition, Bradford books,2019.

Reference(s):

1. K. R. Chowdhary, "Fundamentals of Artificial Intelligence", Springer, 2020.
2. Alpaydin, E, " Introduction to Machine Learning", 2nd Edition, MIT Press,2010
3. Francis X. Govers," Artificial Intelligence for Robotics", Packt Publishing ltd,2018

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC H02 & AI for Robotics	CO1	3	2	3	2	3	2	3			2		3	3	3
	CO2	3	2	2	3	2	2	3		2	3		3	2	3
	CO3	2	2	2	2	3	2			3	2		2	2	2
	CO4	2	3	2	3	3	2	1			3		3	2	2
	CO5	2	3	3	2	2	2	2			2		2	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous							**R2018**
Honours Degree							
50 MC H03 - Robot Kinematics and Dynamics							
Mechatronics Engineering							
Hours/Week			Total hrs	Credit	Maximum Marks		
L	T	P		C	CA	ES	Total
3	0	0	45	3	40	60	100

Objective(s)	• Provide a mathematical and geometrical description of robotic manipulators • To retain the best traditions of traditional calculus. • Derive from first principles robot dynamics and know how to simulate them • Understand basic robot control architectures • Articulate scientific results to your peers
Course Outcomes	At the end of the course, the students will be able to 1. To impart knowledge about kinematic and dynamic analysis of robot manipulators. 2. To control both the position and orientation of the tool in the three dimensional space. 3. The relationship between the joint variables and the position and the orientation of the tool. 4. Planning trajectories for the tool to follow on order to perform meaningful tasks. 5. To precisely control the high speed motion of the system.

Introduction Introduction, position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates.	**[09]**
Direct Kinematics Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.	**[09]**
Inverse Kinematics The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis, Articulated robot.	**[09]**
Workspace Analysis and Trajectory Planning Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning.	**[09]**
Manipulator Dynamics Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange Euler formulation, problems.	**[09]**
Total Hours	**45**

Text Book(s):

1. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
2. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.

Reference(s):

1. John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.
2. Tsuneo Yohikwa, Foundations ofRobotics Analysis and Control, MIT Press., 2003.
3. Bijay K. Ghosh, Ning Xi, T.J. Tam, Control in Robtics and Automation Sensor - Based integration, Academic Press, 1999.
4. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC H03 - Robot Kinematics and Dynamics	CO1	3	3	3	2	3	2	3			2		3	3	3
	CO2	3	2	2	3	2	2	3			2		3	2	3
	CO3	3	3	2	2	3	2				2		3	3	3
	CO4	2	3	2	3	3	2	2			3		3	3	3
	CO5	3	3	3	2	2	2	2			2		2	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

Honours Degree

50 MC H04 - Applied and Industrial Robotics

Mechatronics Engineering

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

Objective(s)	• To familiarize robot structures, classification and Types, levels, need of Automation. • To develop knowledge in Grippers and Sensors for Robotics. • To develop skills in performing Drives, Transmission and Control for Robotics. • To develop knowledge in the Artificial Intelligence for Robotics. • To design and develop a robotic system for a given industrial application.
Course Outcomes	At the end of the course, the students will be able to 1. Identify and understand the automation concepts for Industries. 2. Understand various grippers and sensors for robotics 3. Interpret terminologies related to drives, actuators and controllers. 4. Analyze the principles of AI in robot system integration 5. Integrate the applications of robots and digital technology.

Introduction to Robotics Elements of Robotic Systems, Robot anatomy, DOF, Classification of Robotic systems -work volume, type of drive, Associated parameter - resolution, accuracy, repeatability, dexterity, compliance, Remote Center of Compliance. Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation.	**[09]**
Grippers and Sensors for Robotics Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.	**[09]**
Drives and Control for Robotics Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.	**[09]**
AI in Robotics Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, mobile robotics, New trends & recent updates in robotics. Mobile Robot locomotion: Types of locomotion, hopping robots, legged robots, wheeled robots, stability, manoeuvrability, controllability.	**[09]**
Applications and Digital Manufacturing Robots Manufacturing, Construction, Medical, Defence, Logistics & Storage, Packing & Palletizing, Inspection & Quality Control, Harvesting, Painting & Coating, Cleaning & Hygiene, Aerospace, basics in cyber-physical production systems, data- driven production, industrial internet of things, digital twin technology and simulation methodologies.	**[09]**
Total Hours	**45**

Text Book(s):

1. S. K. Saha, Introduction to Robotics, 2nd Edition, TATA McGraw Hills Education,2014.
2. John.J.Craig, " Introduction to Robotics: Mechanics & control" , Pearson Publication, 4th Edition, 2018.

Reference(s):

1. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, 2019
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2 nd Edition, 2016.
3. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, "Introduction to autonomous mobile robots", 2nd Edition, MIT Press, 2011.
4. S.R. Deb, Robotics Technology and flexible automation, 2nd Edition, Tata McGraw-Hill Education, 2017

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC H04 & Applied and Industrial Robotics	CO1	2	2	3	2	2	3	3		2	2		3	3	3
	CO2	3	2	2	3	2	2	3			2		3	2	3
	CO3	3	3	2	2	3	3		2		2		2	2	2
	CO4	3	3	3	3	3	2	2			3		3	3	3
	CO5	3	3	3	2	3	3	2			2		2	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

Honours Degree

50 MC H05 - Robotics Programming

Mechatronics Engineering

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

Objective(s)	• To introduce the fundamentals of robotic programming • To understand the ROS fundamentals. • To introduce students the criteria for selecting a sensor and actuator for a particular ROS robotic application. • To familiarize with various hardware based robotic application • Learn about various sensors, actuators, robot programming
Course Outcomes	1. Understand the robotics design and implementation. 2. Gain the knowledge on fundamentals of robotic programming 3. Comprehend, classify and analyze the behavior of different types of sensors and actuators 4. Understand the ROS fundamentals 5. Design robotic applications using ROS

Introduction to Robotics Elements of Robotic Systems, Robot anatomy, DOF, Classification of Robotic systems -work volume, type of drive, Associated parameter - resolution, accuracy, repeatability, dexterity, compliance, Remote Center of Compliance. Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation.	**[09]**
Grippers and Sensors for Robotics Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.	**[09]**
Drives and Control for Robotics Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.	**[09]**
AI in Robotics Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, mobile robotics, New trends & recent updates in robotics. Mobile Robot locomotion: Types of locomotion, hopping robots, legged robots, wheeled robots, stability, manoeuvrability, controllability.	**[09]**
Applications and Digital Manufacturing Robots Manufacturing, Construction, Medical, Defence, Logistics & Storage, Packing & Palletizing, Inspection & Quality Control, Harvesting, Painting & Coating, Cleaning & Hygiene, Aerospace, basics in cyber-physical production systems, data- driven production, industrial internet of things, digital twin technology and simulation methodologies.	**[09]**
Total Hours	**45**

Text Book(s):

1. Hughes, C. and Hughes, T., Robot programming: a guide to controlling autonomous robots. Que Publishing, 2016
2. Quigley, M., Gerkey, B. and Smart, W.D., Programming Robots with ROS: a practical introduction to the Robot Operating System. O'Reilly Media, Inc.", 2015

Reference(s):

1. Lentin Joseph, Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, 1st Edition, APress, 2018. 2 Jonathan Cacace; Lentin Joseph, Mastering ROS for R
2. Jonathan Cacace; Lentin Joseph, Mastering ROS for Robotics Programming: Design, build, and simulate

	complex robots using the Robot Operating System, 2nd Edition, Packt Publishing, 2018
3.	Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez, Lentin Joseph. ROS Programming: Building Powerful Robots. Packt Publishing, 2018.
4.	Robotic Engineering by Richard D.Klafter, Prentice Hall

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC H05 & Robotics Programming	CO1	2	2	3	3	3	2	2			2		3	3	3
	CO2	3	2	2	3	2	2	3			2		3	2	3
	CO3	3	3	2	2	3	3	3			2		2	3	3
	CO4	3	3	2	2	2	2	2			3		3	3	3
	CO5	3	3	3	2	3	3	2			2		3	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

K.S.Rangasamy College of Technology – Autonomous **R2018**

Honours Degree

50 MC H06 - Sensors and Machine Vision System

Mechatronics Engineering

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

Objective(s)	• Acquaint students with the various types of sensors, their principles, and their applications in diverse fields. • Provide students with a comprehensive overview of machine vision systems, image processing techniques, and their role in automation and analysis. • Develop practical skills in interfacing sensors, processing visual data, and designing simple vision-based systems. • Enable students to apply sensor and machine vision knowledge to solve real-world challenges in fields like robotics, manufacturing, and healthcare. • Foster an understanding of the ethical considerations related to data collection, privacy, and bias in machine vision applications
Course Outcomes	At the end of the course, the students will be able to 1. Identify and classify various sensor types based on their principles and applications. 2. Assess the suitability of different sensors for specific tasks based on their characteristics. 3. Describe the optical components, image formation process, and image sensor technologies in machine vision systems. 4. Apply image enhancement, transformation, and segmentation techniques to preprocess images for analysis. **5.** Utilize image processing libraries and tools to extract relevant features from images.

Introduction to Sensors Definition and importance of sensors-Sensor classification based on physical properties-Sensing mechanisms : electrical, mechanical, optical, thermal-Sensor characteristics: sensitivity, accuracy, precision, resolution	**[09]**
Sensor Technologies Introduction to different sensor types: temperature, pressure, proximity, motion- Resistive, capacitive, inductive, and piezoelectric sensors- Optical sensors: photodiodes, phototransistors, lasers- Sensor calibration and compensation techniques	**[09]**
Sensor Interfaces and Signal Conditioning Analog and digital sensor interfaces- Amplification and filtering of sensor signals- Analog-to-digital conversion (ADC) and digital-to-analog conversion (DAC)- Noise reduction and error handling in sensor data	**[09]**
Vision Systems Fundamentals Basics of human vision and perception- Image formation: lenses, cameras, optics- Color representation and perception- Image sensors: CCD and CMOS	**[09]**
Image Processing Techniques Image enhancement: filtering, histogram equalization, contrast adjustment- Image transformation: Fourier transform, Hough transform- Image segmentation: thresholding, edge detection- Feature extraction: corners, edges, texture	**[09]**
Total Hours	**45**

Text Book(s):	
1.	Orlando E. Ruiz "Introduction to Sensors" CRC Press,2018
2.	Carsten Steger, Markus Ulrich, and Christian Wiedemann **"**Machine Vision Algorithms and Applications**"** Wiley,2018
Reference(s):	
1.	Ramon Pallas-Areny and John G. Webster "Sensors and Signal Conditioning" Wiley,2010
2.	Jon S. Wilson **"**Sensor Technology Handbook**",** Newnes 2010
3.	Krzysztof Iniewski **"**Smart Sensors for Industrial Applications**"** CRC Press,2013
4.	E. R. Davies "Computer and Machine Vision: Theory, Algorithms, Practicalities**"** Academic Press,2015

Pre-requisite: Nil

MAPPING OF COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COURSE CODE & COURSE NAME	CO	PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
50 MC H06 & Sensors and Machine Vision System	**CO1**	3	3	3	3	3	2	2			2		3	3	3
	CO2	3	2	2	3	2	2	3	2	2	2		3	2	3
	CO3	3	3	2	2	3	3	3			2	3	2	3	3
	CO4	2	2	2	3	3	3	2			3		2	2	3
	CO5	3	3	3	2	3	3	2			2		3	2	2

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution