K.S. Rangasamy College of Technology

(Autonomous)

CURRICULUM AND SYLLABI

of

B. Tech Biotechnology

(For the batch admitted in 2024– 2025)

R 2022

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

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

DEPARTMENT OF B.TECH., BIOTECHNOLOGY

VISION OF THE DEPARTMENT

- To produce competent Scientists, Technologists, Entrepreneurs and Researchers in Biotechnology through quality education.

MISSION OF THE DEPARTMENT

- To be recognized as a place of excellence in teaching-learning through continual improvement process (**Place of excellence** and **continual improvement)**
- To work in close liaison with the industry to achieve socio-economic development through biotechnological ventures (**Socio-economic development)**
- To facilitate students to perform as competent rofessional Biotechnologists (**Professional Competence)**

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: **Fundamentals:** Graduates are professionally competent in Biotechnology to solve problems in environmental, food, biochemical and biomedical engineering and technology.

PEO2: **Career Growth:** Graduates demonstrate proficiency in theory and practice of biotechniques through life-long learning.

PEO3: **Professional Practices:** Graduates perform as an individual and / or member of a team with professional and ethical behaviour.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling 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.

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BOS- Chairman

PROGRAMME SPECIFIC OUTCOMES (PSOs):

Engineering Graduates will be able to:

PSO1: Design and execute industry-oriented experiments in biotechnology using modern tools and techniques

PSO2: Apply the knowledge of Bioengineering and Technology to demonstrate research skills and develop technology for commercialization

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

The B. Tech., Biotechnology Programme outcomes leading to the achievement of the objectives are summarized in the following Table.

Programme Educational Objectives (PEO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO 1	3	1	3	2	2	1	1	1	2	2	3	1	3	3
PEO 2	3	3	3	2	2	1	1	1	2	2	3	1	3	2
PEO 3	3	2	3	2	2	1	1	1	3	2	3	1	1	1

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

Year	Sem.	Course Name	POs												PSOs	
			1	2	3	4	5	6	7	8	9	10	11	12	1	2
I	I	Professional English-I	-	-	-	-	-	-	-	2	3	3	2	3	2.2	2.4
		Matrices and Calculus	3	2	-	-	2	-	-	-	-	-	-	-	-	3
		Basic Electrical and Electronics Engineering	2.6	1.6	-	-	-	0.4	1.4	-	0.6	0.8	-	1.6	-	1.2
		Physics for Biotechnology	2.6	1.6	-	-	-	0.4	1.4	-	0.6	0.8	-	1.6	-	1.2
		Chemistry for Life science	3	2.6	-	-	1.4	0.8	-	0.4	-	-	-	2.4	1.6	2
		Environmental Studies and Climate Change	2.8	2	1.6	1.2	1.4	2	2.6	0.8	-	-	-	2	1.6	1.8
		Heritage of Tamils	-	-	-	-	-	3	3	-	2	-	3	2.6	2.6	-
		Applied Physics Laboratory	3	2	-	-	-	-	-	-	2	-	-	-	0.8	-
		Applied Chemistry Laboratory	2.6	3	-	-	2.2	-	-	-	2	2	-	2.4	2.4	1.6
	II	Professional English-II	-	-	-	-	-	-	-	2	3	3	2	3	2.6	2.6
		Integrals, Partial Differential Equations and Laplace Transform	3	3	-	-	2	-	-	-	-	-	-	-	-	3
		C Programming	3	3	-	-	-	-	-	-	2	2	-	2	-	3
		Engineering Graphics	3	2.8	3	-	1.2	-	-	1.2	-	-	-	-	3	3
		Engineering Mechanics	3	3	2.8	-	1.2	-	-	1.2	-	-	-	-	3	2.8
		Tamils and Technology	-	-	-	-	-	-	3	3	-	2	-	3	2.8	2.8

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BOS- Chairman

		Fabrication and Reverse Engineering Laboratory	3	2	3	-	-	2	2	-	3	-	-	3	-	3
		C Programming Laboratory	3	3	3	-	3	-	-	-	2	2	-	-	3	3
		Career Skill Development-I	-	-	-	-	-	-	-	2	3	3	2	3	0.8	1.2
II	III	Fourier Transform and Numerical Methods	3	2	-	-	2	-	-	-	-	-	-	-	-	2
		Biochemistry	1.6	2	1.2	1.8	1.2	-	0.8	-	1.8	1.8	-	2.2	2.6	2.6
		Microbiology	2.8	1	2.4	0.8	2.6	2.6	2	-	-	-	1.6	2.6	2.6	2.6
		Cell Biology and Genetics	2.6	2.2	1.6	2	1.4	1.4	0.8	-	-	-	1	1.4	2.6	2.6
		Principles of Chemical Engineering	3	3	2.4	1.4	1.2	-	-	-	-	-	1.8	2.8	2.8	2.8
		Molecular Biology	3	3	-	2.4	1	-	-	-	2	-	2.4	0	1.6	2
		Biochemistry Laboratory	-	-	2	3	-	-	-	-	-	1.2	2	-	2.8	2.8
		Microbiology Laboratory	-	-	2	3	-	-	-	-	-	1.2	2	-	2.8	2.8
		Career Skill Development-II	-	-	-	-	-	-	-	2	3	3	2	3	2.8	2.8
		Internship	2.8	3	2.2	3	2.6	2	-	0.6	0.6	0.6	0.6	3	2.6	2.6
	IV	Probability and Statistics	3	2	-	-	2	-	-	-	-	-	-	-	-	2
		Genetic Engineering	3	3	2.6	2.8	1.2	1.8	1.2	1.8	1.2	1.8	1.6	3	3	2.4
		Protein and Enzyme Engineering	0.8	1.4	1	1.6	0.6	0.4	-	-	-	-	-	-	0.4	1.4
		Biochemical Thermodynamics	1.4	1	1.6	0.6	0.4	-	-	-	-	-	-	0.4	1.4	1
		Universal Human Values (UHV)*	-	-	-	-	-	2.4	1.8	3	2.8	0.6	0.4	3	2.4	2.6
		Molecular Biology and Genetic Engineering Laboratory	0.6	0.6	-	2	0.8	-	-	-	-	-	-	0.2	2.6	2.8
		Protein and Enzyme Engineering Laboratory	0.6	0.6	-	2	0.8	-	-	-	-	-	-	0.2	2.6	2.8
		Career Skill Development - III	-	-	-	-	-	-	-	2	3	3	2	3	2.8	2.8
		Internship	2.8	3	2.2	3	2.6	2	-	0.6	0.6	0.6	0.6	3	2.6	2.6
III	V	Plant and Animal Biotechnology	2	-	3	-	-	3	2.6	-	-	-	-	2.4	-	3
		Bioinformatics	3	3	2.6	2.4	2.6	-	-	-	3	3	3	2	3	2.2
		Heat and Mass Transfer Operations	2.8	3	2.6	2.6	2.2	-	-	-	-	-	2.2	2.6	2.8	2.8
		Chemical Reaction Engineering	3	2	2.8	2	1	-	-	-	-	-	1	1	2.6	2.6
		Plant and Animal Biotechnology Laboratory	2	-	3	-	-	3	2.6	-	-	-	-	2.4	-	3
		Chemical Engineering Laboratory	3	2	2.6	1	1	0	1	0	0	0	0	2	2	3
		Design Thinking and Innovation Laboratory	3	3	2.8	3	-	-	-	1.2	1.2	1.2	-	1.2	3	2.8

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BOS- Chairman

		Career Skill Development – IV	-	-	-	-	-	-	-	2	3	3	2	3	2.8	2.8

		Internship	2.8	3	2.2	3	2.6	2	-	0.6	0.6	0.6	0.6	3	2.6	2.6
	VI	Biopharmaceutical Technology	2.8	1.8	1.8	2	-	-	-	1	1	-	-	1	3	3
		Bioprocess Technology	2.8	3	2.6	2.6	1	-	2.2	-	-	-	3	2	3	2
		Computer Aided Drug Design	2.6	2.4	1.6	2.2	1.8	1.8	1.8	0.8	2.2	1.8	1.8	2.8	3	2.6
		Immunology and Immunotechnology	2.2	1.8	2.4	2	2	2.4	2	0.4	1.6	1.2	1.6	1.2	3	2.6
		Startups and Entrepreneurship	2.8	2.6	3	2.4	2.2	1	1	1.4	0.8	0.8	2.2	2.4	2.8	2.6
		Computer Aided Drug Designing Laboratory	2.6	2.4	1.6	2.2	1.8	1.8	1.8	0.8	2.2	1.8	1.8	2.8	3	2.6
		Bioprocess technology Laboratory	2.8	2.6	2.4	2.2	2.4	2.4	2.2	0.8	0.4	2.4	2.6	2.6	2.8	2.6
		Design Thinking and Product Development	3	3	2.8	3	-	-	-	1.2	1.2	1.2	-	1.2	3	2.8
		Comprehension Test	3	3	2	2	-	-	-	-	1	2	2	3	-	-
		Internship	2.8	3	2.2	3	2.6	2	-	0.6	0.6	0.6	0.6	3	2.6	2.6
IV	VII	Engineering Economics and Financial Accounting	1.6	1.2	1	2.2	0.6	0.8	1.4	0.4	-	-	2.2	2	2.2	2.6
		AI for Biotechnology	3	3	0.8	0.8	-	0.8	-	-	1.2	1.2	-	0.4	-	-
		Downstream Processing	2.8	3	2.6	2.6	1	-	2.2	-	-	-	3	2	3	2
		Research Skill Development	0.4	0.4	0.8	0.8	0.6	0.4	0.4	3	3	2.4	-	3	-	-
		NCC/NSS/NSO/YRC/ RRC/ Fine arts	1.8	1.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-	1.8	-	-
		Biological Data Analysis Laboratory	0.4	0.4	0.4	0.4	1.2	0.4	0.4	0.2	-	-	-	-	0.4	0.4
		Downstream Processing Laboratory	3	2	2	2	1	1.6	0.4	2	2	1	1.6	2.6	3	3
		Project Work - Phase I	3	2	3	3	3	2.4	-	-	3	-	-	2	2	3
		Internship	2.8	3	2.2	3	2.6	2	-	0.6	0.6	0.6	0.6	3	2.6	2.6
	VIII	Project Work - Phase II	3	2	3	3	3	2.4	-	-	3	-	-	2	2	3
		Internship	2.8	3	2.2	3	2.6	2	-	0.6	0.6	0.6	0.6	3	2.6	2.6

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BOS- Chairman

Year	Sem.	Course Name	POs												PSOs	
			1	2	3	4	5	6	7	8	9	10	11	12	1	2
ELECTIVE – I																
III	V	Bioresource Technology	2.2	2.4	2	-	1.8	1.8	-	1.6	1.4	1.4	0.4	0.4	-	-
		Intellectual Property Rights	-	-	-	-	-	1.5	2.4	3	-	-	-	-	3	2.6
		Cancer Biotechnology	0.6	2.8	2.4	1.8	2.6	-	-	0.4	-	-	1.2	2.6	3	2.6
		Biosensors	3	1.8	2	1.2	1.4	0.6	0.8	-	-	-	0.6	1.8	1.8	3
		Genomics and Proteomics	2.8	2.8	3	2.8	3	0.8	1.2	-	-	-	2.8	3	3	3
		Food Biotechnology	2.4	-	-	-	-	2.8	2.4	-	-	-	1	2.4	3	2.6
ELECTIVE – II																
III	VI	Bioreactor Design	2.8	3	2.6	2.6	2.2	-	-	-	-	-	-	2	2.2	2.6
		Bioethics and Biosafety	2	3	1	-	1.8	1.8	-	0.6	-	-	1.2	3	2	-
		Stem cell Technology	-	3	2.4	3	2.6	-	-	1	-	-	1.2	2.6	3	2.6
		Marine Biotechnology	2.2	2	1.4	2.6	1.4	0.8	1	1.4	1	0.4	0.6	1.8	3	3
		Computational Biology	3	3	0.8	0.8	-	0.8	-	-	1.2	1.2	-	0.4	-	-
		Organic Farming for Sustainable Agriculture	3	3	2.6	2.8	1.2	1.8	1.2	1.8	1.2	1.8	1.6	3	3	2.4
ELECTIVE – III																
IV	VII	Translational Biotechnology	3	3	-	2.4	1	-	-	-	2	-	2.4	0	1.6	2
		Environmental Hazards and Management	2.8	3	2	-	1.8	3	3	2.8	1.2	-	-	3	3	2.6
		Molecular Medicine	3	3	-	2.4	1	-	-	-	2	-	2.4	0	1.6	2
		Pharmacology and Toxicology	3	-	-	-	-	-	-	-	1.2	1.2	-	0.4	-	-
		Metabolomics and Metabolic Engineering	0.8	0.4	0.8	0.8	1.2	0.8	0.4	0.8	1.2	-	-	-	0.4	0.2
		Biotechniques in Crop Improvement	-	3	2.4	3	2.6	-	-	1	-	-	1.2	2.6	3	2.6
ELECTIVE – IV																
IV	VII	Fermentation Technology	0.8	0.8	1.2	1	0.4	0.4	0.8	-	-	0.6	-	0.6	0.6	0.8
		Clinical Trials and Health Care Policies in Biotechnology	2.2	1.8	2.4	2	2	2.4	2	0.4	1.6	1.2	1.6	1.2	3	2.6
		Human Epigenetics	3	3	2.6	2.8	1.2	1.8	2.4	1.2	0.4	2.2	1.2	2.8	3	2
		Nanobiotechnology	2.2	1.8	2.4	2	2	2.4	2	0.4	1.6	1.2	1.6	1.2	3	2.6
		Next Generation Sequencing and Data Analysis	2.6	2.4	2.6	2.4	2.8	-	-	2.6	2.4	2.6	2.6	2.6	3	2.6
		Agricultural Biotechnology	2.8	2.8	3	2.8	3	-	-	1	-	-	2.8	3	3	3
ELECTIVE – V																
IV	VIII	Bioprocess Modeling and Simulation	2.4	1.2	1	0.6	1.2	-	-	-	-	-	-	-	2	2

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BOS- Chairman

		Regulatory Affairs in Biotechnology	1	2	0.6	-	0.4	-	-	2.4	-	0.8	0	0.8	2	2
		Biomedical Instrumentation	2	2.2	2.2	2.6	3	1.2	1.4	1.6	1.8	2	4.4	4.6	0.2	0.4
		Biomaterials	1.8	1	1.6	0.6	-	0.4	0.2	-	-	-	-	-	2	2
		Systems Biology	3	3	0.8	0.8	-	0.8	-	-	1.2	1.2	-	0.4	-	-
		Biodiversity and its Conservation	-	2.4	1	2.2	2.2	1.8	3	1.2	-	-	1.8	3	-	-
		Crop Production Technology	3	3	2.6	2.8	1.2	1.8	1.2	1.8	1.2	1.6	3	3	2.4	3

K.S. RANGASAMY COLLEGE OF TECHNOLOGY

Credit Distribution for B. TECH (BT) Programme – 2024 –2025 Batch

S. No.	Category	Credits Per Semester								Total Credits	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	2	2	-	-	-	-	3	-	07	4.29
2.	BS	14	4	04	04	-	-	-	-	26	15.9
3.	ES	3	15	-	-	-	-	-	-	18	11.04
4.	PC	-	-	20	14	18	17	09	-	78	47.85
5.	PE	-	-	-	-	3	3	6	3	15	9.20
6.	OE	-	-	-	3	3	3	-	-	09	5.52
7.	CG	-	1*	1*	1*	1*	1*	2	8	10	6.136
8.	MC	MC I	-	-	MC II	-	MC III	-	-	-	-
9.	AC	-	-	-	-	-	-	AC	-	-	-
10.	GE	GE I	GE II	-	-	-	-	-	-	-	-
Total		**19**	**21**	**24**	**21**	**24**	**23**	**20**	**11**	**163**	**100**

HS - HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES

BS - BASIC SCIENCE COURSES

ES - ENGINEERING SCIENCE COURSES

PC - PROFESSIONAL CORE COURSES

PE - PROFESSIONAL ELECTIVE COURSES

MC - MANDATORY COURSES

OE - OPEN ELECTIVE COURSES

CG - CAREER GUIDANCE COURSES

AC - AUDIT COURSES

GE - GENERAL ELECTIVE COURSES

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

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BOS- Chairman

K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE -637215
(An Autonomous Institution affiliated to Anna University)

HUMANITIES AND SOCIAL SCIENCES (HS)

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

BASIC SCIENCES (BS)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 MA 001	Matrices and Calculus	BS	5	3	1	0	4	Nil
2.	60 PH 005	Physics for Biotechnology	BS	3	3	0	0	3	Nil
3.	60 CH 005	Chemistry for Life Sciences	BS	3	3	0	0	3	Nil
4.	60 PH 0P2	Applied Physics Laboratory	BS	4	0	0	4	2	Nil
5.	60 CH 0P1	Applied Chemistry Laboratory	BS	4	0	0	4	2	Nil
6.	60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	BS	5	3	1	0	4	Nil
7.	60 MA 012	Fourier Transform and Numerical Methods	BS	5	3	1	0	4	Nil
8.	60 MA 021	Probability and Statistics	BS	5	3	1	0	4	Nil

ENGINEERING SCIENCES (ES)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 EE 001	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3	Nil
2.	60 CS 001	C Programming	ES	3	3	0	0	3	Nil
3.	60 ME 002	Engineering Graphics	ES	6	2	0	4	4	Nil
4.	60 ME 004	Engineering Mechanics	ES	5	3	1	0	4	Nil
5.	61 ME 0P1	Fabrication and Reverse Engineering Laboratory	ES	4	0	0	4	2	Nil
6.	60 CS 0P1	C Programming Laboratory	ES	4	0	0	4	2	Nil

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BOS- Chairman

PROFESSIONAL CORE COURSES (PC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	61 BT 301	Biochemistry	PC	3	3	0	0	3	Basic Biology
2.	61 BT 302	Microbiology	PC	3	3	0	0	3	Basic Biology
3.	60 BT 303	Cell Biology and Genetics	PC	3	3	0	0	3	Basic Biology
4.	60 BT 304	Principles of Chemical Engineering	PC	5	3	1	0	4	Basic knowledge in Chemistry and Mathematics
5.	60 BT 305	Molecular Biology	PC	3	3	0	0	3	Chemistry, Biochemistry, Cell Biology
6.	61 BT3P1	Biochemistry Laboratory	PC	4	0	0	4	2	Basic Biology and Biochemistry
7.	61 BT 3P2	Microbiology Laboratory	PC	4	0	0	4	2	Introductory Biology and Microbiology
8.	60 BT 401	Genetic Engineering	PC	3	3	0	0	3	Molecular Biology and Biochemistry
9.	60 BT 402	Protein and Enzyme Engineering	PC	3	3	0	0	3	Basic knowledge on Chemistry, Cell Biology and Biochemistry
10.	60 BT 403	Biochemical Thermodynamics	PC	5	3	1	0	4	Basic knowledge of Engineering Mathematics ,Physics and Principles of Chemical Engineering.
11.	61 BT4P1	Molecular Biology and Genetic Engineering Laboratory	PC	4	0	0	4	2	Molecular Biology, Genetic Engineering and Cell Biology
12.	61 BT 4P2	Protein and Enzyme Engineering Laboratory	PC	4	0	0	4	2	Protein and Enzyme Engineering
13.	60 BT 501	Plant and Animal Biotechnology	PC	3	3	0	0	3	Basics of Biology ,Cell biology and Genetics
14.	60 BT 502	Bioinformatics	PC	5	1	0	4	3	Basics of Biochemistry and Molecular Biology

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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15.	60 BT 503	Heat and Mass Transfer Operations	PC	5	3	1	0	4	Basic knowledge in Unit operations & Fluid flow
16.	60 BT 504	Chemical Reaction Engineering	PC	5	3	1	0	4	Thermodynamics, Fluid mechanics, Heat and Mass Transfer Operations
17.	60 BT 5P1	Plant and Animal Biotechnology Laboratory	PC	3	0	0	3	1.5	Plant and Animal Biotechnology
18.	60 BT 6P2	Chemical Engineering Laboratory	PC	3	0	0	3	1.5	Unit operations, Fluid mechanics, Heat and Mass transfer Operations
19.	60 BT 5P3	Design Thinking and Innovation Laboratory	PC	2	0	0	2	1	Nil
20.	60 BT 601	Biopharmaceutical Technology	PC	3	3	0	0	3	Biology / Biochemistry
21.	60 BT 602	Bioprocess Technology	PC	5	3	1	0	4	Heat and Mass Transfer, Chemical Reaction Engineering and Biochemical Thermodynamics
22.	60 BT 603	Computer Aided Drug Design	PC	3	3	0	0	3	Biochemistry, Molecular Biology and Bioinformatics concepts
23.	60 BT 604	Immunology and Immunotechnology	PC	4	2	0	2	3	Biochemistry, Cell Biology and Microbiology
24.	60 BT6P1	Computer Aided Drug Design Laboratory	PC	3	0	0	3	1.5	Biochemistry, Molecular Biology and Bioinformatics concepts
25.	60 BT 6P2	Bioprocess Technology Laboratory	PC	3	0	0	3	1.5	Protein and Enzyme Engineering Laboratory
26.	60 BT 6P3	Design Thinking and Product Development	PC	2	0	0	2	1	Nil

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

27.	60 BT 701	AI for Biotechnology	PC	3	3	0	0	3	Bioinformatics concepts
28.	60 BT 702	Downstream Processing	PC	3	3	0	0	3	Basic knowledge in Unit operations, Fluid mechanics, Chemical kinetics and Bioprocess Engineering
29.	60 BT7P1	Biological Data Analysis Laboratory	PC	3	0	0	3	1.5	Knowledge on Basic Mathematics, Probability and Statistics
30.	60 BT7P2	Downstream Processing Laboratory	PC	3	0	0	3	1.5	Unit operations, Fluid mechanics, Heat and Mass transfer Operations, Bioprocess Engineering

PROFESSIONAL ELECTIVE COURSES (PE)/ HONOURS

SEMESTER V, PROFESSIONAL ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT E11	Bioresource Technology	PE	3	3	0	0	3	Environmental Biology and Microbiology
2.	60 BT E12	Intellectual Property Rights	PE	3	3	0	0	3	Biopharmaceutical Technology
3.	60 BT E13	Cancer Biotechnology	PE	3	3	0	0	3	Basic Knowledge on Cell Biology, Genetics and Molecular Biology
4.	60 BT E14	Biosensors	PE	3	3	0	0	3	Biomedical Engineering
5.	60 BT E15	Genomics and Proteomics	PE	3	3	0	0	3	Bioinformatics
6.	60 BT E16	Food Biotechnology	PE	3	3	0	0	3	Basics of Biology, Microbiology and Biochemistry

Note: Students may opt any elective course for honours degree

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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SEMESTER VI, PROFESSIONAL ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT E21	Bioreactor Design	PE	3	3	0	0	3	Basic knowledge in Fluid flow, Heat and Mass transfer, Chemical Reaction Engineering and Bioprocess Engineering
2.	60 BT E22	Bioethics and Biosafety	PE	3	3	0	0	3	Nil
3.	60 BT E23	Stem Cell Technology	PE	3	3	0	0	3	Basic Knowledge on Cell Biology and Immunology
4.	60 BT E24	Marine Biotechnology	PE	3	3	0	0	3	Biodiversity and its conservation
5.	60 BT E25	Computational Biology	PE	3	3	0	0	3	Basic knowledge of biology and genetics
6.	60 BT E26	Organic Farming for Sustainable Agriculture	PE	3	3	0	0	3	Biology

Note: Students may opt any elective course for honours degree

SEMESTER VII, PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT E31	Translational Biotechnology	PE	3	3	0	0	3	Basic Biology
2.	60 BT E32	Environmental Hazards and Management	PE	3	3	0	0	3	Environment Science
3.	60 BT E33	Molecular Medicine	PE	3	3	0	0	3	Basic Biology
4.	60 BT E34	Pharmacology and Toxicology	PE	3	3	0	0	3	Biochemistry
5.	60 BT E35	Metabolomics and Metabolic Engineering	PE	3	3	0	0	3	Biochemistry, Stoichiometry, Bioprocess / Fermentation Technology
6.	60 BT E36	Biotechniques in Crop Improvement	PE	3	3	0	0	3	Biochemistry, Microbiology, Molecular Biology and Biology

Note: Students may opt any elective course for honours degree

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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SEMESTER VII, PROFESSIONAL ELECTIVE IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT E41	Fermentation Technology	PE	4	2	0	2	3	Microbiology, Stoichiometry
2.	60 BT E42	Clinical Trials and Health Care Policies in Biotechnology	PE	4	2	0	2	3	Molecular biology
3.	60 BT E43	Human Epigenetics	PE	4	2	0	2	3	Molecular Biology, Cell Biology
4.	60 BT E44	Nanobiotechnology	PE	4	2	0	2	3	Chemistry Bioinformatics
5.	60 BT E45	Next Generation Sequencing and Data Analysis	PE	4	2	0	2	3	Biochemistry, Molecular Biology and Bioinformatics concepts
6.	60 BT E46	Agricultural Biotechnology	PE	4	2	0	2	3	Agricultural engineering and Plant Biotechnology

Note: Students may opt any elective course for honours degree

SEMESTER VIII, PROFESSIONAL ELECTIVE V

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT E51	Bioprocess Modeling and Simulation	PE	3	3	0	0	3	Stoichiometry, Bioprocess Technology
2.	60 BT E52	Regulatory Affairs in Biotechnology	PE	3	3	0	0	3	Biopharmaceuti cal Technology
3.	60 BT E53	Biomedical Instrumentation	PE	3	3	0	0	3	Basic Physics, Anatomy and Physiology
4.	60 BT E54	Biomaterials	PE	3	3	0	0	3	Basics of Biology, Microbiology and Biochemistry
5.	60 BT E55	Systems Biology	PE	3	3	0	0	3	Basic Biology
6.	60 BT E56	Biodiversity and its Conservation	PE	3	3	0	0	3	Environmental Science, Plant and Animal Biotechnology
7.	60 BT E57	Crop Production Technology	PE	3	3	0	0	3	Basic Biology

Note: Students may opt any elective course for honours degree

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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MANDATORY COURSES (MC)

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

AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 AC 001	Research Skill Development	AC	1	1	0	0	0	Nil

OPEN ELECTIVE COURSES (OE)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT L01	Agricultural Engineering	OE	3	3	0	0	3	Physics, Chemistry, and Biology
2.	61 BT L02	Animal Studies in Research	OE	3	3	0	0	3	Biology
3.	60 BT L03	Production Technology of Agricultural and Food Processing Machinery	OE	3	3	0	0	3	Biology
4.	60 BT L04	Pollution and its Management	OE	3	3	0	0	3	Biology
5.	60 BT L05	Organic Farming for Sustainable Agriculture	OE	3	3	0	0	3	Biology
6.	60 BT L06	Basics of Bioinformatics	OE	3	3	0	0	3	Biology/ Computer Science

GENERAL ELECTIVE (GE)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	61 GE 001	Heritage of Tamils / தமிழர் மரபு	GE	1	1	0	0	1[β]	Nil
2.	60 GE 002	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	GE	1	1	0	0	1[$]	Nil

INTEGRATED COURSE (IC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 BT E41	Fermentation Technology	PE	4	2	0	2	3	Microbiology, Stoichiometry
2.	60 BT E42	Clinical Trials and Health Care Policies in Biotechnology	PE	4	2	0	2	3	Molecular biology
3.	60 BT E43	Human Epigenetics	PE	4	2	0	2	3	Cell Biology and Genetics
4.	60 BT E44	Nanobiotechnology	PE	4	2	0	2	3	Chemistry Bioinformatics

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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5.	60 BT E45	Next Generation Sequencing and Data Analysis	PE	4	2	0	2	3	Biochemistry, Molecular Biology and Bioinformatics concepts
6.	60 BT E46	Agricultural Biotechnology	PE	4	2	0	2	3	Agricultural engineering and Plant Biotechnology
7.	60 BT 604	Immunology and Immunotechnology	PC	4	2	0	2	3	Biochemistry, Cell Biology and Microbiology

CAREER GUIDANCECOURSES (CG)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 CG 0P1	Career Skill Development I	CG	2	0	0	2	1^{λ}	Basic knowledge of reading and writing in English
2.	60 CG 0P2	Career Skill Development II	CG	2	0	0	2	1^{λ}	Basic knowledge of reading and writing in English
3.	60 CG 0P3	Career Skill Development III	CG	2	0	0	2	1^{λ}	Basic knowledge of Arithmetic and Logical Reasoning
4.	60 CG 0P4	Career Skill Development IV	CG	2	0	0	2	1^{λ}	Basic knowledge of Arithmetic and Logical Reasoning
5.	60 CG 0P5	Comprehension Test	CG	2	0	0	2	$1^{\$}$	Fundamental knowledge in all core subjects.
6.	60 CG 0P6	Internship	CG	0	0	0	0	$1/2/3^{\#}$	NIL
7.	60 BT 7P3	Project Work - Phase I	CG	4	0	0	4	2	NIL
8.	60 BT 8P1	Project Work - Phase II	CG	16	0	0	16	8	Project Work - Phase I

$^{\#}$ Internship additional credits are offered based on the duration

$^{\lambda}$Career Skill Development (CSD) - additional credit is offered not accounted for CGPA.

Passed in BoS Meeting held on 21/05/2024
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K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE -637 215
(An Autonomous Institution affiliated to Anna University)

COURSES OF STUDY

(For the candidates admitted in 2024-2025)

SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		Induction Programme	-	-	-	-	-	**-**
THEORY								
1.	60 EN 001	Professional English-I	HS	3	1	0	2	2
2.	60 MA 001	Matrices and Calculus	BS	5	3	1	0	4
3.	60 EE 001	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
4.	60 PH 005	Physics for Biotechnology	BS	3	3	0	0	3
5.	60 CH 005	Chemistry for Life Sciences	BS	3	3	0	0	3
6.	60 MY 001	Environmental Studies and Climate Change	MC	2	2	0	0	0
7.	61 GE 001	Heritage of Tamils / *தமிழர் மரபு*	GE	1	1	0	0	1^{β}
PRACTICALS								
8.	60 PH 0P2	Applied Physics Laboratory	BS	4	0	0	4	2
9..	60 CH 0P1	Applied Chemistry Laboratory	BS	4	0	0	4	2
			Total	**28**	**16**	**1**	**10**	**19**

I to VII semester

$^{\alpha}$ NCC - Course can be waived with 3 credits in VII semester or offered as extra credits

NSS/NSO/YRC/RRC/Fine Arts$^{\%}$ 3 credits is not accounted for CGPA

$^{\lambda}$Career Skill Development (CSD) - additional credit is offered not accounted for CGPA.

I to VIII semester

$^{\#}$Internship 3 additional credits not accounted for CGPA is offered based on the Internship duration

$^{\beta}$ **Heritage of Tamils /** ***தமிழர் மரபு*** **-extra credit is offered**

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 EN 002	Professional English-II	HS	3	1	0	2	2
2.	60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	BS	5	3	1	0	4
3.	60 CS 001	C Programming	ES	3	3	0	0	3
4.	60 ME 002	Engineering Graphics	ES	6	2	0	4	4
5.	60 ME 004	Engineering Mechanics	ES	5	3	1	0	4
6.	60 GE 002	Tamils and Technology/*தமிழரும் தொழில்நுட்பமும்*	GE	1	1	0	0	$1^{\$}$
PRACTICALS								
7.	61 ME 0P1	Fabrication and Reverse Engineering Laboratory	ES	4	0	0	4	2
8.	60 CS 0P1	C Programming Laboratory	ES	4	0	0	4	2
9.	60 CG 0P1	Career Skill Development I	CG	2	0	0	2	1^{λ}
			Total	**33**	**13**	**2**	**16**	**21**

$^{\lambda}$Career Skill Development I - extra credit is offered

$^{\$}$Tamils and Technology / தமிழரும் தொழில்நுட்பமும் - Extra 1 credit is offered

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 MA 012	Fourier Transform and Numerical Methods	BS	5	3	1	0	4
2.	61 BT 301	Biochemistry	PC	3	3	0	0	3
3.	60 BT 302	Microbiology	PC	3	3	0	0	3
4.	60 BT 303	Cell Biology and Genetics	PC	3	3	0	0	3
5.	60 BT 304	Principles of Chemical Engineering	PC	5	3	1	0	4
6.	60 BT 305	Molecular Biology	PC	3	3	0	0	3
PRACTICALS								
7.	61 BT 3P1	Biochemistry Laboratory	PC	4	0	0	4	2
8.	61 BT 3P2	Microbiology Laboratory	PC	4	0	0	4	2
9.	60 CG 0P2	Career Skill Development – II	CG	2	0	0	2	1^{λ}
10.	60 CG 0P6	Internship	CG	-	-	-	-	$1/2/3^{\#}$
			Total	**32**	**18**	**2**	**10**	**24**

$^{\#}$ Internship extra credits is offered based on duration

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 MA 021	Probability and Statistics	BS	5	3	1	0	4
2.	60 BT 401	Genetic Engineering	PC	3	3	0	0	3
3.	60 BT 402	Protein and Enzyme Engineering	PC	3	3	0	0	3
4.	60 BT 403	Biochemical Thermodynamics	PC	5	3	1	0	4
5.	60 OE L0*	Open Elective – I	OE	3	3	0	0	3
6.	60 MY 002	Universal Human Values	MC	3	3	0	0	$3^{\$}$
PRACTICALS								
7.	61 BT 4P1	Molecular Biology and Genetic Engineering Laboratory	PC	4	0	0	4	2
8.	61 BT 4P2	Protein and Enzyme Engineering Laboratory	PC	4	0	0	4	2
9.	60 CG 0P3	Career Skill Development – III	CG	2	0	0	2	1^{λ}
10.	60 CG 0P6	Internship	CG	-	-	-	-	$1/2/3^{\#}$
			Total	**32**	**18**	**2**	**10**	**21**

$^{\$}$UHV- additional 3 credit is offered and not accounted for CGPA

$^{\#}$Internship extra credits is offered based on duration

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

SEMESTER V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 BT 501	Plant and Animal Biotechnology	PC	3	3	0	0	3
2.	60 BT 502	Bioinformatics	PC	5	1	0	4	3
3.	60 BT 503	Heat and Mass Transfer Operations	PC	5	3	1	0	4
4.	60 BT 504	Chemical Reaction Engineering	PC	5	3	1	0	4
5.	60 BT E1*	Professional Elective – I	PE	3	3	0	0	3
6.	60 OE L0*	Open Elective – II	OE	3	3	0	0	3
PRACTICALS								
7.	60 BT 5P1	Plant and Animal Biotechnology Laboratory	PC	3	0	0	3	1.5
8.	60 BT 5P2	Chemical Engineering Laboratory	PC	3	0	0	3	1.5
9.	60 BT 5P3	Design Thinking and Innovation Laboratory	PC	2	0	0	2	1
10.	60 CG 0P4	Career Skill Development – IV	CG	2	0	0	2	1[λ]
11.	60 CG 0P6	Internship	CG	-	-	-	-	1/2/3[#]
			Total	**34**	**16**	**2**	**14**	**24**

[α] NCC/NSS/NSO/YRC/RRC/Fine Arts - 3 credits can be waived in VII semester or offered as extra Credits

[#]Internship extra credits is offered based on duration

SEMESTER VI

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 BT 601	Biopharmaceutical Technology	PC	3	3	0	0	3
2.	60 BT 602	Bioprocess Technology	PC	5	3	1	0	4
3.	60 BT 603	Computer Aided Drug Design	PC	3	3	0	0	3
4.	60 BT 604	Immunology and Immunotechnology	PC	4	2	0	2	3
5.	60 MY 003	Startups and Entrepreneurship	MC	2	2	0	0	2[&]
6.	60 BT E2*	Profesional Elective – II	PE	3	3	0	0	3
7.	60 OE L0*	Open Elective – III	OE	3	3	0	0	3
PRACTICALS								
8.	60 BT 6P1	Computer Aided Drug Design Laboratory	PC	3	0	0	3	1.5
9.	60 BT 6P2	Bioprocess Technology Laboratory	PC	3	0	0	3	1.5
10.	60 BT 6P3	Design Thinking and Product Development Laboratory	PC	2	0	0	2	1
11.	60 CG 0P5	Comprehension Test	CG	2	0	0	2	1[$]
12.	60 CG 0P6	Internship	CG	-	-	-	-	1/2/3[#]
			Total	**33**	**19**	**1**	**12**	**23**

[$] Comprehension Test-one additional credit is offered and not accounted for CGPA calculation

[#] Internship extra credits is offered based on duration

[&]Startups and Entrepreneurship - Three additional credit is offered and not accounted for CGPA calculation

Passed in BoS Meeting held on 21/05/2024

Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

SEMESTER VII

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 HS 002	Engineering Economics and Financial Accounting	HS	3	3	0	0	3
2.	60 BT 701	AI for Biotechnology	PC	3	3	0	0	3
3.	60 BT 702	Downstream Processing	PC	3	3	0	0	3
4.	60 BT E3*	Professional Elective – III	PE	3	3	0	0	3
5.	60 BT E4*	Professional Elective – IV	PE	4	2	0	2	3
6.	60 AC 001	Research Skill Development	AC	1	1	0	0	0
7.	60 AB 00*	NCC/NSS/NSO/YRC/RRC/Fine Arts	HS	4	2	0	2	3^{α}
PRACTICALS								
8.	60 BT 7P1	Biological Data Analysis Laboratory	PC	3	0	0	3	1.5
9.	60 BT 7P2	Downstream Processing Laboratory	PC	3	0	0	3	1.5
10.	60 BT 7 P3	Project Work - Phase I	CG	4	0	0	4	2
11.	60 CG 0P6	Internship	CG	-	-	-	-	$1/2/3^{\#}$
			Total	**27**	**15**	**0**	**12**	**20**

$^{\#}$ Internship extra credits is offered based on duration

SEMESTER VIII

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

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 163

Note: HS- Humanities and Social Sciences including Management Courses, BS- Basic Science Courses, ES-Engineering Science Courses, PE-Professional Core Courses, PE-Professional Elective Courses, OE- Open Elective Courses, EEC-Employability Enhancement Courses, MC-Mandatory Courses, AC — Audit Courses& GE — General Elective

Note:

1 Hour Lecture is equivalent to 1 credit

2 Hours Tutorial is equivalent to 1credit

2 Hours Practical is equivalent to 1 credit

Passed in BoS Meeting held on 21/05/2024

Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637 215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2024-2025)

FIRST SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 EN 001	Professional English-I	2	40	60	100	45	100
2	60 MA 001	Matrices and Calculus	2	40	60	100	45	100
3	60 EE 001	Basic Electrical and Electronics Engineering	2	40	60	100	45	100
4	60 PH 005	Physics for Biotechnology	2	40	60	100	45	100
5	60 CH 005	Chemistry for Life Sciences	2	40	60	100	45	100
6	60 MY 001	Environmental Studies and Climate Change	2	100	-	100	-	100
7	61 GE 001	Heritage of Tamils / தமிழர் மரபு	2	40	60	100	45	100
PRACTICAL								
8	60 PH 0P2	Applied Physics Laboratory	3	60	40	100	45	100
9	60 CH 0P1	Applied Chemistry Laboratory	3	60	40	100	45	100

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

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- Basic Knowledge of reading and writing in English

Course Outcomes

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

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

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 EN 001 - Professional English I (Common to All Branches)

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

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

Text Book(s):

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

Reference(s):

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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1.	Raman. Meenakshi, Sharma. Sangeeta, 'Professional English'. Oxford university press. New Delhi. 2019
2.	Arthur Brookes and Peter Grundy,' Beginning to Write: Writing Activities for Elementary and Intermediate Learners', Cambridge University Press, New York, 2003
3.	Prof. R.C. Sharma & Krishna Mohan, 'Business Correspondence and Report Writing', Tata McGraw Hill & Co.Ltd., New Delhi, 2001
4.	Arora V.N. and Laxmi Chandra, 'Improve Your Writing', Oxford University Press, New Delhi, 2001

***SDG- 04- Quality Education**

Course Contents and Lecture Schedule

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

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Approved in Academic Council Meeting held on 25/05/2024

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

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

- To familiarize the basic concepts in Cayley-Hamilton theorem and orthogonal transformation
- To get exposed to the fundamentals of differentiation
- To acquire skills to understand the concepts involved in Jacobians and maxima and minima
- To solve various linear differential equations and method of variation of parameters
- To learn various techniques and methods in solving definite and indefinite integrals

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 MA 001- Matrices and Calculus

Common to MECH, ECE, EEE, CSE, MCT, CIVIL, IT, TXT, BT, FT, AI&DS, AI&ML

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

Matrices Characteristic Equation - Eigen Values and Eigen Vectors of a Real Matrix - Properties of Eigen Values and Eigen Vectors - Cayley-Hamilton Theorem - Orthogonal Transformation of a Symmetric Matrix to Diagonal form - Reduction of Quadratic form to Canonical form by an Orthogonal Transformation - Nature of Quadratic form - Applications: Stretching of an Elastic Membrane. **Hands-on:** Matrix Operations - Addition, Multiplication, Transpose, Inverse and Rank	[9]
Differentiation Representation of Functions - Limit of a Function - Continuity - Derivatives - Differentiation Rules (Sum, Product, Quotient, Chain Rules) - Successive Differentiation - Leibnitz's Theorem **-** Applications: Maxima and Minima at Functions of One Variable***** **Hands-on:** Determine the Solution of System of Linear Equations	[9]
Functions of Several Variables Partial Differentiation - Homogeneous Functions and Euler's Theorem - Jacobians - Taylor's Series for Functions of Two Variables - Applications: Maxima and Minima of Functions of Two Variables - Constrained Maxima and Minima: Lagrange's Method of Undetermined Multipliers***** **Hands-on:** Compute the Eigen Values and Eigen Vectors of a Matrix	[9]
Differential Equations Linear Differential Equations of Second and Higher Order with Constant Coefficients - R.H.S is of the Form e^{ax}, $sin\ \alpha\ x$, $cos\ \alpha\ x$, x^n, $n > 0$ - Differential Equations with Variable Coefficients: Cauchy's and Legendre's form of Linear Equations - Method of Variation of Parameters. **Hands-on:** Solve the First and Second Order Ordinary Differential Equations	[9]
Integration Definite and Indefinite Integrals - Substitution Rule - Techniques of Integration: Integration by Parts, Integration of Rational Functions by Partial Fraction, Integration of Irrational Functions - Improper Integrals - Applications: Hydrostatic Force and Pressure, Moments and Centres of Mass. **Hands-on:** Compute the Maxima and Minima of a Function of One Variable	[9]
Total Hours: 45 + 5 (Hands-on) + 10 (Tutorial)	**60**

Text Book(s):

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

Reference(s):

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

* **SDG: 4 – Quality Education**

Passed in BoS Meeting held on 21/05/2024
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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Matrices**	
1.1	Characteristic Equation	1
1.2	Eigen Values and Eigen Vectors of a Real Matrix	1
1.3	Properties of Eigen Values and Eigen Vectors	1
1.4	Cayley-Hamilton Theorem	1
1.5	Orthogonal Transformation of a Symmetric Matrix to Diagonal Form	1
1.6	Reduction of Quadratic form to Canonical form by Orthogonal Transformation	2
1.7	Nature of Quadratic Form	1
1.8	Stretching of an Elastic Membrane	1
1.9	Tutorial	2
1.10	Hands-on	1
2.0	**Differentiation**	
2.1	Representation of Functions	1
2.2	Limit of a Function and Continuity	1
2.3	Differentiation Rules (Sum, Product, Quotient, Chain Rules)	2
2.4	Successive Differentiation	1
2.5	Leibnitz's Theorem	2
2.6	Maxima and Minima of Functions of One Variable	2
2.7	Tutorial	2
2.8	Hands-on	1
3.0	**Functions of Several Variables**	
3.1	Partial Differentiation	1
3.2	Homogeneous Functions and Euler's Theorem	1
3.3	Jacobians	2
3.4	Taylor's Series for Functions of Two Variables	1
3.5	Maxima And Minima of Functions of Two Variables	2
3.6	Lagrange's Method of Undetermined Multipliers	2
3.7	Tutorial	2
3.8	Hands-on	1
4.0	**Differential Equations**	
4.1	Linear Differential Equations of Second and Higher order with Constant Co-Efficient	1
4.2	R.H.S is of the form e^{ax}, $sin\ a\ x$, $cos\ a\ x$, $x^n, n > 0$	2
4.4	Differential Equations with Variable Coefficients: Cauchy's form of Linear Equations	2
4.5	Differential Equations with Variable Coefficients: Legendre's form of Linear Equations	2
4.6	Method of Variation of Parameters	2
4.7	Tutorial	2
4.7	Hands-on	1
5.0	**Integration**	
5.1	Definite and Indefinite Integrals	2
5.2	Substitution Rule	1
5.3	Techniques of Integration: Integration by Parts	1
5.4	Integration of Rational Functions by Partial Fraction	1
5.5	Integration of Irrational Functions	1
5.6	Improper Integrals	1

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5.7	Hydrostatic Force.	1

5.8	Pressure, Moments and Centres of Mass.	1
5.9	Tutorial	2
5.10	Hands-on	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

60 EE 001	Basic Electrical and Electronics Engineering	Category	L	T	P	Credit
		ES	3	0	0	3

Objectives

- To familiarize the basic concept on electrical circuits and its various parameters
- To facilitate the various types of electrical machines and their use
- To gain knowledge on electrical safety
- To provide exposure on the functions of various semiconductor devices
- To familiarize the use of various measuring instruments

Pre-requisites

- NIL

Course Outcomes

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

CO1	Apply the basic laws of electric circuits to calculate the unknown quantities.	Apply
CO2	Acquire knowledge on different electrical machines and select suitable machines for industrial applications.	Apply
CO3	Express the significance of various components of low voltage electrical installations and create awareness on electrical safety.	Understand
CO4	Demonstrate the operation and characteristics of various semiconductor devices.	Understand
CO5	Interpret the operating principles of measuring instruments and choose suitable instrument for measuring the parameters.	Understand

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 EE 001 - Basic Electrical and Electronics Engineering
(Common to CSE, IT, AIDS, AIML, MECH, MCT, BT, FT and CIVIL Branches)

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

Electrical Circuits DC Circuits: Circuit Components: Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws–Simple Problems. Introduction to AC Circuits and Parameters: Waveforms, Average Value and Rms Value of Sinusoidal Waveform Real Power, Reactive Power and Apparent Power, Power Factor — Steady State Analysis of RLC Series Circuits- Simple Problems. Introduction to Three Phase AC Circuits	[9]
Electrical Machines* Construction and Working Principle - Separately and Self Excited DC Generators, EMF Equation, Types and Applications. Working Principle of DC Motors, Torque Equation, Types and Applications. Construction, Working Principle and Applications of Transformer, Three Phases Alternator, Synchronous Motor and Three Phase Induction Motor.	[10]
Electrical Installations* Domestic Wiring, Types of Wires and Cables, Earthing,Protective Devices- Switch Fuse Unit- Miniature Circuit Breaker-Moulded Case Circuit Breaker- Earth Leakage Circuit Breaker, Batteries and Types, UPS,Safety Precautions and First Aid.	[9]
Analog Electronics * Introduction to Semiconductor Materials– PN Junction Diodes, Zener Diode — Characteristics and Applications – Bipolar Junction Transistor-Biasing and Configuration (NPN) - Regulated Power Supply Unit, Switched Mode Power Supply.	[8]
Measurements and Instrumentation * Functional Elements of an Instrument, Standards and Calibration, Operating Principle, Types -Moving Coil and Moving Iron Meters, Operating Principles and Types of Wattmeter, Energy Meter, Instrument Transformers-CT and PT, DSO- Block Diagram- Data Acquisition**.**	[9]
Total Hours:	**45**

Text Book(s):

1.	Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition, McGraw Hill Education, 2020.
2.	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

Reference(s):

1.	Kothari DP and I.J Nagrath, "Basic Electrical Engineering", 4th Edition, McGraw Hill Education, 2019.
2.	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th Edition, 2017.
3.	Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
4.	Kalsi H.S., 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Electrical Circuits**	
1.1	Circuit Components: Resistor, Inductor, Capacitor	1
1.2	Ohm's Law - Kirchhoff's Laws	1
1.3	Ohm's Law - Kirchhoff's Laws – Problems	1
1.4	Introduction to AC Circuits and Parameters: Waveforms, Average value and RMS Value of Sinusoidal Waveform	1
1.5	Real power, Reactive Power and Apparent Power, Power Factor	1
1.6	Steady State Analysis of RLC Series Circuits	2
1.7	RLC Series Circuits – Problems	1
1.8	Introduction to Three Phase System	1
2.0	**Electrical Machines**	

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2.1	Construction and Working Principle of DC Generator	1
2.2	Types and Applications of Separately and Self Excited DC Generators	1
2.3	EMF Equation of DC Generator	1
2.4	Working Principle of DC Motors	1
2.5	Torque Equation	1
2.6	Types and Applications	1
2.7	Construction, Working Principle and Applications of Transformer	1
2.8	Construction, Working Principle and Applications of Three phase Alternator	1
2.9	Construction, Working Principle and Applications of Synchronous Motor	1
2.10	Construction, Working Principle and Applications of Three Phase Induction Motor	1
3.0	**Electrical Installations**	
3.1	Domestic Wiring, Types of Wires and Cables	1
3.2	Earthing, Protective Devices	2
3.3	Switch Fuse Unit- Miniature Circuit Breaker	1
3.4	Molded Case Circuit Breaker- Earth Leakage Circuit Breaker	1
3.5	Batteries and Types	2
3.6	UPS	1
3.7	Safety Precautions and First Aid	1
4.0	**Analog Electronics**	
4.1	Introduction to Semiconductor Materials	1
4.2	Characteristics and Applications of PN Junction Diodes	1
4.3	Characteristics and Applications of Zener Diode	1
4.4	Bipolar Junction Transistor	1
4.5	Biasing & Configuration (NPN)	2
4.6	Regulated Power Supply Unit	1
4.7	Switched Mode Power Supply	1
5.0	**Measurements and Instrumentation**	
5.1	Functional elements of an instrument	1
5.2	Standards and calibration	1
5.3	Moving Coil meters - Operating Principle, types	1
5.4	Moving Iron meters - Operating Principle, types	1
5.5	Operating principles and Types of Wattmeter	1
5.6	Energy Meter	1
5.7	Instrument Transformers – CT & PT	1
5.8	DSO- Block diagram- Data acquisition	2

Course Designer(s)

1. Mr.S.Srinivasan - srinivasan@ksrct.ac.in
2. Ms.R.Radhamani -radhamani@ksrct.ac.in
3. Ms.S.Jaividhya- jaividhya@ksrct.ac.in
4. Dr.S.Gomathi- gomathi@ksrct.ac.in
5. Mr.T.Prabhu- prabhut@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 PH 005	Physics for Biotechnology	Category	L	T	P	Credit
		BS	3	0	0	3

Objectives

- To analyze the crystal parameters to investigate crystal structures and to classify the type of the defect present in the crystal
- To enable the students in understanding the importance of quantum physics and its applications
- To introduce the basics of laser, optical fiber and its applications in biomedical field
- To study the basic concept of ultrasonic waves, production of ultrasonic waves and its applications
- To obtain fundamental concepts and current knowledge of biomaterials and nanotechnology for engineering applications

Pre-requisites

- NIL

Course Outcomes

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

CO1	Recognize the basics of crystallography, crystal imperfections and nucleation	Remember
CO2	Acquire the fundamentals of quantum mechanics and apply to one dimensional motion of particles.	Apply
CO3	Appraise a strong foundational knowledge in lasers and fiber optics and its applications	Understand
CO4	Realize the principle, production, properties and applications of ultrasonic waves	Understand
CO5	Infer the properties of bio materials and nano materials for potential applications ions	Understand

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	16
Understand	46	50	80
Apply	04	-	04
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 PH 005 - Physics for Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Crystallography * Lattice - Unit Cell – Crystal Systems and Bravais Lattice - Crystal Planes and Miller Indices - D Spacing in Cubic Lattice – Packing Factor for HCP – Crystal Imperfections- Edge and Screw Dislocations, Burgers Vector and Elastic Strain Energy- Surface Imperfections – Grain and Twin Boundaries – Polymorphism – Phase Changes – Nucleation and Growth – Homogeneous and Heterogeneous Nucleation.	[9]
Quantum Mechanics* Introduction to Quantum Mechanics-Wave Nature of Particles- De-Broglie Hypothesis — Matter Waves - Time-Dependent and Time Independent Schrodinger Equation for Wave Function- Applications: Particle in a Box (One Dimensional and Three Dimensional) - Uncertainty Principle and its Applications- Electron Microscope: Scanning Electron Microscope	[9]
Laser and Fiber Optics Introduction - Characteristics - Einstein's Coefficients - Population Inversion - Nd:YAG and CO2 Lasers - Applications of Lasers in Therapy and Diagnosis — Endoscopy- Blood Flow Measurement. Optical Fibre- Principle - Classification - Expression for Acceptance Angle and Numerical Aperture- Fiber Optic Sensors: Liquid Level Sensors, Temperature and Displacement Sensors- Optical Fibers in Bio-Sensing Applications.	[9]
Ultrasonics and Applications** Introduction-Properties - Production: Magnetostriction Effect, Magnetostriction Generator- Piezoelectric Effect, Piezoelectric Generator — Ultrasonic Detection- Acoustical Grating- Ultrasound Application in Medicine - Ultrasound Interactions with the Tissues (Reflection, Diffraction, Refraction, Absorption, Scattering) - Safety Aspects of Diagnostic and Therapeutic Ultrasound- Cardiology, Neurology, Ultrasonic Imaging (A, B and Tm-Scan)- Sonogram	[9]
Bio Materials and Nanotechnology Biocompatibility - Bio Functionality- Classification of Biomaterials and its Application - Nanomaterials: Properties- Top-Down Process: Ball Milling Method - Bottom-up Process: Vapour Phase Deposition Method-Carbon Nanotube (CNT): Properties, Preparation (Electric Arc Method) - CNT Applications: Anti- Cancer Treatment, Gene Therapy, Bio Molecule Sensor, Drug Delivery and Radioactive Nano Particles in Biomedical Applications.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Avadhanulu M. N., Kshirsaga P. G. r, TVS Arun Murthy "A Text Book of Engineering Physics", S Chand Publications, New Delhi, 2022.
2.	Malik H. K., Singh A. K. "Engineering Physics" McGraw Hill Education Private Limited, New Delhi. 2021
3.	Joon Park and Lakes R.S., Biomaterials: An Introduction, Springer, 2007.
Reference(s):	
1.	Pillai S.O. "A Textbook of Engineering Physics" New Age International (P) Limited, New Delhi, 2014
2.	Laud B. B., "Lasers and Non-Linear Optics" New Age International Publications, New Delhi, 2015
3.	Palanisamy, P.K., "Physics of Materials", Scitech Publications, Chennai. 2012

*** SDG:4- Quality Education**

**** SDG:3 - Healthy lives and promote well-being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Crystallography**	
1.1	Lattice - Unit Cell – Crystal Systems and Bravais Lattice	2
1.2	Crystal Planes and Miller Indices	1
1.3	D Spacing in Cubic Lattice	1

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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1.4	Packing Factor for HCP	1
1.5	Crystal Imperfections- Edge and Screw Dislocations, Burgers Vector and Elastic Strain Energy	2
1.6	Surface Imperfections – Grain and Twin Boundaries – Polymorphism	1
1.7	Phase Changes – Nucleation and Growth – Homogeneous and Heterogeneous Nucleation.	1
2.0	**Quantum Mechanics**	
2.1	Introduction to Quantum Mechanics	1
2.2	Wave Nature of Particles- De-Broglie Hypothesis – Matter Waves	2
2.3	Time-Dependent and Time Independent Schrodinger Equation for Wave Function	2
2.4	Applications: Particle in a Box (One Dimensional and Three Dimensional)	2
2.5	Uncertainty Principle and its Applications	1
2.6	Electron Microscope: Scanning Electron Microscope.	1
3.0	**Laser and Fiber Optics**	
3.1	Introduction - Characteristics	1
3.2	Einstein's Coefficients	1
3.3	Population Inversion - Nd:YAG Laser	1
3.4	CO_2 Laser	1
3.5	Applications of Lasers in Therapy and Diagnosis – Endoscopy- Blood Flow Measurement.	1
3.6	Optical Fibre- Principle - Classification - Expression for Acceptance Angle and Numerical Aperture	2
3.7	Fiber Optic Sensors: Liquid Level Sensors, Temperature and Displacement Sensors	1
3.8	Optical Fibers in Bio-Sensing Applications	1
4.0	**Ultrasonics and Applications**	
4.1	Introduction-Properties	1
4.2	Production: Magnetostriction Effect, Magnetostriction Generator	1
4.3	Piezoelectric Effect, Piezoelectric Generator	1
4.4	Ultrasonic Detection- Acoustical Grating	1
4.5	Ultrasound Application in Medicine - Ultrasound Interactions with the Tissues (Reflection, Diffraction, Refraction, Absorption, Scattering)	2
4.6	Safety Aspects of Diagnostic and Therapeutic Ultrasound- Cardiology Neurology	2
4.7	Ultrasonic Imaging (A, B and TM-Scan)- Sonogram	1
5.0	**Bio Materials and Nanotechnology**	
5.1	Biocompatibility - Bio functionality- Classification of Biomaterials and its Application	2
5.2	Nanomaterials: Properties- Top-Down Process: Ball Milling Method	1
5.3	Bottom-up process: Vapour Phase Deposition Method	2
5.4	Carbon NanoTube (CNT): Properties, Preparation (Electric Arc Method)	1
5.5	CNT Applications: Anti- Cancer Treatment, Gene Therapy, Bio Molecule Sensor, Drug Delivery	2
5.6	Radioactive Nano Particles in Biomedical Applications	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 CH 005	Chemistry for Life Sciences	Category	L	T	P	Credit
		BS	3	0	0	3

Objectives

- To help the learners to analyse the hardness of water and its removal
- To study the behaviour of solutions based on their properties
- To analyse the factors influencing reaction rates and catalysis
- To study the concepts of electrochemistry and its applications
- To explain the characteristics and application of chemical sensors

Pre-requisites

- NIL

Course Outcomes

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

CO1	Identify the types of hardness of water and its removal	Apply
CO2	Summarize the characteristics of solutions and their applications	Apply
CO3	Illustrate the kinetics of reaction rates and catalysis	Understand
CO4	Interpret the applications of electro chemistry	Apply
CO5	Categorize the types of sensors for various applications	Understand

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 CH 005 - Chemistry for Life Sciences

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

Water Technology* Introduction - Commercial and Industrial uses of Water - Hardness - Types — Estimation of Hardness by EDTA Method Internal Conditioning (Colloidal, Phosphate, Calgon and Carbonate Conditioning Methods) - External Conditioning (Zeolite Process, Demineralization Process) - Desalination Methods (Reverse Osmosis and Electro Dialysis) - Flash Evaporation.	[9]
Solutions** Normality, Molarity, Molality, Percentage Solution, Mole Fraction (Simple Numerical Problems) - Buffer Solutions - Types - Applications - Henderson-Hasselbach Equation. Membrane Permeability - Principle of Diffusion & Osmosis - Donon Membrane Equilibrium. Definition of Osmotic Pressure, Isotonic, Hypotonic & Hypertonic Solutions. Relationship of Osmotic Pressure to Gas Laws. The General Equation for Dilute Solutions, The Influence of Ionization & Molecular Size on Osmotic Pressure - Biological Importance of Osmosis - Colloids - Definition and Types, Gold Number, Preparation and Properties of Colloids - Lyophilic and Lyophobic Sols - Brownian Movements and Tyndall Effect - Emulsion & Emulsifying Agents.	[9]
Chemical Kinetics and Catalysis*** Rate of Reaction, Order and Molecularity - Derivation of First Order Rate Equation - Half-Life Period of First Order Reaction - Determination of Rate Constant of Hydrolysis of Ester - Factors Influencing Rate of Reaction - Activation Energy -Arrhenius Equation - Transition State Theory - Catalyst - Auto Catalyst - Enzyme Catalyst - Michaelis–Menten Equation and its Significance. Catalytic Promoters - Catalytic Poisons - Active Center, Homogeneous and Heterogeneous Catalysis - Reactivity - Coenzymes - Proton Transfer - Metal Ions -Intra Molecular Reactions - Covalent Catalysis - Inclusion Complexation - Industrial Application of Catalysts.	[9]
Electrochemistry ** Electrode Potential - Nernst Equation - Derivation and Problems - Reversible and Irreversible Cells - Types of Electrodes and its Applications - Reference Electrodes - pH, Conductometric and Potentiometric Titrations.	[9]
Chemical Sensors*** Sensors - Chemical Sensors - Characteristics - Elements and Characterization - Potentiometric Sensors - Amperometric Sensors - Sensors Based on Electrochemical Methods - Electrochemical Biosensors - Optical Biosensors: Enzyme Sensors - Bio Affinity Sensors - DNA Sensors. Chemical Sensors as Detectors and Indicators: Indicators for Titration Processes - Separation Methods - Nano Technology in Chemical Sensors.	[9]
Total Hours:	**45**

Text Book(s):

1.	Palanna O.G., “Engineering Chemistry”, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2017
2.	Jain P.C. and Monica Jain, A Textbook of Engineering Chemistry, Dhanpat Rai publications, New Delhi, 16th Edition, 2015

Reference(s):

1.	Peter Grundler, “Chemical Sensors”, Springer Berlin Heidelberg New York, 2007
2.	Puri B. R., Sharma L.R., and Madan S. P., “Principles of Physical Chemistry” Vishal Publishing Company. Gumber Market, Old Railway Road, Jalandhar
3.	Upadhyay A, Upadhyay, K, and Nath, N, “Biophysical chemistry: Principles and Techniques” Himalaya Publishing House, Bombay.
4.	Bahl B.S., Tuli G.D., Arun Bahl, “Essentials of Physical Chemistry”. S.Chand and Company, Ltd. New Delhi

SDG 6 – Improve Clean Water and Sanitation
*** SDG 11 - Sustainable Cities and Communities**
**** SDG 3 - Good Health and Well-being**
*****SDG 9– Industry Innovation and Infrastructure**
*****SDG 8 – Decent Work and Economic Growth**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Water Technology**	
1.1	Introduction – Commercial and Industrial uses of Water	1
1.2	Hardness - Types	1
1.3	Estimation of Hardness of Water by EDTA Method	1
1.4	Internal Conditioning (Colloidal, Phosphate, Calgon and Carbonate)	1
1.5	External Conditioning (Zeolite Process)	1
1.6	Demineralization Process	1
1.7	Desalination Methods (Reverse Osmosis)	1
1.8	Electro dialysis	1
1.9	Flash Evaporation	1
2.0	**Solutions**	
2.1	Normality, Molarity, Molality, Percentage Solution, Mole Fractions (Simple Numerical Problems).	1
2.2	Buffer Solutions – Types - Applications-	1
2.3	Henderson-Hasselbach Equation	1
2.4	Membrane Permeability - Principle of Diffusion & Osmosis - Donon Membrane Equilibrium	1
2.5	Definition of Osmotic Pressure, Isotonic, Hypotonic & Hypertonic Solutions.	1
2.6	Relationship of Osmotic Pressure to Gas Laws.	1
2.7	The General Equation for Dilute Solutions, The Influence of Ionization & Molecular Size on Osmotic Pressure.	1
2.8	Colloids - Definition and Types, Gold Number, Preparation and Properties of Colloids — Lyophilic and Lyophobic Sols.	1
2.9	Brownian Movements and Tyndall Effect - Emulsion & Emulsifying Agents.	1
3.0	**Chemical Kinetics and Catalysis**	
3.1	Rate of Reaction, Order and Molecularity	1
3.2	Derivation of First Order Rate Equation – Half-Life Period of First Order Reaction	1
3.3	Determination of Rate Constant of Hydrolysis of Ester	1
3.4	Factors Influencing Rate of Reaction. Activation Energy -Arrhenius Equation- Transition State Theory	1
3.5	Catalyst– Auto Catalyst- Enzyme Catalyst – Michaelis–Menten Equation and its Significance	1
3.6	Catalytic Promoters – Catalytic Poisons	1
3.7	Active Center, Homogeneous and Heterogeneous Catalysis	1
3.8	Reactivity – Coenzymes – Proton Transfer – Metal Ions – Intra Molecular Reactions	1
3.9	Covalent Catalysis – Inclusion Complexation - Industrial Application of Catalysts	1
4.0	**Electrochemistry**	
4.1	Electrode Potential - Nernst Equation - Derivation and Problems	2
4.2	Reversible and Irreversible Cells	1
4.3	Types of Electrodes and its Applications	1
4.4	Reference Electrodes - pH	1
4.5	Conductometric and Potentiometric Titrations	1
4.6	Principles of Electro Plating and Electro Less Plating	2
4.7	Fabrication Process of Printed Circuit Board	1
5.0	**Chemical Sensors**	
5.1	Sensors – Chemical Sensors - Characteristics	1
5.2	Elements and Characterization	1

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Approved in Academic Council Meeting held on 25/05/2024

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5.3	Potentiometric Sensors, Amperometric Sensors	1
5.4	Sensors Based on Electrochemical Methods	1
5.5	Electrochemical Biosensors	1
5.6	Optical Biosensors : Enzyme Sensors – Bio Affinity Sensors	1
5.7	DNA Sensors. Chemical Sensors as Detectors and Indicators	1
5.8	Indicators for Titration Processes	1
5.9	Separation Methods. Nano technology in Chemical Sensors	1

Course Designer(s)

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

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Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech- Biotechnology

60 MY 001 – Environmental Studies and Climate Change (Common to all branches)

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

Pollution and its Impact on Climate Change* Pollution: Sources and Impacts of Air Pollution – Greenhouse Effect- Global Warming- Climate Change - Ozone Layer Depletion - Acid Rain. Carbon Footprint - Climate Change on Various Sectors – Agriculture, Forestry and Ecosystem – Climate Change Mitigation and Adaptation. Action Plan on Climate Change. IPCC, UNFCCC, Kyoto Protocol, Montreal Protocol on Climatic Changes.	[6]
Integrated Waste Management** Waste - Types a nd Classification. Principles o f Waste Management (5R Approach) - Swachh Bharat Abhiyan — Commercial Waste, Plastic Waste, Domestic Waste, E-Waste - Biomedical Waste - RiskManagement: Collection, Segregation, Treatment and Disposal Methods. Waste Water Treatment- Activate Sludge Process.	[6]
Sustainable Development Practices*** Sustainable Development Goals (Sdgs) **–** Green Computing- Carbon Trading - Green Building – Eco- Friendly Plastic – Alternate Energy: Hydrogen – Bio-Fuels – Solar Energy – Wind – Hydroelectric Power. Water Scarcity- Watershed Management, Ground Water Recharge and Rainwater Harvesting.	[6]
Environment and Agriculture**** Organic Farming – Bio-Pesticides- Composting, Bio Composting, Vermi- Composting, Roof Gardening and Irrigation. Waste Land Reclamation. Climate Resilient Agriculture. Green Auditing	[6]
Geo-Science in Natural Resource Management Data Base Software in Environment Information- Digital Image Processing Applications in Forecasting. GPS - Remote Sensing and Geographical Information System (GIS) - World Wide Web (Www) - Environmental Information System (ENVIS).	[6]
Total Hours:	**30**

Text Book(s):

1.	Anubha Kaushik, C P Kaushik. Perspectives in Environmental Studies, New Age International publishers; 6th Edition (1 January 2018).

Reference(s):

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

***SDG: 13 – Climate Action**
****SDG: 4 – Clean Water and Sanitation**
§SDG: 6 - Affordable and Clean Energy
§§ SDG: 3 – Good Health and Well-being

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Pollution and its Impact on Climate Change**	
1.1	Pollution: Sources and Impacts of Air Pollution – Greenhouse Effect- Global Warming- Climate Change - Ozone Layer Depletion - Acid Rain	2
1.2	Climate Change on Various Sectors: Agriculture, Forestry and Ecosystem. – Climate Change Mitigation and Adaptation	1
1.3	Action Plan on Climate Change - IPCC, UNFCCC, Kyoto Protocol, Montreal Protocol on Climatic Changes	1
2.0	**Integrated Waste Management**	
2.1	Waste - Types and Classification. Principles of Waste Management (5R Approach) - Swachh Bharat Abhiyan	1

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Approved in Academic Council Meeting held on 25/05/2024

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2.2	Commercial Waste, Plastic Waste, Domestic Waste, E-Waste and Biomedical Waste	1
2.3	Risk Management: Collection, Segregation, Treatment and Disposal Methods.	1
2.4	Waste Water Treatment- Activate Sludge Process	1
3.0	**Sustainable Development Practices**	
3.1	Sustainable Development Goals (SDGS) **–** Green Computing- Carbon Trading - Green Building – Eco- Friendly Plastic	1
3.2	Alternate Energy: Hydrogen – Bio-Fuels – Solar Energy – Wind – Hydroelectric Power	2
3.3	Water Scarcity- Watershed Management, Ground Water Recharge and Rainwater Harvesting	1
4.0	**Environment and agriculture**	
4.1	Organic Farming – Bio-Pesticides	1
4.2	Composting, Bio Composting, Vermi-Composting	1
4.3	Roof Gardening and Irrigation	1
4.4	Waste Land Reclamation. Climate Resilient Agriculture, Green Auditing	1
5.0	**Geo-Science in Natural Resource Management**	
5.1	Data Base Software in Environment Information, Digital Image Processing Applications in Forecasting	2
5.2	GPS, Remote Sensing and Geographical Information System (GIS)	1
5.3	World Wide Web (WWW), Environmental Information System (ENVIS)	1

Course Designer(s)

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

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Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 GE 001	Heritage of Tamils (Common to all Branches)	Category	L	T	P	Credit
		GE	1	0	0	1^{β}

Objectives

- To learn the extensive literature of classical tamil
- To review the fine arts heritage of tamil culture
- To realize the contribution of tamils in indian freedom struggle

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Note: Those who studied Tamil as language subject in +2 should write the exams (Model and End Semester Exams) in Tamil Language only. Those who did not study Tamil as language subject in +2 and other state students can write the exams in English Language. It is mandatory.

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BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology - Autonomous R2022								
61 GE 001- Heritage of Tamils (Common to all Departments)								
Semester	Hours/W eek			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	1	0	0	15	1[β]	40	60	100

Language, Literature, Life Skills & Ethics* Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil — Secular Nature of Sangam Literature — Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan- Life, Responsibility, Self-exploration, Attitude, Self-confidence, Goals, Relationships, Leadership, Gender equality	[3]
Heritage - Rock Art Paintings to Modern Art – Sculpture* Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.	[3]
Folk and Martial Arts* Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.	[3]
Thinai Concept of Tamils* Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.	[3]
Contribution of Tamils to Indian National Movement and Indian Culture* Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India — Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine — Inscriptions & Manuscripts — Print History of Tamil Books.	[3]
Total Hours	15

Text Book(s) cum Reference Book(s)

1.	முனைவர் கே. கே. பிள்ளை, தமிழக வரலாறு - மக்களும் பண்பாடும், தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Ed ,2022.
2.	முனைவர் இல. சுந்தரம், கணினித்தமிழ்,விகடன் பிரசுரம், 2nd Ed 2021
3.	முனைவர் இரா.சிவானந்தம், மு.சேரன், கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு, 6th Ed ,2020.
4.	முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு,1st Ed ,2022
5.	ஈரோடு கதிர், உயர்தல் உரிமை, சிக்ஸ் ப்ளஸ் ஒன் ட்ரெயினிங் அகாடமி,1st Ed, 2024
6.	Dr.K.K.Pillay, Social Life of Tamils, TNTB & ESC and RMRL – (In print).
7.	Dr.S.Singaravel, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies, 1st, 2001.
8.	Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies, 2nd, 2010
9.	Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies,
10.	Dr.R.Sivanantham, Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
11.	Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu, K.K. Pillay(Published by the Author.
12.	Dr.R.Sivanantham, Dr.J.Baskar, Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation.
13	R.Balakrishnan, Journey of Civilization Indus to Vaigai, Roja Muthiah Research Library,3rd Ed, 2022

SDG 4 – Quality Education

For Heritage of Tamils, additional 1 credit is offered and not accounted for CGPA.

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 GE 001	தமிழர் மரபு (அனைத்து துறைகளும் பொதுவானது)	Category	L	T	P	Credit
		GE	1	0	0	1β

பாடத்தின் நோக்கங்கள்:

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

முன்கூட்டிய துறை சார் அறிவு

- தேவை இல்லை

பாடம் கற்றதின் விளைவுகள்

- பாடத்தை வெற்றிகரமாக கற்றுமுடித்த பின்பு, மாணவர்களால் முடியும் விளைவுகள்

CO1	தமிழ் மொழியின் செந்தண்மை மற்றும் இலக்கியம் குறித்தும் . வாழ்க்கைத் திறன்கள் **மற்றும்** நெறிமுறைகள் குறித்தும் தெரிதல்	செயல் படுத்துதல்
CO2	தமிழர்களின் சிற்பக்கலை, ஓவியக்கலை மற்றும் இசைக்கருவிகள் குறித்த தெளிவு.	புரிதல்
CO3	தமிழர்களின் நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்த தெளிவு.	புரிதல்
CO4	தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்கள்.	புரிதல்
CO5	இந்திய தேசிய இயக்கம், சுயமரியாதை இயக்கம் மற்றும் சித்த மருத்துவம் பற்றிய புரிதல்.	புரிதல்

Mapping with Programme Outcomes

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

Assessment Pattern

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

Note: Those who **studied Tamil as language subject in +2** should write the exams (Model & End Semester Exams) **in** Tamil Language only. Those who **did not study Tamil as language subject in +2** and

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Approved in Academic Council Meeting held on 25/05/2024

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other state students can write the exams in English Language. It is mandatory.

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

61 GE 001- தமிழர் மரபு (அனைத்து துறைகளும் பொதுவானது)

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	1	0	0	15	1^{β}	40	60	100

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

Text Book(s):

1.	முனைவர் கே. கே. பிள்ளை, தமிழக வரலாறு - மக்களும் பண்பாடும், தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Ed ,2022.
2.	முனைவர் இல. சுந்தரம், கணினித்தமிழ்,விகடன் பிரசுரம், 2nd Ed,2021
3.	முனைவர் இரா.சிவானந்தம், மு.சேரன், கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு, 6th Ed,2020.
4.	முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு,1st Ed ,2022

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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5.	ஈரோடு கதிர், உயர்தல் உரிமை, சிக்ஸ் ப்ளஸ் ஒன் ட்ரெயினிங் அகாடமி,1st Ed,2024
6.	Dr.K.K.Pillay, Social Life of Tamils, TNTB & ESC and RMRL – (In print).
7.	Dr.S.Singaravel, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies, 1st, 2001.
8.	Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies, 2nd, 2010
9.	Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies,
10.	Dr.R.Sivanantham, Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
11.	Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu, K.K. Pillay(Published by the Author.
12.	Dr.R.Sivanantham, Dr.J.Baskar, Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation.
13.	R.Balakrishnan, Journey of Civilization Indus to Vaigai, Roja Muthiah Research Library,3rd Ed ,2022

***SDG 4 – Quality Education**

β For Heritage of Tamils, additional 1 credit is offered and not accounted for CGPA.

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BOS- Chairman

60 PH 0P2	Applied Physics Laboratory (BT)	Category	L	T	P	Credit
		BS	0	0	4	2

Objectives

- To infer the practical knowledge by applying the experimental methods to correlate with the physics theory
- To demonstrate an ability to make physical measurements and understand the limits of precision in measurements
- To introduce different experiments to test basic understanding of physics concepts applied in optics and electronics
- To make ability to develop and fabricate engineering and technical equipment
- To analyze the behavior and characteristics of various materials for its optimum utilization

Pre-requisites

- NIL

Course Outcomes

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

CO1	Apply the concept of stress, strain and elastic limit for a given sample to find their properties	Apply
CO2	Recognize the concept of quantum Physics & magnetic properties by experimental verification	Apply
CO3	Infer the knowledge of properties of light and fiber optic cable	Apply
CO4	Realize the dielectric behavior of a given material	Apply
CO5	Apply the photovoltaic effect to demonstrate the working of solar cell	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 PH 0P2 – Applied Physics Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

List of Experiments:

1. Uniform Bending - Determination of Young's Modulus. *
2. Non-Uniform Bending - Determination of Young's Modulus.
3. Determination of Rigidity Modulus of a Wire by Torsional Pendulum.
4. Determination of Planck's Constant.
5. Determination of Stefan's Constant.
6. V-I Characteristics of Solar Cell.
7. A) Laser- Determination of the Wave Length of the Laser Using Grating.

   B) Optical Fibre -Determination of Numerical Aperture and Acceptance Angle.
8. Determination of Wavelength of Mercury Spectral Lines – Spectrometer Grating.
9. Magnetic Field along the Axis of Current Carrying Coil – Stewart and Gee.
10. Determination of Dielectric Constant.

Lab Manual	
1.	"Lab Manual Applied Physics Laboratory", Department of Physics, KSRCT.

***SDG 4 – Quality Education**

Course Designer(s)

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

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BOS- Chairman

60 CH 0P1	Applied Chemistry Laboratory (BT)	Category	L	T	P	Credit
		BS	0	0	4	2

Objectives

- To investigate the water quality parameters
- To develop experimental skills in determination of pH and emf
- To study the mobility of ions using conductivity meter
- To calculate the extent of adsorption using activated charcoal
- To study the kinetics of ester by hydrolysis

Pre-requisites

- NIL

Course Outcomes

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

CO1	Measure the hardness and dissolved oxygen in water sample	Apply
CO2	Determine the pH of acid and calculate the amount of ferrous ion	Apply
CO3	Calculate the amount acids in the mixture	Apply
CO4	Identify the rate of adsorption by activated charcoal	Apply
CO5	Determine the rate constant by ester hydrolysis.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 CH 0P1 – Applied Chemistry Laboratory (BT)								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

List of Experiments:

1. Estimation of Hardness of Water Sample by Complexometric Method.
2. Determination of Dissolved Oxygen in Water Sample by Winkler's Method.
3. Estimation of HCL by pH Meter.
4. Estimation of Mixture of Acids by Conductivity Meter.
5. Determination of Ferrous Ion by Potentiometric Titration.
6. Determination of Rate Constant of Ester Catalyzed by an Acid.
7. Adsorption of Acetic Acid by Charcoal.

Lab Manual

1.	https://www.sciencebuddies.org/blog/teach-chemical-reactions

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

*** SDG 6 – Improve Clean Water and Sanitation**

*** SDG 12 - Responsible Consumption and Production**

****SDG 13- Climate Action**

*****SDG 14- Life Below Water**

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215
(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted in 2024-2025)

SECOND SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 EN 002	Professional English-II	2	40	60	100	45	100
2	60 MA 003	Integrals, Partial Differential Equations and Laplace Transform	2	40	60	100	45	100
3	60 CS 001	C Programming	2	40	60	100	45	100
4	60 ME 002	Engineering Graphics	2	40	60	100	45	100
5	60 ME 004	Engineering Mechanics	2	40	60	100	45	100
6	60 GE 002	Tamils and Technology \ தமிழரும் தொழிலநுட்பமும்	2	40	60	100	45	100
PRACTICAL								
7	61ME 0P1	Fabrication and Reverse Engineering Laboratory	3	60	40	100	45	100
8	60 CS 0P1	C Programming Laboratory	3	60	40	100	45	100
9	60 CG 0P1	Career Skill Development I	1	100	00	100	00	100

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

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

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

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

Objectives

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

Pre-requisites

- Basic Knowledge of Reading and Writing in English and should have Completed Professional English I

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 EN 002 - Professional English II

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

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

Text Book(s):

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

Reference(s):

1.	Raman. Meenakshi, Sharma. Sangeeta, 'Professional English'. Oxford university press. New Delhi. 2019.
2.	Arthur Brookes and Peter Grundy,' Beginning to Write: Writing Activities for Elementary and Intermediate Learners', Cambridge University Press, New York, 2003
3.	Prof. R.C. Sharma & Krishna Mohan, 'Business Correspondence and Report Writing', Tata McGraw Hill & Co. Ltd., New Delhi, 2001

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4.	Arora and Laxmi Chandra V.N., 'Improve Your Writing', Oxford University Press, New Delhi, 2001

***SDG- 04- Quality Education**

Course Contents and Lecture Schedule

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

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Approved in Academic Council Meeting held on 25/05/2024

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5.7	Numerical Adjectives and Relative Clause - Idioms	1
5.8	Question Types: Wh/ Yes or No/ and Tags	1

Course Designer(s)

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

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BOS- Chairman

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

Objectives

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

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 MA 003 – Integrals, Partial Differential Equations and Laplace Transform (Common to MECH, ECE, EEE, CSE, MCT, CIVIL, IT, TXT, BT, FT)

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

Multiple Integrals Double Integration - Cartesian and Polar Co-Ordinates - Change of Order of Integration - Area as Double Integral - Triple Integration in Cartesian Co-Ordinates - Change of Variables - Cartesian to Polar Co-Ordinates and Cartesian to Cylindrical Co-Ordinates. **Hands - on:** Evaluating double integrals, triple integrals, area as double integrals and volume as triple integrals.	[9]
Vector Calculus* Introduction - Gradient of a Scalar Point Function - Directional Derivative - Angle of Intersection of Two Surfaces - Divergence and Curl (Excluding Vector Identities) – Solenoidal and Irrotational Vectors — Application : Green's Theorem in the Plane - Gauss Divergence Theorem -Stokes' Theorem (Statement Only) . **Hands - on:** Evaluating Gradient, divergence and curls.	[9]
Analytic Functions and Integrals Analytic Function – Necessary and Sufficient Conditions (Statement Only)- Properties — Harmonic Function — Construction of an Analytic Function — Cauchy's Integral Theorem (Statement Only) – Cauchy's Integral Formula – Classification of Singularities – Application: Cauchy's Residue Theorem. **Hands - on:** Plotting and visualizing functions of single variable, two and three variables.	[9]
Partial Differential Equations* Formation of Partial Differential Equations by Eliminating Arbitrary Constants and Arbitrary Functions -Non-Linear Partial Differential Equations of First Order - agrange's Linear Equations - Application: Homogeneous Linear Partial Differential Equations with Constant Coefficients. **Hands - on:** Calculate homogeneous linear partial differential equations.	[9]
Laplace Transform Conditions for Existence – Transforms of Elementary Functions – Basic Properties - Derivatives and Integrals of Transforms - Initial and Final Value Theorem – Transform of Periodic Functions. Inverse Laplace Transform – Convolution Theorem (Excluding Proof) — Application: Solution of Second Order Ordinary Differential Equations with Constant Co- Efficients. **Hands - on:** Evaluating laplace, Inverse laplace transforms and solve differential equations.	[9]
Total Hours: 45 + 5(Hands on) + 10(Tutorial)	**60**

Text Book(s):

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

Reference(s):

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

***SDG- 04- Quality Education**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Course Contents and Lecture Schedule

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

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5.7	Inverse Laplace Transform	1
5.8	Convolution Theorem (Excluding Proof)	1
5.9	Application: Solution of Second Order Ordinary Differential Equation with Constant Co-Efficient	2
5.10	Tutorial	2
5.11	Hands on	1

Course Designer(s)

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

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Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

- To learn most fundamental element of the c language and to examine the execution of branching, looping statements,
- To examine the concepts of arrays, its characteristics and types and strings
- To understand the concept of functions, pointers and the techniques of putting them to use
- functions
- To apply the knowledge of structures and unions to solve basic problems in c language
- To enhance the Knowledge in File Handling Functions for Storage and Retrieval of Data

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 CS 001– C Programming (Common to CSE, CSBS, AI&ML, IT, AI&DS)

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

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

Text Book(s):

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

Reference(s):

1. Balagurusamy E., "Programming in ANSI C", 7th Edition, Tata McGraw Hill Edition, NewDelhi, 2016.
2. Brian W. Kernighan and Dennis M. Ritchie, "C Programming Language", Prentice-Hall.
3. ReemaThareja, "Computer Fundamentals and Programming in C", 2nd Edition, OxfordHigher Education, 2016.
4. King K N, "C Programming: A Modern Approach", 2nd Edition, W.W.Norton, New York,2008.

***SDG 4- Quality Education**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basics of C, I/O, Branching and Loops**	
1.1	Structure of A C Program, Keywords	1
1.2	Data Types, Type Qualifiers	1
1.3	Variables and Constants	1
1.4	Operators–Expressions and Precedence	1
1.5	Console I/O– Unformatted and Formatted Console I/O	1
1.6	Conditional Branching	1
1.7	Iteration and Loops	2
1.8	Writing and Evaluation of Conditionals and Consequent Branching	1

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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2.0	**Arrays and Strings**	
2.1	One Dimensional Array	1
2.2	Two-Dimensional Array and Matrix Manipulation	1
2.3	Character Arrays and Strings Basics	1
2.4	String Manipulation without String Handling Functions	2
2.5	String Manipulation with String Handling Functions	2
3.0	**Functions and Pointers**	
3.1	Scope of a Function – Library Functions, User Defined Functions and Function Prototypes	1
3.2	Function Call by Value and Function Call by Reference, Function Categorization	2
3.3	Arguments to Main Function	1
3.4	Recursion and Application	1
3.5	Passing Arrays to Functions	1
3.6	Storage Class Specifiers	1
3.7	Introduction to Pointer Variables - The Pointer Operators - Pointer Expressions	1
3.8	Pointers and Arrays - Generating a Pointer to an Array -Indexing Pointers	1
3.9	Function and Pointers	1
3.10	Dynamic Memory Allocation	1
4.0	**Structures, Unions, Enumerations, Type def and Preprocessors**	
4.1	Introduction to Structures and Initialization	1
4.2	Arrays and Structures, Arrays of Structures	1
4.3	Structures Within Structures, Passing Structures to Functions	2
4.4	Structure Pointers	1
4.5	Unions and Bit Fields.	1
4.6	Enumerations – Typedef	1
4.7	Preprocessor Commands	2
5.0	**File Handling**	
5.1	File Streams –Reading and Writing Characters - Reading andWriting Strings	2
5.2	File System Functions and File Manipulation	2
5.3	Sequential Access	2
5.4	Random Access Files	2
5.5	Command Line Arguments and Files	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 ME 002- Engineering Graphics

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	2	0	4	90	4	40	60	100

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

Text Book(s):

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

Reference(s):

1. Shah M.B., Rana B.C., and V.K.Jadon., —Engineering Drawing‖, Pearson Education, 2011.
2. Natarajan K.V., A Text Book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2014.
3. Basant Agarwal and C.M.Agarwal., "Engineering Drawing", McGraw Hill Education, 2013.
4. Dhawan R.K., "A Text Book of Engineering Drawing" 3rd Revised Edition, S. Chand Publishing, New Delhi, 2012.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Computer Aided Drafting (CAD) software**	
1.1	Theory of CAD Software	1
1.2	Menu System, Tool bars (Standard, Object Properties, Draw, Modify and Dimension)	4
1.3	Drawing Area (Background, Crosshairs, Coordinate System)	4
1.4	Dialog Boxes and Windows – Shortcut Menus	4
1.5	The Command Line and Status Bar	1
1.6	Different methods of Zoom – Select and Erase objects.	4

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

2.0	**Orthographic Projection**

2.1	Introduction to Orthographic Projections	2
2.2	Planes of Projection,	2
2.3	Projection of Points	2
2.4	Projection of Lines Inclined to Both Planes.	2
2.5	Projection of Planes	2
2.6	Projection of Planes Inclined to Both Planes	2
2.7	Conversions of Pictorial Views to Orthographic Views.	2
2.8	Practice Class for Pictorial Views to Orthographic Views.	2
2.9	Practice Class for Pictorial Views to Orthographic Views.	2
3.0	**Projection of Solids, Sections of solids and Development of surfaces**	
3.1	Projections of Simple Solids: Prism	1
3.2	Projections of Simple Solids: Cylinder	1
3.3	Projections of Simple Solids: Pyramid	1
3.4	Projections of Simple Solids: Cone	1
3.5	Practice Class for Projection of Solids	1
3.6	Axis of Solid Inclined to Both HP and VP	2
3.7	Section of Solids for Prism,	1
3.8	Section of Solids for Cylinder,	1
3.9	Section of Solids for Pyramid,	1
3.10	Section of Solids for Cone	1
3.11	Auxiliary Views - Draw the Sectional Orthographic Views of Geometrical Solids.	2
3.12	Draw the Sectional Orthographic Views of Objects fromlindustry.	1
3.13	Development of Surfaces of Right Solids Prism,	1
3.14	Development of Surfaces of Right Solids Pyramid	1
3.15	Development of Surfaces of Right Solids Cylinder and Cone	2
4.0	**Isometric Projection**	
4.1	Principles of Isometric Projection	2
4.2	Isometric Scale	2
4.3	Isometric Projections of Simple Solids: Prism,	2
4.4	Isometric Projections of Simple Solids: Pyramid,	2
4.5	Isometric Projections of Simple Solids: Cylinder	2
4.6	Isometric Projections of Simple solids: Cone	2
4.7	Isometric Projections of Frustum	2
4.8	Isometric Projections of Truncated Solids	2
4.9	Combination of Two Solid Objects in Simple Vertical Positions.	2
5.0	**Application of Engineering Graphics**	
5.1	Geometry and Topology of Engineered Components:	2
5.2	Creation of Engineering Models and their Presentation in Standard 2D Blueprint Form,	2
5.3	3D Wire-Frame and Shaded Solids – Geometric Dimensioning and Tolerance – Use of Solid Modeling Software for Creating Associative Models	4
5.4	Floor Plans: Windows, Doors, and Fixtures Such as Water Closet (WC), Bath Sink, Shower, Etc.	2
5.5	Applying Colour Coding According to Building Drawing Practice	2
5.6	Drawing Sectional Elevation Showing Foundation to Ceiling	4
5.7	Introduction t o Building Information Modelling (BIM).	2

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 ME 004	Engineering Mechanics	Category	L	T	P	Credit
		ES	3	1	0	4

Objectives

- 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 learn the principle of frictional forces at the contact surfaces and impart basic concept of dynamics of particles
- To acquire the concept of elements of rigid body dynamics

Pre-requisites

- NIL

Course Outcomes

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

CO1	Use scalar and vector analytical techniques for analysing forces in statically determinate structures	Apply
CO2	Apply basic knowledge of scientific concepts to solve real-world problems.	Apply
CO3	Calculate the properties of surfaces and solids using various theorems.	Apply
CO4	Determine the effect of frictional forces and the dynamic forces exerted in the particle.	Apply
CO5	Analysis of rigid body dynamics and calculation af member forces an the rigid body.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 ME 004- Engineering Mechanics

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

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.	[9+3]
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.	[9+3]
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.	[9+3]
Friction * Frictional Force–Laws of Coloumb Friction–Simple Contact Friction–Ladder Friction-Rolling Resistance–Ratio of Tension in Belt. **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.	[9+3]
Elements of Rigid Body Dynamics * Translation and Rotation of Rigid Bodies: Velocity and Acceleration–General PlaneMotion: Crank and Connecting Rod Mechanism.	[9+3]
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.
	James M., Gere and Timoshenko, "Mechanics of Materials", CBS Publisher, New Delhi, 6th Edition, 2012

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basics and Statics of Particles**	
1.1	Introduction, Units and Dimensions, Laws of Mechanics	1
1.2	Principle of Transmissibility, Lame's Theorem,	1
1.3	Parallelogram and Triangular Law of Forces	1
1.4	Tutorial	2
1.5	Vectors, Vectorial Representation of Forces and Moments	1

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1.6	Vector Operations, Coplanar Forces–Resolution and Composition of Forces	2

1.7	Equilibrium of a Particle, Forces in Space	1
1.8	Equivalent Systems of Forces-Single Equivalent Force.	1
1.9	Tutorial	2
2.0	**Equilibrium of Rigid Bodies**	
2.1	Free Body Diagram, Types of Supports and their Reactions	1
2.2	Requirements of Stable Equilibrium, Static Determinacy	1
2.3	Lighting System: Function and Layout	1
2.4	Vehicle Pollutants and its Effect	1
2.3	Moments and Couples–Moment of a Force About a Point and About an Axis	2
2.4	Vectorial Representation of Moments and Couples	1
2.5	Tutorial	2
2.6	Varignon's Theorem	1
2.7	Equilibrium of Rigid Bodies in Two Dimensions	2
2.8	Tutorial	2
3.0	**Properties of Surfaces and Solids**	
3.1	Determination of Areas and Volumes-Centroid	1
3.2	Moment of Inertia of Plane Area (Rectangle, Circle, Triangle using Integration Method	2
3.3	Tutorial	2
3.4	Moment of Inertia of Plane Area (T Section, I Section, Angle Section)	1
3.5	Moment of Inertia of Plane Area (Hollow Section)	1
3.6	Parallel Axis Theorem and Perpendicular Axis Theorem	1
3.7	Polar Moment of Inertia	1
3.8	Mass Moment of Inertia of Thin Rectangular Section.	1
3.9	Tutorial	2
4.0	**Friction & Dynamics of Particles**	
4.1	Frictional Force, Laws of Coloumb Friction, Simple Contact Friction	1
4.2	Ladder Friction	1
4.3	Rolling Resistance–Ratio of Tension in Belt	1
4.4	Tutorial	2
4.5	Displacement, Velocity, Acceleration and their Relationship, Relative Motion	1
4.6	Projectile Motion in Horizontal Plane	1
4.7	Newton's Law	1
4.8	Work Energy Equation	1
4.9	Impulse and Momentum	1
4.10	Tutorial	2
5.0	**Elements of Rigid Body Dynamics**	
5.1	Translation and Rotation of Rigid Bodies	1
5.2	Translation and Rotation of Rigid Bodies - Velocity	2
5.3	Translation and Rotation of Rigid Bodies - Acceleration	2
5.4	Tutorial	2
5.5	General Plane Motion	1
5.6	General Plane Motion - Crank and Connecting Rod Mechanism	2
5.7	Tutorial	2

Course Designer(s)

1. Mr.S.Karthick- skarthick@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

- To learn weaving, ceramic and construction technology of tamils
- To understand the agriculture, irrigation and manufacturing technology of tamils
- To realize the development of scientific tamil and tamil computing

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	End Semester Examination (Marks)
Remember	40	40
Understand	40	40
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 GE 002 – Tamils and Technology
(Common to all Branches)

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	1	0	0	15	1$	40	60	100

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

Text Book(s):

1.	முனைவர் கே. கே. பிள்ளை, தமிழக வரலாறு - மக்களும் பண்பாடும், தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Ed, 2022.
2.	முனைவர் இல. சுந்தரம், கணினித்தமிழ்,விகடன் பிரசுரம், 2nd Ed, 2021
3.	முனைவர் இரா.சிவானந்தம், மு.சேரன், கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு, 6th Ed 2020.
4.	முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு,1st Ed, 2022
5.	Dr.K.K.Pillay, Social Life of Tamils, TNTB & ESC and RMRL – (In print).
6.	Dr.S.Singaravel, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies, 1st Ed, 2001.
7.	Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies, 2nd, 2010
8.	Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies,
9.	Dr.R.Sivanantham, Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
10.	Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu, K.K. Pillay(Published by the Author.
11.	Dr.R.Sivanantham, Dr.J.Baskar, Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation.
12.	R.Balakrishnan, Journey of Civilization Indus to Vaigai, Roja Muthiah Research Library,3rd Ed 2022

***SDG:4- Quality Education**

$For Tamils and Technology, additional 1 credit is offered and not accounted for CGPA.

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 GE 002	தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளும் பொதுவானது)	Category	L	T	P	Credit
		GE	1	0	0	1$

பாடத்தின் நோக்கங்கள்:

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

முன்கூட்டிய துறை சார் அறிவு

- தேவை இல்லை

பாடம் கற்றதின் விளைவுகள்

பாடத்தை வெற்றிகரமாக கற்று முடித்த பின்பு, மாணவர்களால் முடியும் விளைவுகள்

CO1	சங்ககாலத் தமிழர்களின் நெசவு மற்றும் பானை வனைதல் தொழில்நுட்பம் குறித்த கற்றுணர்தல்.	புரிதல்
CO2	சங்ககாலத் தமிழர்களின் கட்டிட தொழில்நுட்பம் கட்டுமானப் பொருட்கள் மற்றும் அவற்றை விளக்கும் தளங்கள் குறித்த அறிவு.	புரிதல்
CO3	சங்ககாலத் தமிழர்களின் உலோகத் தொழில் நாணயங்கள் மற்றும் மணிகள் சார்ந்த தொல்லியல் சான்றுகள் பற்றிய அறிவு.	புரிதல்
CO4	சங்ககாலத் தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள் மற்றும் முத்து குளித்தல் குறித்த தெளிவு.	புரிதல்
CO5	நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிந்துகொள்ளலும் மற்றும் பயன்படுத்துதலும்.	செயல்படுத்துதல்

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Note: Those who **studied Tamil as language subject in +2** should write the exams (Model & End Semester Exams) **in** Tamil Languag**e** only. Those who **did not study Tamil as language subject in +2** and **other state students** can write the exams in English Language. It is mandatory.

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 GE 002- தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளும் பொதுவானது)

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	1	0	0	15	1$	40	60	100

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

Text Book(s):

1.	முனைவர் கே. கே. பிள்ளை, தமிழக வரலாறு - மக்களும் பண்பாடும், தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Ed, 2022.
2.	முனைவர் இல. சுந்தரம், கணினித்தமிழ்,விகடன் பிரசுரம், 2nd Ed 2021
3.	முனைவர் இரா.சிவானந்தம், மு.சேரன், கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு, 6th Ed 2020.
4.	முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு,1st Ed 2022
5.	Dr.K.K.Pillay, Social Life of Tamils, TNTB & ESC and RMRL – (In print).
6.	Dr.S.Singaravel, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies, 1st Edition, 2001.
7.	Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies, 2nd Edition, 2010
8.	Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies,
9.	Dr.R.Sivanantham, Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
10	Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu, K.K. Pillay(Published by the Author.

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

11.	Dr.R.Sivanantham, Dr.J.Baskar, Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation.
12	R.Balakrishnan, Journey of Civilization Indus to Vaigai, Roja Muthiah Research Library,3rd Edition 2022

***SDG:4- Quality Education**

$For Tamils and Technology, additional 1 credit is offered and not accounted for CGPA.

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 ME 0P1	Fabrication and Reverse Engineering Laboratory (Common to All branches)	Category	L	T	P	Credit
		ES	0	0	4	2

Objectives

- To provide hands-on training on Carpentry, Sheet metal, Fitting and Welding.
- To offer real time activity on plumbing connections and power tools in domestic applications.
- To provide hands-on training on CNC Wood Router and 3D Printing
- To provide hands-on training on household wiring and dismantling and assembling the home appliances.
- To offer real time activity on embedded programming using Arduino

Pre-requisites

-Nil-

Course Outcomes

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

CO1	Make a wooden model using carpentry, Sheet metal Process.	Apply
CO2	Mate a model using filing and joining using MS Plate and repair & maintenances of water lines, power tools for home applications.	Apply
CO3	Cultivate the skills necessary for developing innovative and desirable products, including the ability to integrate user needs, market trends and technological advancement into the design process.	Apply
CO4	Trouble shoot the electrical and electronic circuits, electrical appliances and facilitate the house wiring.	Apply
CO5	Acquire practical knowledge on embedded programming using Arduino.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

(Common to All branches)

61 ME 0P1 – Fabrication and Reverse Engineering Laboratory

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

List of Experiments:

1. Making of Metal Model and Carpentry Process

a) Making of Tray using Sheet Metal Process

b) Making of T / Cross Joint using Carpentry Process.

2. Mating of Square Joint using the Filling Process

3. Fabrication of Welded model

4. Repair and Maintenance of Pipe Fitting for Home Applications

a) Assembly of GI pipes/PVC, Pipe Fitting and Cutting of Threads in GI pipes.

b) Fitting of Pipe with Clamps using Power Tools

5. Making of Model using CNC Wood Router

a) 2D profile cutting on plywood/MDF (6-12 mm) for press fit design

b) Machining of 3D geometry on soft material such as softwood

6. 3D Printing of scanned geometry using FDM or SLA Printer.

7. Dismantling and Assembling of

a) Iron Box

b) Mixer Grinder

c) Ceiling Fan

d) Table Fan

e) Water Heater

f) Induction Stove

8. Design and Execution of Residential house wiring with UPS.

a) 1 BHK

b) 2 BHK

9. Design and fabrication of domestic LED lamps

a) Schematic and PCB layout design of the given circuit and fabrication and testing of the same.

b) Soldering

10. Embedded programming using Arduino

Lab Manual

1.	"Fabrication and Reverse Engineering Laboratory Manual", Department of Mechanical Engineering, KSRCT.

*SDG 9 – Industry Innovation and Infrastructure

Course Designer(s)

1. Mr.S Sakthivel - sakthivel_s@ksrct.ac.in
2. Dr.G.Vijayagowri – vijayagowri@ksrct.ac.in
3. Mr. K.Raguvaran – raguvaran@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 CS 0P1 – C Programming Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

List of Experiments:

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

1.	"C Programming Lab Manual", Department of CSE, KSRCT.

*** SDG:4- Quality Education**

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- Basic knowledge of reading and writing in English

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

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

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

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

*** SDG- 04- Quality Education**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Listening**	
1.1	Listening for General Information and Specific Details	1
1.2	Listening to Podcasts, Documentaries and Interviews with Celebrities	1
1.3	Narrating Personal Experiences	1
1.4	Reading Relevant to Technical Contexts and Emails	1
1.5	Listen to a Product and Process Descriptions	1
2.0	**Speaking**	
2.1	Self-Introduction	1
2.2	Summarizing of Documentaries & Picture Narration	1

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2.3	Small Talk; Mini Presentations	1
2.4	Group Discussions, Debates & Role Plays.	1
2.5	Group Discussions	1
3.0	**Reading**	
3.1	Loud Reading Vs Silent Reading, Skimming & Scanning of Passages	1
3.2	Reading Social Media Messages Relevant to Technical Contexts	1
3.3	Reading Newspaper Reports and Travel & Technical Blogs	1
3.4	Reading Advertisements, Gadget Reviews and User Manuals	1
3.5	Reading Newspaper Articles and Journal Reports	1
4.0	**Writing**	
4.1	Writing Letters – Informal and Formal	1
4.2	Paragraph Texting	1
4.3	Definitions and Instructions	1
4.4	Note-Making / Note-Taking	1
4.5	Essay Texting	1
5.0	**Verbal Ability**	
5.1	Reading Comprehension (Mcqs) and Cloze Test	1
5.2	Sequencing of Sentences	1
5.3	Paraphrasing and Summarizing	1
5.4	Error Detection and Spelling Test	1
5.5	Prepositions	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted in 2024-2025)

THIRD SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 MA 012	Fourier Transform and Numerical Methods	2	40	60	100	45	100
2	61 BT 301	Biochemistry	2	40	60	100	45	100
3	61 BT 302	Microbiology	2	40	60	100	45	100
4	60 BT 303	Cell Biology and Genetics	2	40	60	100	45	100
5	60 BT 304	Principles of Chemical Engineering	2	40	60	100	45	100
6	60 BT 305	Molecular Biology	2	40	60	100	45	100
PRACTICAL								
7	61 BT 3P1	Biochemistry Laboratory	3	60	40	100	45	100
8	61 BT 3P2	Microbiology Laboratory	3	60	40	100	45	100
9	60 CG 0P2	Career Skill Development – II	1	100	-	100	-	100
10	60 CG 0P6	Internship	-	100	-	100	-	100

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

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 MA 012	Fourier Transform and Numerical Methods	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To provide exposure and ability to use fourier series
- To familiarize the basic concepts of fourier transform
- To get exposed to various techniques to solve equations numerically
- To know the concepts of interpolation and numerical integration
- To learn the basics concepts of initial value problems

Pre-requisites

- NIL

Course Outcomes

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

CO1	Obtain the fourier series expansion for the periodic functions.	Apply
CO2	Apply fourier transform techniques for the continuousfunctions.	Apply
CO3	Employ various iteration techniques for solving algebraic, transcendental and system of linear equations.	Apply
CO4	Apply different techniques to find the intermediate values and to evaluate single definite integrals.	Apply
CO5	Compute the solution for initial value problems using single and Multi-step methods	Apply

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 MA 012 – Fourier Transform and Numerical Methods
(Common to Biotechnology and Food Technology)

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

Fourier Series* Dirichlet's Conditions - Fourier Series - Odd and Even Functions - Half Range Fourier Series - RootMean Square Value of a Function - Parseval's Identity - Harmonic Analysis. **Hands-on:** Generate the Fourier Series of the Function in (- π, π), Plot and Visualize	[9]
Fourier Transform* Fourier Transform Pair - Fourier Transform of Simple Functions - Fourier Sine and Cosine Transform -Properties - Convolution Theorem - Parseval's Identity. **Hands-on:** Compute The Fourier Transform of the Function, Plot and Visualize	[9]
Solution of Equations and Eigen Value Problem* Algebraic and Transcendental Equations - Newton Raphson Method – Horner's Method – Gauss Elimination Method – Gauss Jordan Method – Iterative Methods: Gauss Jacobi Method – Gauss Seidel Method – Eigen Value of a Matrix by Power Method. **Hands-on:** Determine the Solution of Non-Linear Equations using Iteration Methods	[9]
Interpolation and Numerical Integration* Lagrange's and Newton's Divided Difference Interpolations (Unequal Intervals) - Newton's Forward and Backward Interpolation (Equal Intervals)* - Two Point and Three Point Gaussian Quadrature — Trapezoidal, Simpson's 1/3 And 3/8 Rule (Single Integral). **Hands-on:** Compute Newton's Forward and Backward Interpolation Method	[9]
Numerical Solution of Ordinary Differential Equations* Single Step Methods: Taylor's Series Method - Euler's Method - Modified Euler's Method - Fourth order Runge-Kutta Method for Solving First Order Equations - Multi Step Methods: Milne's Predictor and Corrector Method - Adam's Predictor and Corrector Method. **Hands-on:** Determine the Solution of First Order ODE using Fourth Order Runge-Kutta Method	[9]
Total Hours: 45 + 5 (Hands-on) + 10 (Tutorial)	**60**

Text Book(s):

1. Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2018.
2. Faires J D and Burden R L, "Numerical Methods", Thomson publications, 4th Edition, New Delhi,2012.

Reference(s):

1. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons (Asia) Limited,New Delhi, Reprint 2012.
2. Grewal B.S and Grewal J.S, "Numerical Methods in Engineering and Science", 10th Edition, KhannaPublishers, New Delhi, 2012.
3. Veerarajan T, "Transforms and Partial Differential Equations", 3rd Edition, Tata McGraw-Hill PublishingCompany Ltd, New Delhi, 2016.
4. Kandasamy P, Thilagavathy K and Gunavathi K, "Numerical Methods", 3rd Edition, Sultan Chand &Sons, New Delhi, 2010.

***SDG 4 – Quality Education**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Fourier Series**	
1.1	Dirichlet's Conditions	1
1.2	Fourier Series - Even Functions	2
1.3	Fourier Series - Odd Functions	1
1.4	Half Range Fourier Series	1

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1.5	Root Mean Square Value of a Function	1

1.6	Parseval's Identity	1
1.7	Harmonic Analysis	2
1.8	Tutorial	2
1.9	Hands-on	1
2.0	**Fourier Transform**	
2.1	Fourier Transform Pair	1
2.2	Fourier Transform of Simple Functions	1
2.3	Fourier Sine Transform	1
2.4	Fourier Cosine Transform	1
2.5	Properties of Fourier Transform	1
2.6	Convolution Theorem	2
2.7	Parseval's Identity	2
2.8	Tutorial	2
2.9	Hands-on	1
3.0	**Solution of Equations and Eigen Value Problem**	
3.1	Newton-Raphson Method	2
3.2	Horner's Method	1
3.3	Gaussian Elimination Method	1
3.4	Gauss-Jordan Method	1
3.5	Gauss-Jacobi Method	1
3.6	Gauss-Seidel Method	2
3.7	Eigen Value of a Matrix by Power Method	2
3.8	Tutorial	2
3.9	Hands-on	1
4.0	**Interpolation and Numerical Integration**	
4.1	Lagrange's Divided Difference Interpolation	2
4.2	Newton's Divided Difference Interpolation	1
4.3	Newton's Forward and Backward Interpolations	2
4.4	Two and Three Point Gaussian Quadrature	2
4.5	Trapezoidal and Simpson's 1/3 and 3/8 Rules	2
4.6	Tutorial	2
4.7	Hands-on	1
5.0	**Numerical Solution of Ordinary Differential Equations**	
5.1	Taylor series method	2
5.2	Euler's method	1
5.3	Modified Euler's method	1
5.4	Runge-Kutta method	2
5.5	Milne's predictor and corrector method	2
5.6	Adam's predictor and corrector method	1
5.7	Tutorial	2
5.8	Hands-on	1

Course Designer(s)

1. Mr.G.Mohan - mohang@ksrct.ac.in
2. Ms.K.Geetha - geethak@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT 301	Biochemistry	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To learn the basic chemical structure and biological functions of biomolecules
- To impart knowledge on role of biomolecules for orderly structures of the cells/tissues
- To illuminate the metabolism of essential biomolecules that are indispensable for life
- To dissipate the knowledge on formations of specialized products from biomolecules
- To learn the principles of bioenergetics and redox reactions of the cell

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Identify the structure of carbohydrates and understand their classification, synthesis, essential chemical characteristics that make them indispensable for life.	Apply
CO2	Explore the structure, classification, biological functions of lipids and their metabolism	Apply
CO3	Organize the structure and classification of amino acids, proteins, vitamins andits vital functions in the human body.	Apply
CO4	Experiment with the metabolism of the essential building blocks of life and its conversion to specialized products.	Apply
CO5	Examine the purpose of electron transport chain and how cellular ATP:ADP ratio regulates the rare of ATP production by oxidative phosphorylation	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

61 BT 301 - Biochemistry

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

Carbohydrates* Carbohydrates: Basic Chemical Structure, Classification - Monosaccharide, Disaccharides, Polysaccharides, Structure and Function - Anaerobic Pathway of Glucose Metabolism: Glycolysis - Aerobic Pathway of Glucose Metabolism: Citric Acid Cycle - Alternate Pathways of Carbohydrate Metabolism: Pentose Phosphate Pathway. Synthesis of Carbohydrates from Various Sources: Gluconeogenesis.	[9]
Lipids* Lipids: Structure, Function of Fatty Acids and Lipids. Classification, Major Lipid Subclasses - Phospholipids, Glycolipids, Sphingolipids and Steroids - Lipoproteins: Types and Functions - Lipid Metabolism: Biosynthesis of Fatty Acid, Oxidation of Fatty acids - Beta Oxidation, Other Types of Fatty Acid Oxidation - Alpha and Omega Oxidation.	[9]
Proteins and Vitamins* Amino Acids: Structure and Classification. Proteins: Structure and Classification: Primary, Secondary, Tertiary and Quaternary Structure. Properties - Denaturation and Renaturation. Oxidative Degradation of Amino Acids: Transamination, Oxidative Deamination, Decarboxylation, Biosynthesis of Urea, Conversion of Amino Acids in to Specialized Products: Dopa, Dopamine, Epinephrine and Norepinephrine. **Vitamins:** Vitamin C, Vitamin B12, Vitamin D, Vitamin E, deficiency diseases.	[9]
Nucleic Acids* Nucleic Acids: Nitrogenous Bases, Nucleosides, Nucleotides,Structure of DNA and RNA - Biosynthesis of Purine and Pyrimidine Nucleotides: Denovo and Salvage Pathway - Purine and Pyrimidine Degradation - Clinical significance – gout, Lesch-Nyhan syndrome	[9]
Bioenergetics* Biological oxidation and Redox Reaction, Mitochondrial Electron Transport Chain: Electron Carriers, Sites of ATP Production, Inhibitors of Electron Transport Chain. Oxidative Phosphorylation: Structure of ATPase Complex, Chemiosmotic Theory, Uncouplers and Inhibitors of Oxidative Phosphorylation	[9]
Total Hours:	**45**

Text Book(s):

1. Lehninger, "Principles of Biochemistry", David L. Nelson and Michael M. Cox. Palgrave Macmillan, Freeman, Low Price Edition, 8th Edition, 2021.
2. Harpers "Illustrated Biochemistry" , Victor Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil McGraw Hill Lange, International Edition, 32th Edition, 2023.
3. Jain J.L; Sunjay Jain and Nithin Jain ,"Fundamentals of Biochemistry" S Chand & Company Pvt. Ltd. 7th Edition, 2022.

Reference(s):

1. Koolman J. and Roehm K.H. " Color Atlas of Biochemistry", Georg Thieme Verlag publishers, 2nd Edition, 2005.
2. Berg Jeremy M.; John L. Tymoczko; Lubert Stryer, "Biochemistry", W. H. Freeman and Co., NewYork, USA, 7th Edition, 2010.
3. Voet Donald and Judy G Voet, "Biochemistry", 4th Edition, John Wiley & Sons Inc., 2012.
4. Denise R. Ferrier, "Biochemistry-Lippincott Illustrated Reviews Series" 7th Edition, Wolters Kluwer Law & Business, 2017.

***SDG 3 - Good Health and Well-Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Carbohydrates**	
1.1	Carbohydrates: Basic Chemical Structure	2
1.2	Classification – Monosaccharide	1

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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1.3	Disaccharides, Polysaccharides, Structure and Function	2
1.4	Anaerobic Pathway of Glucose Metabolism: Glycolysis	1
1.5	Aerobic Pathway of Glucose Metabolism: Citric Acid Cycle, Pentose Phosphate Pathway Synthesis	2
1.6	Synthesis of Carbohydrates from Various Sources: Gluconeogenesis.	1
2.0	**Lipids**	
2.1	Lipids: Structure and Function of Fatty Acids and Lipids	1
2.2	Classification, Major Lipid Subclasses Phospholipids, Glycolipids, Sphingolipids and Steroids.	2
2.3	Lipoproteins: Types and Functions	1
2.4	Lipid Metabolism: Biosynthesis of Fatty Acid,	1
2.5	Oxidation of Fatty acids - Beta Oxidation,	2
2.6	Other Types of Fatty Acid Oxidation - Alpha and Omega Oxidation	2
3.0	**Proteins and Vitamins**	
3.1	**Amino Acids:** Structure and Classification.	1
3.2	**Proteins:** Structure and Classification:	1
3.3	Primary, Secondary, Tertiary and Quaternary Structure	1
3.4	Properties - Denaturation and Denaturation	1
3.5	Oxidative Degradation of Amino Acids: Transamination, Oxidative Deamination, Decarboxylation	2
3.6	Biosynthesis of Urea, Conversion of Amino Acids into Specialized Products: DOPA, Dopamine, Epinephrine and Norepinephrine.	1
3.7	**Vitamins-** Vitamin C, Vitamin B12, Vitamin D, Vitamin E, deficiency diseases.	2
4.0	**Nucleic Acids**	
4.1	Nucleic Acids: Nitrogenous Bases	1
4.2	Nucleosides, Nucleotides	1
4.3	Structure of DNA and RNA	1
4.4	Biosynthesis of Purine and Pyrimidine Nucleotides- Denovo Pathway	2
4.5	Biosynthesis of Purine and Pyrimidine Nucleotides- Salvage Pathway	2
4.6	Purine and Pyramidine Degradation, - Clinical significance – gout, Lesch-Nyhan syndrome	2
5.0	**Bioenergetics**	
5.1	Biological oxidation and Redox Reaction	2
5.2	Mitochondrial Electron Transport Chain: Electron Carriers, Sites of ATP Production, Inhibitors.	2
5.3	Oxidative Phosphorylation: Structure of ATPase Complex,	2
5.4	Chemiosmotic Theory, Uncouplers	2
5.5	Inhibitors of Oxidative Phosphorylation	1

Course Designer(s)

1. Dr.S.Sidhra - sidhra@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT 302	Microbiology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To understand the basic and history of microbiology
- To impart the knowledge about the microorganisms and its classifications
- To understand the cellular organization of microbes and its identification system
- To study the nutritional requirements for the growth of microbes
- To learn about the basics of microbial growth, mode of infection and its control

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Develop the knowledge about history, contributions and various classification system the field of microbiology.	Apply
CO2	Build the basics knowledge about microscopy techniques and its identification using different staining methods.	Apply
CO3	Consider the structural organization and multiplication of microorganism.	Apply
CO4	Identify the nutritional requirements of microbial growth.	Apply
CO5	Examine the various industrial application of microorganisms and role in bioremediation justify the different processes of sterilization, disinfection and action mechanism of antimicrobial agents.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
61 BT 302 – Microbiology								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Introduction to Microbiology History and Scope of Microbiology - Basic Concepts, Spontaneous Generation, Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff and Fleming - Classification Systems- Phenetic, Numerical, Phylogenetic, Major Characteristics used in Taxonomy, Bergey's Manual of Determinative Bacteriology.	[9]
Microscopy and Identification of Microbes Microscopy-Simple and Compound Microscope, Phase Contrast, Dark Field, Fluorescent, Electron Microscope, Identification of Bacteria - Stain and Staining Techniques - Simple, Differential (Gram's,Spore and AFB) and Special (Capsule Staining, Flagellar Staining)– Fungal Staining. Estimation of Microbes.	[9]
Structural Organization and Multiplication of Microbes Morphology and Reproduction — Bacteria, Actinomycetes, Archeabacteria, Virus - Bacteriophage(Lytic and Lysogeny), Algae, Microalgae, Fungi, Yeast, Lichens, Protozoan.	[9]
Microbial Nutrition and Growth Nutritional Requirements and Classification of Bacteria, Algae and Fungi - Media Preparation — Solid,Liquid, and Semisolid, Types of Media- Selective, Enriched, Basal, Simple, Complex and Synthetic Media, Pure Culture Techniques - Anaerobic Culture Techniques - Kinetics of Growth - Generation Time, Mean Generation Time (G) and Mean Growth Rate Constant (K) - Calculations- Influence of Environmental Factors on Microbial Growth - pH, Temperature, Pressure, Oxygen and Salt- Measurement of Microbial Growth - Cell Mass and Cell Numbers.	[9]
Control of Microorganisms * Sterilization and Disinfection - Physical Methods and Chemical Methods; Assessment of Chemical Disinfectant - Phenol Co-Efficient Test, Sterility Testing- Preservation and Maintenance of Microorganisms. Mechanism and Mode of Action of Anti-Bacterial, Anti-Fungal and Anti-Viral Agents - Drug Resistance — Antibiotic Sensitivity Test.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Prescott, L.M., Harley, J.P. and Klein, D.A. "Microbiology", 7th Edition, Tata McGraw-Hill Publications, New Delhi, India, 2010.
2.	Pelczar, M.J., Chan, E.C.S. and Krieg, M.R. "Microbiology: An application Based Approach". Tata McGraw- Hill Publications, New Delhi, India, 2005.
Reference(s):	
1.	Black, J.G. "Microbiology: Principles and Explorations". 6th Edition. John Wiley and Sons, Inc,Singapore, 2004.
2.	Kamal, Rao, G.P. and Modi, D.R. "Concepts of Microbiology". International Book Distributing Co.,Lucknow, India, 2005.
3.	Gerard J. Tortora Berdell R. Funke Christine L. Case Derek Weber Warner Bair, "Microbiology: AnIntroduction", 4th Edition, Pearson Education (US), 2019.
4.	Surinder Kumar, " Essentials of Microbiology", 1st Edition, Jaypee Brothers Medical Publishers (P)Ltd, New Delhi, 2016

***SDG 3 - Good Health and Well-Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Microbiology**	
1.1	History and Scope of Microbiology - Basic Concepts	1
1.2	Spontaneous Generation Thoery	1

Passed in BoS Meeting held on 21/05/2024
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1.3	Contributions of Leeuwenhoek Louis Pasteur, Robert Koch in Microbiology	2
1.4	Contributions of Elie Metchnikoff and Fleming in the Field of Microbiology	2
1.5	Classification Systems - Phenetic, Numerical, Phylogenetic, Major Characteristics Used in Taxonomy	2
1.6	Bergey's Manual of Determinative Bacteriology	1
2.0	**Microscopy and Identification of Microbes**	
2.1	Microscopy-Simple and Compound Microscope	1
2.2	Phase Contrast, Dark Field, Fluorescent, Electron Microscope	2
2.3	Identification of Bacteria - Stain and Staining Techniques	2
2.4	Simple, Differential (Gram's, Spore And AFB) and Special (Capsule Staining, Flagellar Staining)	2
2.5	Fungal Staining	1
2.6	Estimation of Microbes.	1
3.0	**Structural Organization and Multiplication of Microbes**	
3.1	Morphology and Reproduction – Bacteria, Actinomycetes,Archeabacteria	2
3.2	Morphology and Reproduction Viruse - Bacteriophage (Lytic and Lysogeny)	2
3.3	Morphology and Reproduction - Algae, Microalgae	2
3.4	Morphology and Reproduction - Fungi, Yeast, Lichens, Protozoan	2
3.5	Morphology and Reproduction - Lichens, Protozoan	1
4.0	**Microbial Nutrition and Growth**	
4.1	Nutritional Requirements and Classification of Bacteria, Algae and Fungi	1
4.2	Media Preparation – Solid, Liquid, and Semisolid	2
4.3	Types of Media- Selective, Enriched, Basal, Simple, Complex and synthetic Media	1
4.4	Pure Culture Techniques - Anaerobic Culture Techniques	1
4.5	Kinetics of Growth - Generation Time, Mean Generation Time (G) and Mean Growth Rate Constant (K) — Calculations	2
4.6	Influence of Environmental Factors on Microbial Growth - pH,Temperature, Pressure, Oxygen and Salt	1
4.7	Measurement of Microbial Growth - Cell Mass and Cell Numbers	1
5.0	**Control of Microorganisms**	
5.1	Sterilization and Disinfection	1
5.2	Physical Methods and Chemical Methods	1
5.3	Assessment of Chemical Disinfectant- Phenol Co-Efficient Test,Sterility Testing	1
5.4	Preservation and Maintenance of Microorganisms	1
5.5	Mechanism and Mode of Actions of Anti-Bacterial, Anti-Fungal	2
5.6	Anti-Viral Agents - Drug Resistance	2
5.7	Antibiotic Sensitivity Test	1

Course Designer(s)

1. Ms.R.Krishnaveni - rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 303	Cell Biology and Genetics	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To build the knowledge on cell structure and functions of prokaryotes and eukaryotes at molecular level
- To provide an insight on the process of eukaryotic cell division, regulation of cellular processes via signaling molecules and cell cycle regulation
- To impart the concept of mendelian genetics and gene interactions
- To learn structure of chromosomes, ploidisim and concept of mutation in genetics
- To understand the concepts in population genetics and its application for species analysis

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Designate about cell organelles and transport of molecules across membrane	Understand
CO2	Deliberate the structure and functions of prokaryotic and eukaryotic cells andcellular components	Apply
CO3	Expound the concept of mendelism and chromosomal theory	Apply
CO4	Designate in techniques in cytogenetics and types of mutations with the concept of cancer	Apply
CO5	Validate the importance of population genetics and evolution	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT 303 - Cell Biology and Genetics

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

Cell and Cell Organelles Cell and Cell Organelles; Cell Membranes (Chemical Composition, Organization and Fluidity), Plant Cell Wall, Endoplasmic Reticulum, Golgi Complex and their Role in Protein Sorting and Post Translation Modifications, Vesicular Transport in Eukaryotic Cells, Lysosomes, Plastids (Chloroplasts and Vacuoles), Nucleus: Structure of Nuclear Pore and Nuclear-Cytosol Transport, Mitochondria and Chloroplast, Cell Permeability - Concentration Gradient and Partition Coefficient, Transport of Small Molecules - Active, Passive, Ion Channels and Facilitated Diffusions.	[9]
Transport Across Cell Membranes and Cell Cycle Cell Membrane - Composed of Proteins, Lipids and Carbohydrates, Membrane Proteins, Molecular Models of Cell Membrane, Cell Permeability and Cell Division: Different Stages of Mitosis and Meiosis, Cell Cycle; Molecules that Control Cell Cycle.	[9]
Mentalism and the Chromosomal Theory Mendel's Principles: Mendel's Experiments, Segregation, Gene Interactions, Supplementary Genes- Comb Patterns in Fowls, Complementary Genes - Flower Colour in Sweet Peas, Epistasis- inhibitory and colored Genes in Fowls, and Simple Problems. Identification of Genetic Material, Classical Experiments- Hershey & Chase, Avery, Mcleod etc., Multiple Alleles and Groups Antigens, Independent Assortments (Test Cross and Back Cross), Sex Determination, Dosage Compensation, Sex Linkage and Pedigree Analysis.	[9]
Cytogenetic and Mutations * Variation in Chromosomal Structure: Deletion, Inversion, Translocation, Duplication. Variation in Chromosomal Numbers: Aneuploidy, Euploidy, Polyploidy. Mutations: Types of Mutations, Mutagenesis, Ionizing and Non-Ionizing Radiation, Ames Test, Cancer Biology: Cancer and its Types	[9]
Population Genetics and Evolution Hardy-Weinberg Equilibrium, Extensions of Hardy- Weinberg Equilibrium, Non-Random Mating, Population Analysis, Models for Population Genetics. Mutation and Migration Size. Natural Selection, Evolution: Darwinian Evolution, Speciation, Genetic Variation and Sociobiology.	[9]
Total Hours:	**45**

Text Book(s):

1.	Ajoy Paul ,Textbook of Genetics ,ISBN: 978-93-84294-11-3 Pages: 1298 2nd Edition:2018
2.	Phillip Sheeler and Donald E. Bianchi, Cell and Molecular Biology, 3rd Paperback — 1, January 2009

Reference(s):

1.	Alberts B., Johnson A., Lewis, J., Raff M., Roberts K., and Walter P, "Molecular Biology of the Cell", Garland Science., New York, 2002
2.	Benjamin Lewin, "Gene IX", Oxford University Press, New Delhi, India, 2000.
3.	Jacobs M., "Cell And Molecular Biology" Vol.1., CBS Publishers and Distributors, 2016
4.	Vyas S.P. and Mehta A., "Cell And Molecular Biology" CBS Publishers and Distributors, 2020

***SDG 3 - Good Health and Well-Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Cell and Cell Organelles**	
1.1	Cell and Cell Organelles	2
1.2	Cell Membranes (Chemical Composition, Organization and Fluidity), Plant Cell Wall	1

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1.3	Endoplasmic Reticulum, Golgi Complex and their Role in Protein Sorting and Post Translation Modifications	1
1.4	Vesicular Transport In Eukaryotic Cells, Lysosomes, Plastids (Chloroplasts and Vacuoles), Nucleus: Structure of Nuclear Pore and Nuclear-Cytosol Transport	1
1.5	Mitochondria and Chloroplast, Cell Permeability - Concentration Gradient and Partition Coefficient	2
1.6	Transport of Small Molecules - Active, Passive, Ion Channels and Facilitated Diffusions.	2
2.0	**Transport Across Cell Membranes and Cell Cycle**	
2.1	Cell membrane- Composed of Proteins	1
2.2	Lipids and Carbohydrates	2
2.3	Membrane Proteins, Molecular Models of Cell Membrane, Cell permeability	2
2.4	Cell Division: Different Stages of Mitosis and Meiosis,	3
2.5	Cell cycle; Molecules that control Cell Cycle.	1
3.0	**Mendelism and the Chromosomal Theory**	
3.1	Mendel's Principles: Mendel's Experiments, Segregation, Gene Interactions.	2
3.2	Supplementary Genes - Comb Patterns in Fowls, Complementary Genes - Flower color in Sweet Peas	2
3.3	Epistasis- Inhibitory and Colored Genes in Fowls, Simple Problems. Identification of Genetic Material,	2
3.4	Classical Experiments- Hershey & Chase, Avery, Mcleod etc., Multiple Alleles and Groups Antigens, Independent Assortments (Test Cross and Back Cross),	2
3.5	Sex determination, Dosage compensation, Sex Linkage and Pedigree Analysis	1
4.0	**Cytogenetics and Mutations**	
4.1	Variation in Chromosomal Structure	1
4.2	Deletion, Inversion, Translocation, Duplication Ionizing	2
4.3	Non-Ionizing Radiation in Mutation	2
4.4	Variation in Chromosomal Numbers: Aneuploidy, Euploidy, Polyploidy	1
4.5	Mutations: Types of Mutations, Mutagenesis,	1
4.6	Ames Test	1
4.7	Cancer Biology. Cancer and its Types	1
5.0	**Population Genetics and Evolution**	
5.1	Hardy-Weinberg Equilibrium, Extensions of Hardy- Weinberg Equilibrium,	2
5.2	Non-Random Mating, Population Analysis, Models for Population Genetics	2
5.3	Mutation and Migration Size	1
5.4	Natural Selection Evolution: Darwinian Evolution	1
5.5	Speciation	1
5.6	Genetic variation	1
5.7	Sociobiology	1

Course Designer(s)

1. Dr. J. Philip Robinson - philip@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 304	Principles of Chemical Engineering	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To impart basic knowledge in unit conversion, and basic chemical calculations
- To understand the applications of material balance calculations
- To impart the basics of energy balance calculations
- To understand the fluid flow under various conditions
- To know mechanical operations and flow through columns

Pre-requisites

- Basic knowledge in Chemistry and Mathematics

Course Outcomes

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

CO1	Review the basis of unit conversion, unit operations and unit processes	Apply
CO2	Execute material balance calculations with and without chemical reactions	Apply
CO3	Interpret energy balance calculations and enthalpy changes accompanying chemical reactions	Apply
CO4	Enlighten the fluid behaviour, types and multiphase flow concept	Apply
CO5	Analyze the size reduction equipment and principle of packed and fluidized columns	Analyze

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 304 - Principles of Chemical Engineering								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	3	1	0	60	4	40	60	100

Fundamentals of Chemical Engineering Overview of Process Industries, Units and Dimensions, Basic Laws, Unit Conversion, Methods of Expressing Composition of mixtures and Solutions, Average Molecular Weight of Gas Mixture, Unit Operations and Unit Processes.	[9]
Material Balance Calculations Guidelines for Material Balance Calculations - Material Balance with and without Chemical Reactions - Stoichiometry of Microbial growth and Product Formation - Recycling and Bypass Operations.	[9]
Energy Balance Calculations* Basics Energy Balance Calculations, First Law of Thermodynamics, Sensible and Latent Heat, Heat Capacities, Mean Molal Heat Capacities, Enthalpy Changes Accompanying Chemical Reactions, Adiabatic Process, Heat of Solution and Mixing.	[9]
Flow of Fluids Nature of Fluids, Classification of Fluids; Concept of Viscosity, Laminar and Turbulent Flow, Equation of Continuity, Bernoulli's Equation and its Applications, Friction Factor, Multiphase Flow.	[9]
Mechanical Operations and Flow Through Packed and Fluidized Bed Laws of Size Reduction; Differential and Cumulative Size Analysis; Size Reduction Equipment –Jaw Crusher, Roll Crusher, Ball Mill, Hammer Mill. Packed Bed: Flow Through Porous Media- Erguns Equation, Fluidization: Principle; Types and Applications.	[9]
Total Hours 45+15(Tutorial)	**60**

Text Book(s):	
1.	Bhatt, B.I., Vora S.M., "Stoichiometry", 4th Edition, Tata McGraw-Hill Publication, New Delhi,2004.
2.	McCabe, W.L., Smith, J.C and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition,McGraw — HillInc., New Delhi, 2004.
Reference(s):	
1.	Salil K. Ghosal, Shyamal K. Sanyal and Siddhartha Datta, "Introduction to Chemical Engineering",Tata McGraw — Hill Publication, New Delhi, 2011.
2.	Gavhane K.A.," Introduction to Process Calculation", Nirali prakashan Publication, New Delhi, 2008.
3.	Gavhane K.A.,"Unit operations-I", Nirali prakashan Publication, 19th Edition, New Delhi, 2010.
4.	Geankoplis C.J., "Transport Processes and Unit Operations", Prentice Hall India, New Delhi, 2002.

***SDG 9: Industry Innovation and Infrastructure**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Fundamentals of Chemical Engineering**	
1.1	Over View of Process Industries	1
1.2	Units and Dimensions	1
1.3	Basic Laws	1
1.4	Unit Conversion	1
1.5	Methods of Expressing Composition of Mixtures and Solutions	2
1.6	Calculations	1
1.7	Average Molecular Weight of Gas Mixture	1
1.8	Unit Operations and Unit Processes	1
1.9	Tutorial	3

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2.0	**Material Balance Calculations**	
2.1	Guidelines for Material Balance Calculations	1
2.2	Material Balance Without Chemical Reactions	2
2.3	Calculations: Material Balance Without Chemical Reactions	1
2.4	Material Balance with Chemical Reactions	1
2.5	Calculations: Material Balance with Chemical Reactions	2
2.6	Stoichiometry of Microbial Growth and Product Formation	1
2.7	Recycling and Bypass Operations	1
2.8	Tutorial	3
3.0	**Energy Balance Calculations**	
3.1	Basic Energy Balance Calculations	1
3.2	First Law of Thermodynamics & Sensible and Latent Heat	1
3.3	Heat Capacities & Mean Molal Heat Capacities	1
3.4	Enthalpy Changes Accompanying Chemical Reactions	2
3.5	Problems on Heat Capacities and Energy Balance Calculations	2
3.6	Adiabatic Process	1
3.7	Heat of Solution and Mixing	1
3.8	Tutorial	3
4.0	**Flow of Fluids**	
4.1	Nature of Fluids: Classification of Fluids	1
4.2	Concept of Viscosity	1
4.3	Laminar and Turbulent Flow	1
4.4	Equation of Continuity	1
4.5	Bernoulli's Equation and Applications	1
4.6	Friction Factor	1
4.7	Calculations	2
4.8	Multiphase Flow	1
4.9	Tutorial	3
5.0	**Mechanical Operations and Flow Through Packed and Fluidized Bed**	
5.1	Laws of Size Reduction	1
5.2	Differential and Cumulative Size Analysis	1
5.3	Size Reduction Equipment –Jaw Crusher, Roll Crusher, Ball Mill,Hammer Mill	1
5.4	Packed Bed: Flow Through Porous Media and Pressure Drop Calculations	1
5.5	Packed Bed: Ergun's Equation	1
5.6	Pressure Drop Calculations	1
5.7	Fluidization: Principle,Types and Applications	1
5.8	Calculations	2
5.9	Tutorial	3

Course Designer(s)

1. Dr.S.Poornima – spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 305	Molecular Biology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- Explain the fundamental chemistry and structure of nucleic acids.
- Explore DNA replication, transcription, and translation in both prokaryotes and eukaryotes.
- Analyze mechanisms of DNA mutation and repair.
- Review the regulation of gene expression including operon concepts.
- Apply knowledge to problem-solving scenarios in molecular biology.

Pre-requisites

- Chemistry, Biochemistry, Cell Biology

Course Outcomes

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

CO1	Interpret the chemistry and structure of nucleic acids, including DNA and RNA and their role in genetic information storage.	Apply
CO2	Explicate the process of DNA replication in prokaryotes and eukaryotes, and thefunctions of dna polymerases.	Analyze
CO3	Designate the transcription process and its regulation in prokaryotes and eukaryotes.	Aanalyze
CO4	Interpret the genetic code and understand protein synthesis in both prokaryotic and eukaryotic ribosomes.	Analyze
CO5	Evaluate gene expression regulation mechanisms in prokaryotes and eukaryotes, including small noncoding RNAs and epigenetic modifications.	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT 305 – Molecular Biology

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

Chemistry and Structure of Nucleic Acids Central Dogma of Molecular Biology, Basics of Nucleic Acid Chemistry: Nucleosides, Nucleotides, and Nucleic Acids, Base Pairing Rules, Hydrogen Bonding and Base Stacking in DNA and RNA, Primary Structure of Nucleic Acids: Sugar-Phosphate Backbone and Base Sequence, Secondary and Tertiary Structures: DNA Double Helix, Supercoiling, Quadruplex Structures, and RNA Structures. Structural Organization of Chromosomes: Nucleosome, Euchromatin, Chromatin and Heterochromatin.	[9]
DNA Replication and Repair * DNA Replication Models: Semiconservative, Conservative, and Dispersive, DNA Polymerases and their Functions in Replication, DNA Replication origins and Initiation, Molecular Mechanisms of DNA Replication in Prokaryotes and Eukaryotes, Telomeres and Telomerase, Types of DNA Mutations: Point Mutations, Frameshift Mutations, and In-dels, DNA Repair Pathways: Base Excision Repair, Nucleotide Excision Repair, and Mismatch Repair. Problem Solving: Case Studies on DNA Replication and Repair.	[9]
Transcription * Structure and Function of mRNA, rRNA and tRNA.Characteristics of Promoter and Enhancer Sequences. RNA Polymerase and its Subunits in Prokaryotes and Eukaryotes, RNA Synthesis: Initiation, Elongation and Termination, Termination of Transcription in Prokaryotes, Eukaryotic Transcription and its Regulation: Promoters, Enhancers and Transcription Factors, 5' Capping, 3' Polyadenylation, and Splicing in Eukaryotic RNA Processing, RNA Editing and Alternative Splicing. Problem Solving: Designing Experiments in Transcription.	[9]
Translation * Introduction to Genetic Code: Elucidation of Genetic Code, Codon Degeneracy, Wobble Hypothesis and its Importance, Prokaryotic and Eukaryotic Ribosomes. Steps in Translation: Initiation, Elongation and Termination of Protein Synthesis in Prokaryotes and Eukaryotes. Inhibitors of Protein Synthesis. Posttranslational Modifications and its Importance. Problem Solving: Deciphering the Genetic Code and Protein Synthesis.	[9]
Regulation of Gene Expression Operon Concepts in Prokaryotes, Lac Operon, Trp Operon, and Ara Operon, Role of Small Noncoding RNAs: miRNAs and siRNAs, Riboswitches: RNA-Based Genetic Regulation, Epigenetic Modifications and their Role in Gene Expression Control, DNA Methylation, Histone Modifications, and Chromatin Remodeling.Problem Solving: Case Studies in Gene Expression Regulation.	[9]
Total Hours:	**45**

Text Book(s):

1. Lodish H., Berk, A., Zipurursky S. L., Matsudaria P., Baltimore D, and DarnellJ, "Molecular Cell Biology", W. H. Free Man and Company, England (2000).
2. Benjamin Lewin, "Gene IX", Oxford University Press, New Delhi, India, 2000.

Reference(s):

1. Watson J. D. et al. Molecular Biology of Gene. 7th Edition. Pearson (2017).
2. Gerald Karp Cell and Molecular Biology: Concepts and Experiments, 5th Edition. Wiley Publication (2008).
3. Krebs J. E., Goldstein E. S. and Kilpatrick S. T. Lewin's GENES XII. Jones and Bartlett Learning (2018).
4. Weaver R. Molecular Biology. 5th Edition. McGraw-Hill Education (2011).

***SDG 3 - Good Health and Well-Being**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Chemistry and Structure of Nucleic Acids**	
1.1	Central Dogma of Molecular Biology, Basics of Nucleic Acid Chemistry: Nucleosides, Nucleotides and Nucleic Acids	1
1.2	Base Pairing Rules, Hydrogen Bonding and Base Stacking in DNA and RNA	1
1.3	Primary Structure of Nucleic Acids: Sugar-Phosphate Backbone and Base Sequence	1
1.4	Secondary and Tertiary Structures: DNA Double Helix, Supercoiling, Quadruplex Structures	1
1.5	RNA Structures	1
1.6	Structural Organization of Chromosomes	1
1.7	Nucleosome, Euchromatin, Chromatin and Heterochromatin.	1
1.8	Problem Solving: Analyzing the Structure of Nucleic Acids, Predicting DNA Secondary Structures and their Effects on Gene Expression.	2
2.0	**DNA Replication and Repair**	
2.1	DNA Replication Models: Semiconservative, Conservative, and Dispersive	1
2.2	DNA Polymerases and their Functions in Replication	1
2.3	DNA Replication Origins and Initiation, Telomeres and Telomerase	1
2.4	Molecular Mechanisms of DNA Replication in Prokaryotes and Eukaryotes	1
2.5	Types of DNA Mutations: Point Mutations, Frameshift Mutations, and In-dels	1
2.6	DNA Repair Pathways: Base Excision Repair	1
2.7	Nucleotide Excision Repair, and Mismatch Repair	1
2.8	Problem Solving: Case Studies on DNA Replication and Repair	2
3.0	**Transcription**	
3.1	Structure and Function of mRNA, rRNA and tRNA. Characteristics of Promoter and Enhancer Sequences	1
3.2	Termination of Transcription in Prokaryotes	1
3.3	RNA Polymerase and its Subunits in Prokaryotes and Eukaryotes	1
3.4	RNA Synthesis: Initiation, Elongation and Termination	1
3.5	Transcription Initiation: Promoters and Transcription Factors	1
3.6	Eukaryotic Transcription and its Regulation: Promoters, Enhancers and Transcription Factors	1
3.7	RNA Capping, Polyadenylation	1
3.8	Splicing in Eukaryotic RNA Processing, RNA Editing and Alternative Splicing	1
3.9	Problem Solving: Designing Experiments in Transcription	1
4.0	**Translation**	
4.1	Introduction to Genetic Code: Elucidation of Genetic Code	1
4.2	Codon Degeneracy, Wobble Hypothesis and its Importance	1
4.3	Prokaryotic and Eukaryotic Ribosomes	1
4.4	Initiation, Elongation and Termination of Protein Synthesis in Prokaryotes	1
4.5	Initiation, Elongation and Termination of Protein Synthesis in Eukaryotes	1
4.6	Inhibitors of Protein Synthesis	1
4.7	Posttranslational Modifications and its Importance	1
4.8	Problem Solving: Deciphering the Genetic Code and Protein Synthesis	2
5.0	**Regulation of Gene Expression**	
5.1	Operon Concepts in Prokaryotes, Lac Operon	1
5.2	Trp Operon and Ara Operon	1
5.3	Role of Small Noncoding RNAs: miRNAs and siRNAs	1
5.4	Riboswitches: RNA-Based Genetic Regulation	1
5.5	Epigenetic Modifications and their Role in Gene Expression Control	1
5.6	DNA Methylation, Histone Modifications	1

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5.7	Chromatin Remodeling	1
5.8	Problem Solving: Case Studies in Gene Expression Regulation	2

Course Designer(s)

1. Dr.B.Kalpana – kalpana@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT 3P1	Biochemistry Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To learn the fundamental approaches for experimental investigation
- To learn the theoretical foundations for the methods used for biochemical analysis
  To determine the characteristics features of various molecules with reference to its analytical characters
- To evaluate and esimate the biological molecules through various methods
- To analyze the level of various elements through suitable standards

Pre-requisites

- Basic Biology and Biochemistry

Course Outcomes

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

CO1	Describe the calibration of glass-wares and understand the preparation of solutions.	Apply
CO2	Standardize the pH meter and preparation of buffer solutions.	Apply
CO3	Evaluate the fundamental analysis of carbohydrates and lipids qualitatively and quantitatively	Apply
CO4	Examine and interpret the results by determining the amount of carbohydrate and cholesterol.	Apply
CO5	Estimate the amount of protein and creatinine quantitatively	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
61 BT 3P1– Biochemistry Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	0	0	4	60	2	60	40	100

List of Experiments:

1. Calibration of Glass Wares- Pipettes and Volumetric Flasks
2. Preparation of Solutions:1) Percentage Solutions, 2) Molar Solutions, 3) Normal Solutions
3. Standardization of PH Meter and Preparation of Buffer of a given pH and Molarity
4. Qualitative Analysis of Carbohydrates- Monosaccharides
5. Qualitative Analysis of Carbohydrates- Disaccharides and Polysacccharides
6. Qualitative Analysis of Lipids - Determination of Acid Number of Edible Oil.
7. Determination of Total Carbohydrate Content.
8. Estimation of Cholesterol
9. Estimation of Protein
10. Estimation of Creatinine

Lab Manual

1.	"Lab Manual Biochemistry Labotory", Department of Biotechnology, KSRCT.

***SDG 3: Good Health and Well-Being**

Course Designer(s)

1. Dr.S.Sidhra – sidhra@ksrct.ac.in
2. Dr. K.Syed Zameer Ahmed – syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT 3P2	Microbiology Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To understand the growth and development of microbes through various culturing methods
- To observe the differences in staining reactions in bacteria and fungi
- To learn the culture conditions of anaerobic microbes
- To understand the concept of quality analysis of water and milk samples
- To analyze the level of various elements through suitable standards

Pre-requisites

- Introductory Biology and Microbiology

Course Outcomes

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

CO1	Perform the aseptic methods to be followed in laboratory and preparation of liquid and solid media and cultivation of microorganisms	Apply
CO2	Interpret the differential staining techniques for identification of bacteria and fungi	Apply
CO3	Demonstrate anaerobic microbe culture techniques	Apply
CO4	Analysis for physiological identification of microorganisms	Apply
CO5	Examine the quality of water and milk, and carry out the antibiotic sensitivity test	Analyze

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
61 BT 3P2 - Microbiology Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	0	0	4	60	2	60	40	100

List of Experiments:

1. Preparation of Liquid and Solid Nutrient Media.
2. Cultivation of Microorganisms.
3. Preparation of Various Selective Media and Observation of Bacteria colony.
4. Bacterial Gram's Staining
5. Fungal Staining.
6. Determination of Microbial Growth.
7. Physiological Characterization test for Microbes.
8. Rapid Detection of Bacteriological Quality of Water.
9. Quality Analysis of Milk Samples - Methylene Blue Reduction Test.
10. Antibiotic Resistance / Sensitivity Test.

Lab Manual

1.	"Lab Manual Microbiology Labotory", Department of Biotechnology, KSRCT.

***SDG 3: Good Health and Well-Being**

Course Designer(s)

2. Ms.R.Krishnaveni - rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- Basic knowledge of reading and writing in English

Course Outcomes

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

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

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some **POs**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

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

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

Reference(s):

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

***SDG:4- Quality Education**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Listening**	
1.1	Evaluative Listening: Advertisements, Product Descriptions	1
1.2	Listening to Longer Technical Talks and Completing– Gap Filling Exercises.	1
1.3	Listening Technical Information from Podcasts	1
1.4	Listening to Process/Event Descriptions to Identify Cause & Effects and Documentaries Depicting a Technical Problem and Suggesting Solutions	1
1.5	Listening to TED Talks	1
2.0	**Speaking**	
2.1	Marketing a Product, Persuasive Speech Techniques	1
2.2	Describing and Discussing the Reasons of Accidents or Disasters Based on News Reports,	1
2.3	Group Discussion (Based on Case Studies)	1
2.4	Presenting Oral Reports, Mini Presentations on Select Topics with VisualAids	1

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2.5	Participating in Role Plays and Virtual Interviews	1

3.0	**Reading**	
3.1	Reading Advertisements, User Manuals and Brochures	1
3.2	Reading - Longer Technical Texts– Cause and Effect Essays, and Letters/ Emails of Complaint	1
3.3	Case Studies, Excerpts from Literary Texts, News Reports Etc.	1
3.4	Company Profiles	1
3.5	Statement of Purpose (Sops)	1
4.0	**Writing**	
4.1	Professional Emails, Email Etiquette	1
4.2	Compare and Contrast Essay	1
4.3	Writing Responses to Complaints	1
4.4	Precis Writing, Summarizing and Plagiarism	1
4.5	Job / Internship Application – Cover Letter & Résumé	1
5.0	**Verbal Ability**	
5.1	Reading Comprehension (Inferential Fillups) and Theme Detection	1
5.2	Spotting Errors	1
5.3	Verbal Analogies	1
5.4	Change of Voice and Change of Speech	1
5.5	One Word Substitution	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2024-2025)

FOURTH SEMESTER

S. No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 MA 021	Probability and Statistics	2	40	60	100	45	100
2	60 BT 401	Genetic Engineering	2	40	60	100	45	100
3	60 BT 402	Protein and Enzyme Engineering	2	40	60	100	45	100
4	60 BT 403	Biochemical Thermodynamics	2	40	60	100	45	100
5	60 OE L0*	Open Elective – I	2	40	60	100	45	100
6	60 MY 002	Universal Human Values	2	100	-	100	-	100
PRACTICAL								
7	61 BT 4P1	Molecular Biology and Genetic Engineering Laboratory	3	60	40	100	45	100
8	61 BT 4P2	Protein and Enzyme Engineering Laboratory	3	60	40	100	45	100
9	60 CG 0P3	Career Skill Development – III	1	100	-	100	-	100
10	60 CG 0P6	Internship	-	100	-	100	-	100

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

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

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BOS- Chairman

60 MA 021	Probability and Statistics	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To get exposed to the basic concepts of probability
- To familiarize the concepts of correlation and regression
- To familiarize various methods in hypothesis testing
- To get exposed to the fundamentals of analysis of variance
- To learn basics of descriptive statistics and control charts

Pre-requisites

- NIL

Course Outcomes

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

CO1	Interpret the basic concepts of probability	Apply
CO2	Calculate coefficient of correlation and regression	Apply
CO3	Apply Student's t test, F test and Chi-square test for testing the statistical hypothesis	Apply
CO4	Apply the concepts of ANOVA to test the equality of means for more than two populations	Apply
CO5	Compute measures of central tendency and measures of dispersion, and apply the concepts of control charts for decision making	Apply

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R2022)

B.Tech - Biotechnology

60 MA 021 – Probability and Statistics (Common to Biotechnology and Food Technology)

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

Probability and Random Variable* Probability - Axioms of Probability - Total Probability - Conditional Probability - Bayes Theorem - Random Variable - Discrete Random Variable - Probability Mass Function - Continuous Random Variable - Probability Density Function - Moment Generating Function. **Hands-on:** Calculate the Probability for one Dimensional Random Variable	[9]
Two Dimensional Random Variables Joint Distribution - Marginal Distribution - Conditional Distribution - Covariance - Correlation -Rank Correlation - Regression. **Hands-on:** Computing Coefficient of Correlation	[9]
Testing of Hypothesis Type I and Type II Errors - Test of Significance of Small Samples: Student's 'T' Test — Single Mean - Difference of Means - F- Test - Chi-Square Test - Goodness of Fit - Independence of Attributes. **Hands-on:** Visualizing Data and Performing Testing of Hypothesis	[9]
Design of Experiments Analysis of Variance - One Way Classification - Completely Randomized Design - Two Way Classification - Randomized Block Design - Latin Square Design. **Hands-on:** Visualizing Data and Performing Analysis of Variance	[9]
Statistics and Quality Control **Measures of Central tendency***: Mean, Median, Mode - Measures of Dispersion: Quartile deviation – Standard deviation - Coefficient of variation - Control charts: Mean $\bar{X}$ chart and Range (R) chart - nP chart - C chart **Hands-on:** Plotting and Visualizing Control Charts	[9]
Total Hours: 45 + 5 (Hands-on) + 10 (Tutorial)	**60**

Text Book(s):

1. Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, New Delhi, 2020.
2. Richard A Johnson, "Miller & Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education Limited, New Delhi, 2018.

Reference(s):

1. Sheldon Ross, "A first course in Probability", 10th Edition, Pearson Education, New Delhi, 2019.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, New Delhi, 2011.
3. Veerarajan T., "Probability, Statistics and Random Process", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
4. Lipschutz, Seymour, Schiller John. J., "Schaum's outlines – Introduction to Probability andStatistics", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1998.

***SDG 4 – Quality Education**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Probability and Random Variable**	
1.1	Axioms of Probability	1
1.2	Total Probability	1
1.3	Conditional Probability	1
1.4	Bayes Theorem	2
1.5	Discrete Random Variable - Probability Mass Function	2

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1.6	Continuous Random Variable - Probability Density Function	2
1.7	Moment Generating Function	1
1.8	Tutorial	2
1.9	Hands-on	1
2.0	**Two Dimensional Random Variables**	
2.1	Joint Distribution	1
2.2	Marginal Distribution	1
2.3	Conditional Distribution	1
2.4	Covariance	1
2.5	Correlation	2
2.6	Rank Correlation	1
2.7	Regression	2
2.8	Tutorial	2
2.9	Hands-on	1
3.0	**Testing of Hypothesis**	
3.1	Student's 't' Test – Single Mean	1
3.2	Student's 't' Test - Difference of Means	2
3.3	F- Test	2
3.4	Chi-Square Test -Goodness of Fit	2
3.5	Chi-Square Test - Independence of Attributes	2
3.6	Tutorial	2
3.7	Hands-on	1
4.0	**Design of Experiments**	
4.1	Analysis of Variance - One Way Classification	2
4.2	Analysis of Variance - Completely Randomized Design	1
4.3	Analysis of Variance - Two Way Classification	2
4.4	Analysis of Variance - Randomized Block Design	2
4.5	Analysis of Variance - Latin Square	2
4.6	Tutorial	2
4.7	Hands-on	1
5.0	**Statistics and Quality Control**	
5.1	Mean, Median, Mode	2
5.2	Quartile Deviation	1
5.3	Standard Deviation	1
5.4	Coefficient of Variation	1
5.5	Mean □X□ Chart and Range (R) Chart	2
5.6	nP Chart	1
5.7	C Chart	1
5.8	Tutorial	2
5.9	Hands-on	1

Course Designer(s)

1. Mr.G.Mohan - mohang@ksrct.ac.in
2. Mrs.K.Geetha - geethak@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 401	Genetic Engineering	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To discuss the methods, tools and techniques involved in genome analysis, expression of cloned genes in different host system
- To understand the production of recombinant proteins, mutation analysis and the importance of PCR in genome analysis
- To learn about various aspects of Genetic Engineering, its application and ethical issues
- To determine the strategies involved in gene cloning with the help of genomic libraries, cDNA librariesand other libraries
- To discuss the production of useful molecules like cytokines, vaccines and antibiotics and define thesafety guidelines for recombinant

Pre-requisites

- Molecular Biology and Biochemistry

Course Outcomes

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

CO1	Comprehend restriction and modification system and their role in genetic engineering	Understand
CO2	Recognize about the cloning vectors used in manipulation of genes.	Apply
CO3	Examine the strategies involved in gene cloning and methods involved in screening of cloned genes to identify the targetgene.	Apply
CO4	Illustrate the PCR based techniques involved in genetic manipulation including mutagenesis and demonstrate various sequencing techniques	Apply
CO5	Comprehend the applications of rDNA technology and describe the role of knock out and RNA Interference technology in gene expression studies.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	34
Understand	30	20	30
Apply	20	30	36
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R2022)								
B.Tech - Biotechnology								
60 BT 401 – Genetic 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

Fundamental Techniques of Gene Manipulation* Restriction Enzymes: Types and Mechanisms, DNA Modification Enzymes - Alkaline Phosphatase- Terminal Deoxynucleotidal Transferase- Polynucleotide Kinase- DNA Methyltransferases (DNAmts)- DNA Polymerases, S1 Nuclease , Restriction Mapping, Design of Linkers and Adapters, Joining of DNA Molecules, Basics of Cloning.	[9]
Biology of Cloning Vectors Characteristics of Cloning Vectors, Types of Vectors, Selectable Markers, and Experimental Applications of Vectors: Plasmids- pBR322, PUC, λ Vectors, Cosmids, M13 Vectors, Phagemids, Artificial Chromosomes: YAC, PAC, BAC, HAC, Expression Vectors, Insect, Yeast and Mammalian Vectors.	[9]
Gene Cloning Strategies and screening Cloning of Genes: Genomic Libraries, cDNA Libraries, Directional cDNA Cloning, PCR Based Libraries-RACE, Subtraction Libraries, Screening: Nucleic Acid Probe Hybridization, Immuno Screening and Functional Screening.	[9]
Amplification and Sequencing of DNA PCR: Mechanism, Types- Nested, Hot Start, Colony PCR, Taqman Assay, Molecular Beacons, Site Directed Mutagenesis: Primer Extension - Strand Selection -Cassette Mutagenesis - PCR Based, Methods of Nucleic Acid Sequencing: Sanger's Method, Automated Sequencing. Next Generation Sequencing Method: Illumina and Ion Torrent.	[9]
Applications of rDNA Technology Differential Display, Microarrays, FISH, Knock-Out Analysis, Antisense and RNA Interference, Yeast Two Hybrid System, RAPD, RFLP, VNTRs and SSR; Production of Useful Molecules: Cytokines, Vaccines and Antibodies, Improving Agronomic Traits. Safety Guidelines for Recombinant DNA Technology.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Smita Rastogi and Neelam Pathak, "Genetic Engineering", Oxford Publication, 2010.
2.	Ragagopal K., "Recombinant DNA Technology and Genetic Engineering", Tata McGraw Hill Education Private Ltd.,2012.
Reference(s):	
1.	Primrose S.B. &Twyman R.M., "Principles of Gene Manipulation and Genomics", 7th Edition, Blackwell Publishing,2006.
2.	Richard J. Reece., "Analysis of Genes and Genomes", John Wiley and Sons Ltd., Singapore, 2004.
3.	Desmond S.T. Nicholl, "An Introduction to Genetic Engineering", 3rd Edition Cambridge University Press NewYork, 2008.
4.	Gyana Ranjan Rout, K,V, Peter, " Genetic Engineering of Horticultural crops" Academic Press An imprint of Elsevier, 2018.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	Fundamental Techniques of Gene Manipulation	
1.1	Restriction Enzymes: Types and Mechanisms	1
1.2	DNA Modification Enzymes - Alkaline Phosphatase- Terminal deoxynucleotidal Transferase- Polynucleotide Kinase	2
1.3	DNA Methyltransferases (DNMTs)- DNA Polymerases, S1 Nuclease	2
1.4	Restriction Mapping	1
1.5	Design of Linkers and Adapters	1
1.6	Joining of DNA Molecules	1
1.7	Basics of Cloning	1
2.0	**Biology of Cloning Vectors**	
2.1	Characteristics of Cloning Vectors	1

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2.2	Types of Vectors, Selectable Markers	1
2.3	Experimental Applications of Vectors: Plasmids- pBR322,	1
2.4	pUC, λ Vectors, Cosmids, M13 vectors	1
2.5	Phagemids	1
2.6	Artificial Chromosomes: YAC, PAC, BAC, HAC	1
2.7	Esxpression vectors	1
2.8	Insect, Yeast and Mammalian vectors.	2
3.0	**Gene Cloning Strategies and Screening**	
3.1	Cloning of Genes: Genomic Libraries,	1
3.2	cDNA Libraries, Directional cDNA Cloning	1
3.3	PCR Based Libraries-RACE	2
3.4	Subtraction Libraries	1
3.5	Screening: Nucleic Acid Probe Hybridization	2
3.6	Immuno Screening and Functional Screening	2
4.0	**Amplification and Sequencing of DNA**	
4.1	Pcr: Mechanism, Types- Nested,	1
4.2	Hot Start, Colony PCR, Taqman Assay	1
4.3	Molecular Beacons	1
4.4	Site Directed Mutagenesis: Primer Extension	1
4.5	Strand Selection -Cassette Mutagenesis - PCR Based	1
4.6	Methods of Nucleic Acid Sequencing: Sanger'smethod	1
4.7	Automated Sequencing	1
4.8	Next Generation Sequencing Method: Illumina and Ion Torrent	2
5.0	**Applications of rDNA Technology**	
5.1	Differential Display, Microarrays	1
5.2	FISH, Knock-Out Analysis	1
5.3	Antisense and RNA Interference, Yeast Two Hybrid System	1
5.4	RAPD, RFLP	1
5.5	VNTRS and SSR	1
5.6	Production of useful Molecules: Cytokines, Vaccines and Antibodies	2
5.7	Improving Agronomic traits.	1
5.8	Safety Guidelines for Recombinant rDNA Technology.	1

Course Designer(s)

1. Dr.Swathy J S - swathy@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 402	Protein and Enzyme Engineering	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To impart concept on Protein engineering and Enzyme Engineering.
- To learn basic principles in Enzyme kinetics and catalysis
- To evaluate the Production and purification of Proteins and Enzymes
- To comprehend the various methods of protein and enzyme engineering
- To analyze the application of proteins and enzymes in various industries

Pre-requisites

- Basic knowledge on Chemistry, Cell Biology and Biochemistry

Course Outcomes

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

CO1	Demonstrate the basic, types and structural confirmation ofproteins and enzymes	Apply
CO2	Examine the concepts of enzyme activity and its catalysis	Apply
CO3	Illustrate the protein/ enzyme purification methods and factors affecting immobilization	Apply
CO4	Infer the strategies for protein/ enzyme engineering and rational enzyme design.	Apply
CO5	Examine the design of enzyme electrodes and applications ofprotein/ enzyme in various domain	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R2022)								
B.Tech - Biotechnology								
60 BT 402 - Protein and Enzyme 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

Introduction to Proteins and Enzymes Introduction to Proteins - Structural Characterization and Determination - Ramachandran Plot.Enzymes: Definition- Nomenclature and Classification of Enzymes: Holoenzymes, Apoenzymes, Metalloenzymes and Ribozyme, Factors Affecting Enzyme Activity, Regulation of Enzyme Activity- Allosteric Regulation, Enzyme Inhibition (Competitive, Noncompetitive and Uncompetitive Inhibition)	[9]
Enzyme kinetics and catalysis Concept of Active Site -Mechanism of Enzyme Action - Specificity of Enzyme Action -: Michaelis Menton Equation and its Transformations, Turn Over Number, Analytical Problems in Turn Over Number, Transformations of MM Equations. Catalysis- Acid Base Catalysis, Covalent Catalysis, Mechanism of Action of Lyzosymes.	[9]
Production and purification of Proteins and Enzymes Production and Purification of Enzyme from Plant, Animal and Microbial Source: Extraction, Precipitation, Dialysis, Ion Exchange Chromatography, Hydrophobic Interaction Chromatography, Gel Filtration Chromatography. Types of Enzyme Immobilization.	[9]
Strategies for protein and enzyme engineering Protein Engineering Cycle, Protein Splicing, Random and Site Directed Mutagenesis, Peptidomimetics, In Vitro Protein Evolution (DNA Shuffling, Error Prone PCR), Cell Surface Display Technology - Rational Enzyme Design: Reshaping Enzyme Specificity, Reengineering Catalytic Mechanisms, Engineering by Molecular Assembling.	[9]
Application of Proteins and Enzymes* Importance of Recombinant Enzymes and Proteins, Industrial Applications of Enzymes, Designof Enzyme Electrodes - Case Studies on Protein Engineering Applications in Food, Detergent, Environment and Health Care Industries.	[9]
Total Hours	**45**

Text Book(s):	
1.	Palmer, T. and Bonner, P., "Enzymes: Biochemistry, Biotechnology and Clinical chemistry", Affiliated East - West Press Pvt. Ltd., New Delhi, India, 2008.
2.	Devasena T., "Enzymlogy", 2nd Edition, Oxford University Press, New Delhi, India, 2014.
Reference(s):	
1.	Branden, C. and Tooze, J., "Introduction to Protein structure", 2nd Edition, GarlandPublishing, New York, US, 1999.
2.	Moody, P.C.E. and Wilkinson, A.J., "Protein Engineering", IRL Press, Oxford, UK, 1990.

***SDG 9: Industry, Innovation, and Infrastructure**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Proteins and Enzymes**	
1.1	Introduction to Proteins	1
1.2	Structural Characterization and Determination - Ramachandran Plot	1
1.3	Enzymes: Definition, Nomenclature	1
1.4	Classification of Enzymes	1
1.5	Holoenzymes, Apoenzymes, Metalloenzymes, and Ribozyme,	1
1.6	Factors Affecting Enzyme Activity	1
1.7	Regulation of Enzyme Activity	1
1.8	Allosteric Regulation	1
1.9	Enzyme Inhibition (Competitive, Noncompetitive and Uncompetitive Inhibition)	1
2.0	**Enzyme kinetics and catalysis**	
2.1	Concept of Active Site	1
2.2	Mechanism of Enzyme Action	1
2.3	Specificity of Enzyme Action	1

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2.4	Michaelis Menton Equation and its Transformations	1
2.5	Turn Over Number, Analytical Problems in Turn Over Number,	1
2.6	Transformations of MM Equations.	1
2.7	Catalysis- Acid Base Catalysis,	1
2.8	Covalent Catalysis	1
2.9	Mechanism of Action of Lyzosymes	1
3.0	**Production and purification of Proteins and Enzymes**	
3.1	Production and Purification of Enzyme from Plant,	2
3.2	Animal and Microbial Source:	1
3.3	Extraction, Precipitation,	1
3.4	Dialysis, Ion Exchange Chromatography,	1
3.5	Hydrophobic Interaction Chromatography,	1
3.6	Gel Filtration Chromatography.	1
3.7	Types of Enzyme Immobilization	2
4.0	**Strategies for protein and enzyme engineering**	
4.1	Protein Engineering Cycle	1
4.2	Protein Splicing,	1
4.3	Random and Site Directed Mutagenesis,	1
4.4	Peptidomimetics,	1
4.5	In Vitro Protein Evolution (DNA Shuffling, Error Prone PCR Mechanisms, Engineering By Molecular Assembling).	1
4.6	Cell Surface Display Technology	1
4.7	Rational Enzyme Design:	1
4.8	Reshaping Enzyme Specificity,	1
4.9	Reengineering Catalytic	1
5.0	**Application of Proteins and Enzymes**	
5.1	Importance of Recombinant Enzymes and Proteins	2
5.2	Industrial Applications of Enzymes,.	2
5.3	Design of Enzyme Electrodes	1
5.4	Case Studies on Protein Engineering	1
5.5	Applications in Food, Detergent,	1
5.6	Environment and Health Care Industries	2

Course Designer(s)

1. Dr.S.Sidhra - sidhra@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 403	Biochemical Thermodynamics	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To learn about basic thermodynamic relations and properties of fluids
- To understand partial molar properties and property change of mixing
- To understand the concept of phase equilibria
- To know the application of chemical reaction equilibrium
- To apply the thermodynamics concepts in bioengineering

Pre-requisites

- Basic knowledge of Engineering Mathematics Physics and Principles of Chemical Engineering

Course Outcomes

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

CO1	Gain the basic laws of thermodynamics to predict the thermodynamic properties of pure fluids	Understand
CO2	Recognize the various thermodynamic properties of solutions	Understand
CO3	Identify the criteria of phase equilibria for single andmulticomponent systems	Understand
CO4	Apply the concept of chemical reaction equilibria and equilibrium conversion	Apply
CO5	Analyze the bioenergetics and thermodynamics of biochemical reactions	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R2022)								
B.Tech - Biotechnology								
60 BT 403- Biochemical Thermodynamics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	3	1	0	60	4	40	60	100

Thermodynamic Properties of Pure Fluids Basic Concepts and Laws of Thermodynamics - Basics of Entropy - Volumetric Properties of Fluids - Estimation of Thermodynamic Properties using Equations of State, Calculations Involving Actual Property Changes, Maxwell's Relations and Applications.	[9]
Solution Thermodynamics* Partial Molar Properties - Concept of Chemical Potential and Fugacity in Solutions - Activity - Activity Coefficients - Effect of Pressure and Temperature - Gibbs-Duhem Equations - Property Changes of Mixing - Heat Effects of Mixing in Biological Broths.	[9]
Phase Equilibria Criteria for Phase Equilibria - Phase Equilibria in Single and Multicomponent Systems - Duhem's Theorem. V-L-E Calculations for Binary and Multi Component Systems. Liquid-Liquid Equilibria and Solid-Liquid Equilibria.	[9]
Chemical Reaction Equilibria Chemical Reaction Equilibrium: Evaluation of Equilibrium Constant, Effect of Temperature and Pressure on Equilibrium Constant, Equilibrium Conversion for Single and Multiple Reactions.	[9]
Biochemical Thermodynamics Thermodynamics and Energetics of Metabolic Pathways, Oxygen Requirement and Heat Generation in Aerobic Growth, Energy Coupling (NADH and ATP), Thermodynamics of Oxidation-Reduction Reactions. Case Study.	[9]
Total Hours: (45 +15 Tutorial)	**60**

Text Book(s):	
1.	Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics, 6th Edition, McGraw-Hill, 2001.
2.	Narayanan K.V., "A Text Book of Chemical Engineering Thermodynamics", 2nd Edition, Prentice Hall of India, New Delhi, 2016.
Reference(s):	
1.	Gopinath Halder, "Introduction to Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd. New Delhi, 2009.
2.	Sandler S. I., Chemical, Biochemical and Engineering Thermodynamics, 4th Edition, John Wiley & Sons Inc., 2006.
3.	Gavhane K.A, "Chemical Engineering thermodynamics-1", Nirali Prakasan Publications, Pune, 2013.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Thermodynamic Properties of Pure Fluids**	
1.1	Basic Concepts and Laws of Thermodynamics	1
1.2	Basics of Entropy	1
1.3	Volumetric Properties of Fluids	1
1.4	Estimation of Thermodynamic Properties using Equations of State	2
1.5	Calculations Involving Actual Property Changes	3
1.6	Maxwell's Relations and Applications	1
1.7	Tutorial	3
2.0	**Solution Thermodynamics**	
2.1	Partial Molar Properties	2
2.2	Concept of Chemical Potential	1
2.3	Fugacity in Solutions	1
2.4	Activity and Activity Coefficients	1
2.5	Effect of Pressure and Temperature	1
2.6	Gibbs-Duhem Equations	1

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2.7	Property Changes of Mixing	1
2.8	Heat Effects of Mixing in Biological Broths	1
2.9	Tutorial	3
3.0	**Phase Equilibria**	
3.1	Criteria for Phase Equilibria	1
3.2	Phase Equilibria in Single and Multicomponent Systems	1
3.3	Duhem's Theorem	1
3.4	V-L-E Calculations for Binary and Multi Component Systems	3
3.5	Liquid-Liquid Equilibria	2
3.6	Solid-Liquid Equilibria	1
3.7	Tutorial	3
4.0	**Chemical Reaction Equilibria**	
4.1	Chemical Reaction Equilibrium	1
4.2	Evaluation of Equilibrium Constant	2
4.3	Effect of Temperature and Pressure on Equilibrium Constant	2
4.4	Equilibrium Conversion for Single Reactions	2
4.5	Equilibrium Conversion for Multiple Reactions	2
4.6	Tutorial	3
5.0	**Biochemical Thermodynamics**	
5.1	Thermodynamics and Energetics of Metabolic Pathways	2
5.2	Oxygen Requirement and Heat Generation in Aerobic Growth	2
5.3	Energy Coupling (NADH and ATP)	1
5.4	Thermodynamics of Oxidation-Reduction Reactions	2
5.5	Case Study	2
5.6	Tutorial	3

Course Designer(s)

1. Dr.S.Poornima – spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R 2022)								
B.Tech- Biotechnology								
60 MY 002- Universal Human Values (Common to all Branches)								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3*	100	-	100

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

Text Book(s):	
1.	Gaur, R. R., Asthana, R., Bagaria G. P., "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana
Reference(s):	
1.	Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age International. Publishers, New Delhi, 2004.

***SDG:5 – Quality Education**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Value Education**	
1.1	Discussion on Present Education System and Skill Based Education	1
1.2	Understanding Value Education	1
1.3	Self-exploration as the Process for Value Education	1
1.4	Basic Human Aspirations - Continuous Happiness and Prosperity	1
1.5	Basic requirements to Fulfill Human Aspirations - Right Understanding, Relationship and Physical facility	1
1.6	Transformation from Animal Consciousness to Human Consciousness	1
1.7	Sources of Happiness and Prosperity – Harmony and Disharmony	1
1.8	Current Scenario and Role of Education	1
1.9	Outcome of Human Education and Method to Fulfill the Basic Human Aspirations	1
2.0	**Harmony in the Human Being**	
2.1	Understanding Human being - As Co-Existence of the Self and the Body - The Needs of the Self and the Body	1

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2.2	Understanding Human being - As Co-Existence of the self and the Body -The Activities and Response of the Self and the Body	2
2.3	The body as an Instrument of the Self	1
2.4	Understanding Harmony in the Self	1
2.5	Harmony of the Self with the Body	2
2.6	Programme to Ensure Self-Regulation and Health	1
2.7	My Participation (Value) Regarding Self and my Body - Correct Appraisal of our Physical Needs	1
3.0	**Harmony in the Family and Society**	
3.1	Harmony in the Family - Understanding Values in Human Relationships	1
3.2	Family as the basic Unit of Human Interaction	1
3.3	Values in Human Relationships	1
3.4	Trust - the Foundation value in Relationship	1
3.5	Respect as the Right Evaluation, the Basis for Respect, Assumed Bases for Respect Today	1
3.6	Harmony from Family to World Family: Undivided Society	1
3.7	Extending Relationship from Family to Self, Identification of the Comprehensive Human Goal	1
3.8	Programs needed to Achieve the Comprehensive Human Goal: The Five Dimensions of Human Endeavour	1
3.9	Harmony from Family Order to World Family Order – Universal Human Order	1
4.0	**Harmony in the Nature / Existence**	
4.1	The Four Orders in Nature	1
4.2	Participation of Human Being in Entire Nature	1
4.3	Natural Characteristics - Tendency of Human Living with Animal Consciousness / The Holistic Perception of Harmony in Existence	1
4.4	Present day Problems	1
4.5	Recyclability and Self-Regulation in Nature	1
4.6	Relationship of Mutual Fulfillment	1
4.7	An Introduction to Space, Co-existence of Units in Space	1
4.8	Harmony in Existence – Understanding Existence as Co- Existence	1
4.9	Natural Characteristic of Human Living with Human Consciousness	1
5.0	**Implications of the Holistic Understanding**	
5.1	Natural Acceptance of Human Values	1
5.2	Definitiveness of Ethical Human Conduct - Development of Human Consciousness	1
5.3	Identification of Comprehensive Human Goal	1
5.4	Basis for Humanistic Education and Humanistic Constitution	1
5.5	Ensuring Competence in Professional Ethics	1
5.6	Issues in Professional Ethics-The Current Scenario	1
5.7	Holistic Technologies and Production Systems and Management Models - Typical Case Studies	2
5.8	Strategies for Transition Towards Value Based Life and Profession	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT 4P1	Molecular Biology and Genetic Engineering Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To understand steps involved in the isolation of DNA form bacteria, fungi and plant
- To understand the concepts of plasmid DNA extraction and transformation
- To provide hands-on experience in performing basic recombinant DNA techniques
- To develop the ability to design, conduct, analyze and interpret data related to genetic engineering experiments
- To inculcate the research aptitude and technical skills to fulfill the need of both industry and research

Pre-requisites

- Molecular Biology ,Genetic Engineering and Cell Biology

Course Outcomes

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

CO1	Apply the knowledge of DNA extraction to isolate DNA from different sources.	Apply
CO2	Analyse and interpret the data obtained from the agarose gel using graphical, UV spectrophotometric and software methods.	Apply
CO3	Identify the correct restriction enzymes to digest the vector DNA that give cohesive ends, ligate it to make recombinant DNA and transform it with *E.coli* DH5 αcells	Apply
CO4	Apply the knowledge of restriction digestion, ligation, transformation by cloning and screening and interpret the data obtained from the results	Analyze
CO5	Perform PCR at appropriate concentration and operate the thermocycler to amplify the DNA	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R2022)

B.Tech- Biotechnology

61 BT 4P1 – Molecular Biology and Genetic Engineering Laboratory*

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

List of Experiments:

1. Pipette Handling
2. Isolation of Genomic DNA from Bacterial Cells.
3. Isolation of Genomic DNA from Fungal Cells.
4. Isolation of DNA from Blood cells.
5. DNA and RNA Quantification
6. Isolation of Plasmid DNA from bacteria.
7. Restriction Enzyme Digestion of Vector and Genomic DNA
8. Ligation of Restricted DNA.
9. Competent Cell Preparation.
10. Bacterial Transformation and selection of recombinants cell.
11. Polymerase Chain Reaction.

Lab Manual

1.	"Lab Manual Molecular Biology and Genetic Engineering Laboratory", Department of Biotechnology, KSRCT.

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

Course Designer(s)

1. Dr.B.Kalpana - kalpana@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT 4P2	Protein and Enzyme Engineering Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To extract and estimate extracellular proteins from bacterial sources, fostering hands-on skills in protein quantification techniques.
- To evaluate the production and activity of enzymes, emphasizing their industrial and biological applications.
- To explore protein digestion and amino acid quantification, connecting biochemical reactions to metabolic pathways.
- To determine the impact of pH and temperature on enzyme activity, providing insights into enzyme stability and functionality.
- To analyze enzyme kinetics, inhibition mechanisms, and protein purification methods for optimizing biocatalytic processes.

Pre-requisites

- Protein and Enzyme Engineering

Course Outcomes

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

CO1	Design and conduct experiments to extract and estimate extracellular proteins, interpreting results effectively.	Apply
CO2	Demonstrate the ability to produce and estimate enzyme activity, correlating it to specific biological and industrial processes.	Apply
CO3	Quantify amino acids from digested milk protein, linking biochemical experiments to real-world applications.	Apply
CO4	Assess the influence of pH, temperature, and inhibitors on enzyme activity, drawing conclusions about enzyme behavior.	Analyse
CO5	Assess the kinetic parameters (Km, Vmax) and purification techniques using SDS PAGE and enzyme immobilization, comparing free and immobilized enzyme efficiencies	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous (R2022)

B.Tech - Biotechnology

61 BT 4P2 – Protein and Enzyme Engineering Laboratory*

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

List of Experiments:

1. Extraction and estimation of extra-cellular proteins from bacteria
2. Production and estimation of an enzyme
3. Digestion of milk protein into amino acids with quantification
4. Effect of pH on enzymatic activity
5. Effect of temperature on enzymatic activity
6. Kinetic characterization (Km &Vmax) of enzymes
7. Identification of enzyme Inhibition types
8. SDS PAGE analysis for separation of protein sample
9. Immobilization of enzymes
10. Comparative kinetic characterization of free and immobilized enzymes

Lab Manual

1. "Lab Manual Protein and Enzyme Engineering Laboratory", Department of Biotechnology, KSRCT.

***SDG 3 – Good Health and Well Being**

Course Designer(s)

1. Dr. S. Nadanasabapathi – nadanasabapathi@ksrct.ac.in
2. Dr. Rengesh Balakrishnan – rengeshbalakrishnan@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

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

Objectives

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

Pre-requisites

- Basic knowledge of Arithmetic and Logical Reasoning

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

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

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

Reference(s):

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

***SDG 4: Quality Education**
****SDG 8: Decent work and Economic growth**
*****SDG 9: Industry, Innovation and Infrastructure**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Logical Reasoning**	
1.1	Analogies - Alpha and Numeric Series	1
1.2	Number Series - Coding and Decoding	1
1.3	Blood Relations - Coded Relations	1
1.4	Order and Ranking – Odd Man Out	2
1.5	Direction and Distance	1
2.0	Quantitative Aptitude – Part 1	
2.1	Number System	1
2.2	Squares & Cubes - Divisibility	1
2.3	Unit Digits - Remainder Theorem	1
2.4	HCF & LCM- Geometric and Arithmetic Progression	2
2.5	Surds & Indices	1
3.0	Critical Reasoning	
3.1	Syllogism	1
3.2	Statements and Conclusions, Cause And Effect	1
3.3	Statements and Assumptions	1
3.4	Identifying Strong Arguments and Weak Arguments	2
3.5	Cause and Action -Data Sufficiency	1
4.0	Quantitative Aptitude – Part 2	
4.1	Average - Ratio and Proportion	1

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4.2	Ages – Partnership	1
4.3	Percentage	1
4.4	Profit & Loss	2
4.5	Discount - Mixture and Allegation	1
5.0	**Quantitative Aptitude – Part 3**	
5.1	Time & Work	1
5.2	Pipes and Cistern	1
5.3	Time, Speed & Distance - Trains	1
5.4	Boats and Streams	2
5.5	Simple Interest a nd Compound Interest	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2024-2025)

FIFTH SEMESTER

S. No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 BT 501	Plant and Animal Biotechnology	2	40	60	100	45	100
2	60 BT 502	Bioinformatics	2	50	50	100	45	100
3	60 BT 503	Heat and Mass Transfer Operations	2	40	60	100	45	100
4	60 BT504	Chemical Reaction Engineering	2	40	60	100	45	100
5	60 BT E1*	Professional Elective — I	2	40	60	100	45	100
6	60 OE L0*	Open Elective – II	2	40	60	100	45	100
PRACTICAL								
7	60 BT 5P1	Plant and Animal Biotechnology Laboratory	3	60	40	100	45	100
8	60 BT 5P2	Chemical Engineering Laboratory	3	60	40	100	45	100
10	60 BT 5P3	Design Thinking and Innovation Laboratory	3	60	40	100	45	100
11	60 CG 0P4	Career Skill Development – IV	3	100	-	100	-	100
12	60 CG 0P6	Internship	-	100	-	100	-	100

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

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

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60 BT 501	Plant and Animal Biotechnology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To develop the skills of the students in the area of Plant Biotechnology and its wide applications
- To widen the knowledge about the production and applications of transgenic plants and its use
- To study the animal cell culture techniques and types of media used in animal cell cultures
- To widen the knowledge about production and applications of transgenic animals
- To study the applications of Plant and Animal Biotechnology

Pre-requisites

- Basics of Biology, Cell biology and Genetics

Course Outcomes

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

CO1	Summarize the concepts of plant tissue culture, media preparation in the field of in vitro culture of plants.	Understand
CO2	Develop the process of conservation of plants for future posterity and production of hybrid plants.	Apply
CO3	Examine the crucial animal cell culture techniques and types of media used in animal cell cultures.	Apply
CO4	Utilize the concept of production of transgenic animals and ethical issues related to transgenic animals.	Apply
CO5	Organize the prospects and problems of GM crops along with the guidelines as well as safety Regulations for transgenic plants and exemplify the concept of cytotoxic and viability assessment using different assays.	Apply

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 501 - Plant and Animal Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Plant Tissue Culture* Preparation of Plant Tissue Culture Media and Plant Growth Regulators, Sterilization of Explants, Callus and Suspension Cultures, Micropropagation, Meristem Culture, Organogenesis, Regeneration of Shoots and Roots, Embryo Culture, Somatic Embryogenesis, Synthetic Seeds, Haploid Plant Production: Anther, Pollen and Ovary Culture, Protoplast Culture, Somatic Hybrids and Cybrids, Transfer and Establishment of Whole Plants to Greenhouse and Field.	[9]
Transgenic Plants Gene Transformation Techniques - Direct Gene Transformation: Electroporation, Particle Gun Method, Lipofection, Microinjection, Fibre Mediated DNA Delivery and Laser Induced DNA Delivery. Biological Gene Transfer: Agrobacterium Mediated Gene Transformation, Transgenic Plants: Disease Resistance; Insect Resistance, Virus Resistance, Biotic and Abiotic Stress Resistance, GM Crops- Prospects and Problems.	[9]
Introduction to Animal Cell Line Basic Tissue Culture Techniques, Animal Cell Culture Media and its Preparations, Types of Primary Culture , Chicken Embryo Fibro Blast Culture , Secondary Culture , Trypsinization, Suspension Cultures, Dependent Culture, Continuous Flow Cultures, Immobilized Cultures, Role of Serum and Supplements, Preservation of Animal Cell Cultures, Measurement of Viability and Cytotoxicity.	[9]
Production of Transgenic Animals Gene Transformation Techniques in Animals, Transgenic Mice, Transgenic Rabbits, Transgenic Cattle, Transgenic Pig and Transgenic Fish, Embryonic Stem Cell Transfer. Artificial Animal Breeding: *In Vitro* Fertilization, Embryo Transfer and Nuclear Transplantation.	[9]
Applications of Plant and Animal Biotechnology Production of Antibodies and Biodegradable Plastics in Plants. Applications of Secondary Metabolites: Isolation, Characterization and Drug Development, Plant Derived Vaccines: Edible Vaccines and Plantigens. Animal Vaccines: Attenuated Vaccines, Live Vaccines and Genetic Vaccines.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Singh, B.D., "Biotechnology", 1st Edition, Kalyani Publishers, New Delhi, India, 2015.
2.	Chawla H S., "Introduction To Plant Biotechnology",3rd Edition , Paperback – 1 , January 2020.
Reference(s):	
1.	Ranga, M.M., "Animal Biotechnology", 3rd Edition, Agrobios India limited, Jodhpur. India, 2013.
2.	Purohit, S. S., "Plant Tissue Culture", Student Edition, Jodhpur, India, 2010.
3.	Suresh Kumar Gahlawat, Joginder Singh Duhan, Raj Kumar Salar, Priyanka Siwach, Suresh Kumar, Pawan Kaur, "Advances in Animal Biotechnology and its Applications", Springer Nature Singapore Pvt. Ltd., 2018.
4.	Ian freshney, R., "Culture of Animal Cells", 5th Edition, Wiley Publications, New Delhi, India, 2006.

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	Plant Tissue Culture	
1.1	Preparation of Plant Tissue Culture Media and Plant Growth Regulators	1
1.2	Sterilization of Explants, Callus and Suspension Cultures	1
1.3	Micropropagation, Meristem Culture	1
1.4	Organogenesis, Regeneration of Shoots and Roots, Embryo Culture	1
1.5	Somatic Embryogenesis, Synthetic Seeds	1

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1.6	Haploid Plant Production: Anther, Pollen and Ovary Culture	2

1.7	Protoplast Culture, Somatic Hybrids and Cybrids	1
1.8	Transfer and Establishment of Whole Plants to Greenhouse and Field.	1
2.0	**Transgenic Plants**	
2.1	Gene Transformation Techniques - Direct Gene Transformation: Electroporation, Particle Gun Method, Lipofection	2
2.2	Microinjection, Fibre Mediated DNA Delivery and Laser Induced DNA Delivery	2
2.3	Biological Gene Transfer: Agrobacterium Mediated Gene Transformation	2
2.4	Transgenic Plants: Disease Resistance; Insect Resistance	1
2.5	Biotic and Abiotic Stress Resistance, GM Crops- Prospects and Problems.	2
3.0	**Introduction to Animal Cell Line**	
3.1	Basic Tissue Culture Techniques, Animal Cell Culture Media and its Preparations	1
3.2	Types of Primary Culture , Chicken Embryo Fibro Blast Culture	2
3.3	Secondary Culture , Trypsinization, Suspension Cultures	2
3.4	Continuous Flow Cultures, Immobilized Cultures	1
3.5	Role of Serum and Supplements	1
3.6	Preservation of Animal Cell Cultures	1
3.7	Measurement of Viability and Cytotoxicity	1
4.0	**Production of Transgenic Animals**	
4.1	Gene Transformation Techniques in Animals, Transgenic Mice	2
4.2	Transgenic Rabbits	1
4.3	Transgenic Cattle	1
4.4	Transgenic Pig and Transgenic Fish	1
4.5	Embryonic Stem Cell Transfer	1
4.6	Artificial Animal Breeding: *In Vitro* Fertilization, Embryo Transfer	2
4.7	Nuclear Transplantation	1
5.0	**Applications of Plant and Animal Biotechnology**	
5.1	Production of Antibodies	1
5.2	Biodegradable Plastics in Plants	1
5.3	Applications of Secondary Metabolites: Isolation, Characterization and Drug Development	2
5.4	Plant Derived Vaccines: Edible Vaccines	1
5.5	Plantigens	1
5.6	Animal Vaccines: Attenuated Vaccines , Live Vaccines	1
5.7	Genetic Vaccines	2

Course Designer(s)

1. Dr.M. Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

60 BT 502	Bioinformatics	Category	L	T	P	Credit
		PC	1	0	4	3

Objectives

- To develop inter disciplinary skills in the application of computers in biotechnology and learn about the biological databases and machine learning techniques
- To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources
- To analyze the structure and functions of protein and DNA using *in silico* tools
- To understand the concepts involved in biological macromolecular structures and structure prediction methods
- To apply the acquired programming knowledge for in silico Biology applications

Pre-requisites

- Basics of Biochemistry and Molecular Biology

Course Outcomes

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

CO1	Get acquainted with various biological primary databases, secondary databases and different sequence formats	Analyse
CO2	Characterize the optimal alignment of sequences either by local or global algorithm and apply BLAST and FASTA algorithms in similarity search	Analyse
CO3	Classify the phylogenetic analysis, and categorize the protein and RNA structure prediction algorithms	Analyse
CO4	Describe and infer soft computing algorithms that are applied in protein structure prediction	Analyse
CO5	Acquire programming skills in Python and apply to solve *in silico* problems	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 502 - Bioinformatics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	1	0	4	75	3	50	50	100

Biological Databases* Biological Sequences, Classification of Biological Databases - Sequence Databases, Structure Databases, Data File Formats.	**[3+12]**
Sequence Analysis* Sequence Analysis, Pairwise Alignment, Dynamic Programming Algorithms - Needleman and Wunsch Algorithm, BLAST and FASTA Algorithms, Multiple Sequence Alignment.	**[3+12]**
Molecular Phylogeny* Phylogenetics Basics, Distance Matrix Methods - UPGMA, NJ, FM. Character Based Methods-Maximum Parsimony, Evaluating Phylogenetic Methods- Boot Strapping, Jackknifing	**[3+12]**
Macromolecular Structure Analysis* Protein Structure Visualization, Prediction of Protein Secondary Structure, Tertiary Structure Prediction- Homology Modelling.	**[3+12]**
Python Programming* History of Python in Bioinformatics; Simple Values; Expressions; Names; Functions; Modules; Collections – Sets, Sequences, Mappings, Streams; Control Statements – Conditionals, Loops, Iterations.	**[3+12]**
Total Hours :15+60 (Practical)	**75**

Text Book(s):	
1.	Arthur K. Lesk, "Introduction to Bioinformatics" Oxford University Press. ,4th Edition 2014
2.	Rastogi, S.C., "Bioinformatics — Concepts, Skills and Applications", CBS Publishers and Distributors, New Delhi, India, 2003.
Reference(s):	
1.	David W. Mount., "Bioinformatics Sequence and Genome Analysis", 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US, 2004
2.	Xinkunwang, "Next Generation Sequencing Data Analysis", CRC Press, 2016
3.	Durbin R., Eddy S., Krogh A., Mitchisong.,"Biological Sequence Analysis Probabilistic Models of Proteins and Nucleic Acids", Cambridge University Press, 2013

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Biological Databases**	
1.1	Biological Sequences and Data	1
1.2	Classification of Biological Databases	1
1.3	Sequence Databases, Structure Databases, Data File Formats	1
1.4	Searching Bibliographic Database for Relevant Information	3
1.5	Searching Sequence and Retrieve from Nucleic Acid and Protein Sequence Database	3
1.6	PDB: Protein Data Bank and Structure Visualization	3
1.7	Pattern Identification using Secondary Protein Databases	3
2.0	**Sequence Analysis**	
2.1	Sequence Analysis, Pairwise Alignment – Dot Matrix Analysis	2
2.3	Dynamic Programming Algorithms for Computing Edit Distance and String Similarity	3
2.4	Pair wise Alignment of the Sequences	3
2.5	Searching Sequence Database using BLAST and FASTA Algorithm	3
2.6	Multiple Sequence Alignment: CLUSTAL OMEGA, T-COFFEE, etc., Methods	3
2.7	Active Site Prediction from Macro Molecule Structures	1
3.0	**Molecular Phylogeny**	
3.1	Distance Matrix Methods- UPGMA,NJ, FM	3

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3.2	Character Based Methods-Maximum Parsimony	3
3.3	Methods of Evaluating Phylogenetic Methods - Boot Strapping, Jackknifing	3
3.4	Evolutionary Relationship / Phylogenetic Analysis	3
3.5	Phylogeny Analysis using Phylip, iTOL, etc.,	3
4.0	**Macromolecular Structure Analysis**	
4.1	Protein Structure Visualization Tools Overview	3
4.2	Prediction of Protein Secondary Structure- Chou Fass Man, GOR, ML	3
4.3	Tertiary Structure Prediction- Homology Modeling using Modeller 19v7, Swiss Model	3
4.4	Ab initio Method and Fold Recognition Method with Tools	3
4.5	Predicted Structure Assessment and Validation Tools	3
5.0	**Python Programming**	
5.1	Simple Values and Expressions with Sample Codes	1
5.2	Names, Functions and Modules with Sample Codes	2
5.3	Sets, Sequences, Mappings, Streams with Examples	3
5.4	Align DNA and Protein Sequences, Identify Genetic Variations, and Perform Gene Expression Analysis using Biopython	3
5.5	Analysis and Visualization of Protein Structures using PyMol	3
5.6	Scikit-Learn a Machine Learning Approach to Classify Genes, Predict Protein Structures	3

Course Designer(s)

1. Dr.Punithaa Prabhu - punithaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 503	Heat and Mass Transfer Operations	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To provide fundamental knowledge on heat transfer operations.
- To understand the principle of phase change operations and functions of heat exchangers
- To explore different vapour-liquid and gas-liquid operations
- To know the principle of various liquid-liquid and solid-fluid operations
- To apply the principle of heat and mass transfer operations in biological systems

Pre-requisites

- Basic knowledge in Unit operations & Fluid flow

Course Outcomes

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

CO1	Demonstrate different modes of heat transfer and understand heat transfer coefficient.	Understand
CO2	Quantify heat transfer for phase change operations and know types of heat exchangers and flow arrangements	Apply
CO3	Enlighten the principle of molecular diffusion, distillation and gas absorption.	Apply
CO4	Illuminate the operations of extraction, leaching, adsorption and drying	Analyze
CO5	Emphasize the heat and mass transfer correlations and their applications in bioreactors	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 503 – Heat and Mass Transfer Operations								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	
V	3	1	0	60	4	40	60	

Basics of Heat Transfer Operations Modes of Heat Transfer Operation- Fourier's Law of Heat Conduction- Heat Transfer Resistance and Conductance, Thermal Conductivity- Steady State Conduction- Heat Flow through Plane Wall- Heat Flow through Composite Wall, Cylindrical Surface and Sphere- Individual Heat Transfer Coefficient and Overall Heat Transfer Coefficient.	
Heat Transfer with Phase Change and Heat Exchangers* eat Exchangers-Shell and Tube and Double Pipe Heat Exchangers, Flow Arrangements in eat Exchangers, LMTD, Single and Multiple Effect Evaporators; Natural and Forced irculation Evaporators; Heat Transfer with Phase Change. Case Studies.	
Diffusion, Vapour-Liquid and Gas-Liquid Operations Molecular Diffusion in Gas, Liquid and Solids, Mass Transfer Coefficients, Interphase Mass Transfer, Diffusivity and Flux Calculations; Simple Distillation, Continuous Rectification- Binary Systems, McCabe Thiele Analysis and Calculations. Absorption: Principle; Minimum Liquid-Gas Ratio; Industrial Absorbers. Case Studies.	
Liquid-Liquid, Solid-Liquid and Solid-Fluid Operations Liquid-Liquid Extraction-Distribution Co-Efficient, Solvent Selection Criteria for Extraction, Extraction Equipment. Solid-Liquid Extraction –Principle, Operation and Equipment. Adsorption: Principle; Batch and Fixed Bed Adsorption. Drying: Basic Principle, Drying Curve and Industrial Dryers. Case Studies.	
Applications of Heat and Mass Transfer in Biological Systems** Heat Transfer in Bioreactors, Relationship Between Heat Transfer, Cell Concentration and Stirring Conditions; Role of Diffusion in Bioprocess, Factors Affecting Oxygen Transfer in Fermenters, Mass Transfer Correlations for Oxygen Transfer. Case Studies.	[9]
Total Hours: 45+15(Tutorial)	**60**

Text Book(s):	
1.	McCabe, W.L., Smith, J.C., and Harriott, P. "Unit Operations of Chemical Engineering", 7th Edition., McGraw Hill International Edition, 2005.
2.	Yunus A,.Cengal, Afshin J.Ghajar, Heat and Mass Transfer fundamentals and applications, Mc Graw Hill Education,6th Edition, 2019.
Reference(s):	
1.	Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer" New Age Science, 2009.
2.	Geankoplis, C.J., "Transport Processes and Unit Operations", Prentice Hall Inc.,2006.
3.	Pauline M. Doran "Bioprocess Engineering Principles" 2nd Edition, Academic Press, 2005.
4.	Kurt Rolle, "Heat and Mass Transfer", 2nd Edition, Cengage Learning, 2015

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 12 – Responsible consumption and production**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basics of Heat Transfer Operations**	
1.1	Modes of Heat Transfer Operation	1
1.2	Fourier's Law of Heat Conduction	1
1.3	Heat Transfer Resistance and Conductance, Thermal Conductivity	2
1.4	Steady State Conduction- Heat Flow Through Plane Wall	1
1.5	Heat Flow Through Composite Wall, Cylindrical Surface and Sphere	2
1.6	Individual Heat Transfer Coefficient and Overall Heat Transfer Coefficient	2
1.7	Tutorial	3
2.0	**Heat Transfer with Phase Change and Heat Exchangers**	
2.1	Heat Exchangers-Shell and Tube and Double Pipe Heat Exchangers	2
2.2	Flow Arrangements in Heat Exchangers	1
2.3	LMTD	1

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2.4	Single and Multiple Effect Evaporators	1
2.5	Natural and Forced Circulation Evaporators	1
2.6	Heat Transfer with Phase Change	2
2.7	Case Studies	1
2.8	Tutorial	3
3.0	**Diffusion, Vapour-liquid and Gas-liquid operations**	
3.1	Molecular Diffusion in Gas, Liquid and Solids	1
3.2	Mass Transfer Coefficients & Interphase Mass Transfer	1
3.3	Diffusivity and Flux Calculations	1
3.4	Simple Distillation & Continuous Rectification- Binary Systems	2
3.5	Mccabe Thiele Analysis and Calculations	2
3.6	Absorption: Principle; Minimum Liquid-Gas Ratio	2
3.7	Industrial Absorbers. Case Studies	1
3.8	Tutorial	3
4.0	**Liquid-liquid, Solid-liquid and Solid-fluid operations**	
4.1	Liquid-Liquid Extraction-Distribution Co-Efficient	1
4.2	Solvent Selection Criteria for Extraction & Extraction Equipment	1
4.4	Solid-Liquid Extraction –Principle	1
4.5	Operation and Equipment	1
4.6	Adsorption: Principle; Batch and Fixed Bed Adsorption	2
4.7	Drying: Basic Principle, Drying Curve	1
4.8	Industrial Dryers	1
4.9	Case Studies	1
4.10	Tutorial	3
5.0	**Applications of Heat and Mass Transfer in Biological Systems**	
5.1	Heat Transfer in Bioreactors	1
5.2	Relationship Between Heat Transfer Cell Concentration and Stirring Conditions	1
5.4	Role of Diffusion in Bioprocess	2
5.5	Factors Affecting Oxygen Transfer in Fermenters	2
5.6	Mass Transfer Correlations for Oxygen Transfer	2
5.7	Case Studies	1
5.8	Tutorial	3

Course Designer(s)

1. Dr.S.Poornima - spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 504	Chemical Reaction Engineering	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To learn chemical kinetics for different reactions.
- To impart knowledge on design of single and multiple reactors.
- To acquire knowledge to analyze non-ideal reactors.
- To understand catalysis and multiphase reactor systems.
- To apply reaction engineering concepts in various biochemical reaction systems.

Pre-requisites

- Thermodynamics, Fluid mechanics, Heat and Mass Transfer Operations

Course Outcomes

On the successful complet ion of the course, students will be able to

CO1	Develop rate equation and to know concentration and temperature dependence of rate equation	Understand
CO2	Design single and multiple reactors and understand performance analysis of reactors	Apply
CO3	Identify the basics aspects, models and performance of non-ideal reactors	Apply
CO4	Demonstrate the mechanism of catalytic reactions and design of multiphase reactors	Apply
CO5	Apply various modes of fermentors in microbial and enzyme fermentation.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022							
B. Tech - Biotechnology							
60 BT 504 - Chemical Reaction Engineering							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	T	P		C	CA	ES
V	3	1	0	60	4	40	60

Scope of Chemical Kinetics & Chemical Reaction Engineering Broad Outline of Chemical Kinetics; Rate Equation; Concentration and Temperature Dependence of Rate Equation; Development of Rate Equation for Irreversible Unimolecular First- Order Reactions, Irreversible Bi-Molecular Second -Order Reactions; Zero Order Reactions; Pseudo First Order and Second Order Reactions, Autocatalytic Reactions.	
Ideal Reactors* Design of Ideal Reactors - Performance Equation of Batch Reactor, Semi Batch Reactor, Mixed Flow Reactor, Plug Flow Reactor, Recycle Reactor; Performance Comparison of Single Reactors; Multiple-Reactor Systems.	
Non-Ideal Flow* Basic Aspects of Non-Ideal Flow, Residence Time Distribution; C, E and F Curves; Reactor Performance with Non-Ideal Flow; Conversion in Non-Ideal Flow Reactors; Non-Ideal Flow Models-Tank in Series Model, Dispersion Model; Mean Concentration and Conversion in Non-Ideal Reactors. Case Studies.	[9]
Heterogeneous Catalysis Catalytic Reactions-Mechanism, Pore Diffusion Resistance Combined with Surface Kinetics, Performance Equation of Porous Catalytic Reactors; Experimental Methods of Finding Rates; Multiphase Reactors: Design Equation of Slurry Reactor and Trickle Bed Reactor.	[9]
Biochemical Reaction Systems** General Reaction Kinetics for Biological Systems; Enzyme Fermentation- Batch, Plug Flow and Mixed Flow Fermentors; Microbial Fermentation-Batch, Plug Flow and Mixed Flow Fermentors. Case Studies.	[9]
Total Hours: 45+15(Tutorial)	**60**

Text Book(s):	
1.	Levenspiel, O., "Chemical Reaction Engineering", 4th Edition. John Wiley and Sons, 2009
2.	Fogler, H.S., "Elements of Chemical Reaction Engineering", 6th Edition, Prentice Hall Inc, 2020.
Reference(s):	
1.	Hayes, R.E., Mmbaga, J.P., "Introduction to Chemical Reactor Analysis", 2nd Edition, CRC Press, 2013.
2.	Dawande, S.D., "Principles of Reaction Engineering", 1st Edition, Central Techno Publications, 2001.
3.	Martin Schmal, "Chemical Reaction Engineering: Essentials, Exercises and Examples", CRC Press, Taylor & Francis Group, 2014
4.	Mark E. Davis , Robert J. Davis, "Fundamentals of Chemical Reaction Engineering", 1st Edition, Tata McGraw Hill Publishing Company Ltd, New York, 2014.

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 12 – Responsible consumption and production**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Scope of Chemical Kinetics & Chemical Reaction Engineering**	
1.1	Broad Outline of Chemical Kinetics- Rate Equation	1
1.2	Concentration and Temperature Dependence of Rate Equation	1
1.3	Development of Rate Equation for Irreversible Unimolecular Type First-Order Reactions	2
1.4	Irreversible Bi-Molecular Type Second -Order Reactions	2
1.5	Zero Order Reactions	1
1.6	Pseudo First Order and Second Order Reactions	1
1,7	Autocatalytic Reactions	1

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Approved in Academic Council Meeting held on 25/05/2024

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1.8	Tutorial	3
2.0	**Ideal Reactors**	
2.1	Design of Ideal Reactors	1
2.2	Performance Equation of Batch Reactor, Semi Batch Reactor,	2
2.3	Performance Equation of Mixed Flow Reactor, Plug Flow Reactor & Recycle Reactor	3
2.4	Performance Comparison of Single Reactors	1
2.5	Multiple-Reactor Systems	2
2.6	Tutorial	3
3.0	**Non-Ideal Flow**	
3.1	Basic Aspects of Non-Ideal Flow	1
3.2	Residence Time Distribution; C, E and F Curves	2
3.4	Conversion in Non-Ideal Flow Reactors	1
3.5	Non- Ideal Flow Models-Tank in Series Model	2
3.6	Non- Ideal Flow Models-Dispersion Model	1
3.7	Mean Concentration and Conversion in Non-Ideal Reactors	1
3.8	Case Studies	1
3.9	Tutorial	3
4.0	**Heterogeneous Catalysis**	
4.1	Catalytic Reactions-Mechanism	1
4.2	Pore Diffusion Resistance Combined with Surface Kinetics	1
4.3	Performance Equation of Porous Catalytic Reactors	2
4.4	Experimental Methods of Finding Rates	1
4.5	Multiphase Reactors	1
4.6	Design of Slurry Reactor	2
4.7	Design of Trickle Bed Reactor	1
4.8	Tutorial	3
5.0	**Biochemical Reaction Systems**	
5.1	General Reaction Kinetics for Biological Systems	2
5.2	Enzyme Fermentation- Batch, Plug Flow and Mixed Flow Fermentors	3
5.4	Microbial Fermentation-Batch, Plug Flow and Mixed Flow Fermentors	3
5.5	Case Studies	1
5.6	Tutorial	3

Course Designer(s)

1. Dr.S.Poornima - spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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60 BT 5P1	Plant and Animal Biotechnology Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To prepare growth media for the development of explant for initiating plant tissue culture
- To perform the technique of micropropagation using various explants
- To develop the production of aseptic synthetic seeds.
- To experiment the techniques in sterilization and maintenance of various animal cell culture and handling of animals
- To produce the haploid plant using anther, pollen and ovary culture

Pre-requisites

- Plant and Animal Biotechnology

Course Outcomes

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

CO1	Adapt the preparation of plant tissue culture media for plant cell, tissue and organ culture with effective and safe operation	Apply
CO2	Demonstrate the steps involved in developing a reliable protocol and required hormonal combination for *in vitro* culturing of plants.	Apply
CO3	Experiment the aseptic explant production through in vitro seed germination and micro propagation,	Apply
CO4	Adapt the various sterilization procedures followed in cell line laboratory and perform the cytotoxicity assay	Apply
CO5	Analyze the process of subculturing without and contamination and isolation of Primary cells from Chicken fibroblast.	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	40	25	80	80
Analyse	10	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 5P1 – Plant and Animal Biotechnology Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Preparation of Stock Solutions of MS Basal Medium and Plant Growth Regulator Stocks and Safety Regulations*
2. Micropropagation of Plants through Meristematic Explants.
3. Micropropagation of Plants through Auxillary Bud as Explants
4. Preparation of Synthetic Seed
5. Basic Animal Handling Methods
6. Sterilization Procedures Followed in Cell Line Laboratory
7. Cytotoxicity Assay (MTT Assay)
8. Isolation of Primary Cells from Chicken Fibroblast

Design Experiments:

9. Haploid Plant Production (Ovary and Pollen Culture)
10. Micropropagation of Rice by Indirect Organogenesis from Embryo

Lab Manual	
1.	"Lab Manual Plant and Animal Biotechnology Laboratory", Department of Biotechnology, KSRCT.

***SDG 3 – Good Health and Well Being**

Course Designer(s)

1. Dr.M.Nithya – nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 5P2	Chemical Engineering Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To understand the kinetic analysis of various mode of reactors.
- To analyze non-ideality in real reactors.
- To study the principles of fluid flow and flow measuring devices
- To learn the operation of size reduction equipment.
- To know the principles of heat and mass transfer operations.

Pre-requisites

- Unit operations, Fluid mechanics, Heat and Mass transfer Operations

Course Outcomes

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

CO1	Demonstrate kinetic studies and performance analysis of various reactors	Apply
CO2	Interpret non-ideal flow and residence time distribution in real reactors	Apply
CO3	Comprehend fluid flow operations and flow measuring devices.	Apply
CO4	Characterize mean particle size by size reduction and size separation operations.	Analyse
CO5	Utilize the concept of unit operations and estimation of heat and mass transfer co-efficients	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	40	15	25	75
Analyse	10	10	25	25
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

Passed in BoS Meeting held on 21/05/2024
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B. Tech - Biotechnology								
60 BT 5P2 - Chemical Engineering Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Kinetic Studies in Batch Reactor
2. Performance Characteristics of Mixed Flow Reactor
3. Performance Characteristics of Plug Flow Reactor
4. Residence Time Distribution Studies in Flow Reactors
5. Determination of Co-Efficient of Discharge of Orifice Meter/Venturi Meter
6. Friction Factor Studies in Straight Pipes
7. Size Reduction and Size Separation by Crushing and Sieve Analysis
8. Studies on Adsorption Equilibrium

Design Experiments:

9. Studies on Flow Through Packed Column / Filtration Studies
10. Determination of Minimum Fluidization Velocity/ Heat Transfer Studies

Lab Manual	
1.	"Lab Manual Chemical Engineering Laboratory", Department of Biotechnology, KSRCT.

***SDG 09 – Industry, Innovation and Infrastructure**

Course Designer(s)

1. Dr. S. Poornima – spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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60 BT 5P3	Design Thinking and Innovation Laboratory	Category	L	T	P	Credit
		PC	0	0	2	1

Objectives

- Study a problem from multiple perspectives
- Learn how to frame the design challenge properly.
- Learn how to ideate, prototype and Iterate solutions.
- Learn from the overall design process how to create value as entrepreneurs
- Learn how to design successful products or enterprises

Pre-requisites

- NIL

Course Outcomes

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

CO1	Identify an Opportunity from a Problem	Understand
CO2	Frame a Product/Service Idea	Analyse
CO3	Empathize with the customers	Apply
CO4	Design and develop a Prototype	Analyse
CO5	Pitch their idea	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

1,2 Hours: **Introduction to Design Thinking**

Duration	Activity	Materials	
		Faculty	Students
10 Minutes	**Individual:** Students have to write their thoughts to the following questions in the worksheet. 1) What is Design? 2) Who is a Designer? 3) What is Design Thinking? 4) What are the steps of Design Thinking Process? 5) Who is a Design Thinker?	Worksheet: Space for writing Answer	Pen & File

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20 Minutes	**Individual:** Students have to watch the video 1 and reflection the thought to the following questions in the work sheet. Video 1: Toilet Bed - https://www.youtube.com/watch?v=KJ5TRHE7omU&ab_channel=sjkinnovations 1) What are the problems faced by the elderly/injured people? 2) How did Saravana Muthu solve the problem? 3) Where Saravana Muthu want updating/changes in the product? Why? 4) Saravana Muthu is a Designer? Justify the Statement. 5) Toilet Bed is a Design. Justify the Statement.	Worksheet: QR Code contain Video Link Space for writing Answer	Cellphone , Headphone, Pen & File
20 Minutes	**Individual:** Students have to watch the video 2 and reflection the thought to the following questions in the work sheet. Video 2 : Jaipur Foot, India https://youtu.be/7W6ckXZbL4o 1) What are the problem faced by the handicapped in India? 2) How did Ramachandra Sharma solve the problem? 3) Why Ramachandra Sharma used rubber material for foot? Where he got idea? 4) Dr.Mathur is a Designer? Justify the Statement 5) Jaipur is a Design? Justify the statement.	Worksheet: QR Code contain Video Link Space for writing Answer	Cellphone , Headphone, Pen & File
10 Minutes	**Individual:** Students have to share the thought written in the worksheet	Randomly Call any two or three student and ask him to share the thoughts with other students.	Communicate the thoughts with clarity.
30 Minutes	**Individual:** Students have to watch the video 3 and reflection the thought to the following questions in the work sheet. Video 3: What you **understand** from the video? What are the **rules to be followed** by policeman on bandobast? How does the policeman **doing bandobast**? What the policeman **feel** while on the bandobast?	Worksheet: QR Code contain Video Link Space for writing Answer	Cellphone , Headphone, Pen & File

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	What the policeman **like to have** on the bandobast? As a designer, what will you **do to the policeman** easy to do their bandobast duty?		
30 Minutes	**Individual:** Students have to watch the video 4 and reflection the thought to the following questions in the work sheet. Video 4: What you **understand** from the video? How the **Parkinson's disease affect** the Ali? Why Ali is not drinking coffee when surrounding by many people? What Ali **feel** while walking on the Staircase? What Ali **like** to do daily? As a designer, what **will you do** to Ali easy to do their daily activity?	Worksheet: QR Code contain Video Link Space for writing Answer	Cellphone , Headphone, Pen & File
10 Minutes	**Individual:** Students have to share the thought written in the worksheet	Randomly Call any two or three student and ask him to share the thoughts with other students.	Communicate the thoughts with clarity.

After the class

Outcome: Students understand the design thinking process.

Students have to watch the videos in the playlist: It will enhance the understand ability of design thinking process

Design Thinking Series Playlist : Tamil. https://www.youtube.com/playlist?list=PLf_-l5JEujRhJmOGcj8YOLZQI15cG7x7Z

3,4 Hours: **Mind-sets of Design Thinking**

Duration	**Activity**	**Materials**	
		Faculty	**Students**
10 Minutes	Individual: Recap of Last Class Students have to share what they learned on last class	Randomly Call any two or three student and ask him to share the thoughts of design thinking process with other students.	Communicate the thoughts with clarity.

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70 Minutes	Team: Maximum 3 Students Design Challenge : Build a tower of spaghetti/straw noodles that will hold one marshmallow/rubber. Make the tallest tower possible from the materials supplied. The marshmallow/rubber must be able to sit on top without falling off. Time : 10 Minutes for Define the design challenge + 05 Minutes (Team Discussion) + 20 Minutes (Build) + 10 Minutes (Measurement and Compare) + 15 Minutes (Reflection of Thought) + 10 Minutes of watch Video 20 sticks of (uncooked) spaghetti or straws per team ● One yard (36 inches) of masking tape per team ● One yard (36 inches) of string/thread per team (the string must be easily breakable by hand. If the string is thick, include scissors in your kit.) ● One marshmallow/ eraser per team: around 1.5 inches in size across. ● Measuring tape to measure the height of the structures. ● Countdown Timer/ stopwatch to keep track of the time. Personal reflection: • What was my role in the team? • What worked well on Ideation/Prototype/ test? What failed on Ideation/Prototype/ test? • What would I improve next time in my team's work? • What learning would you take away from this challenge? • Are you a design thinker? Justify the Answer. Team reflection: • What was the team's strategy to solve the challenge? • What worked well on team/Collaboration? Please refer to the Faculty Guide: https://www.sessionlab.com/methods/marshmallow-challenge-with-debriefing https://static1.squarespace.com/static/57c6b79629687fde090a0fdd/t/58ab5a6046c3c4e069a2842d/1487624802348/SpaghettiMarshmallow.pdf **Students watch** **VIDEO | Tom Wujec - Build a Tower, Build a Team:** https://www.ted.com/talks/tom_wujec_build_a_tow	Define the design challenge . Facilitate the students to do design challenge	Discuss the design ideas, discuss structures and strengths, and even sketch ideas before you begin. Build your design Measure Reflection the thought to the questions in the work sheet
20 Minutes	Individual: Students have to write their thoughts to the following questions in the worksheet Do you make it something and what it? Where you do iterate? Why? Do you learn anything from failure? What? Are you an optimistic on your design? How? Do you have a confidence on your creative? How it help	Worksheet: Space for writing Answer	Pen & File

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	it? **Design Kit: Mindset Videos:** https://www.youtube.com/watch?v=_yWAllNl7E4&list=PLIeYpC-T18cbnZcjli2x9ScBABYL76n12&index=2&ab_channel=IDEO.org		
Additional	Team: Maximum 3 Students Design Challenge: Build a Strong Paper Structures that will hold many books. Time : 05 Minutes for Define the design challenge + 05 Minutes (Team Discussion) + 20 Minutes (Build) + 10 Minutes (Count and Compare) + 15 Minutes (Reflection of Thought) Materials: •Tape •Books •Paper (regular copy paper will do) Please refer to the Faculty Guide: https://littlebinsforlittlehands.com/strong-paper-structures/ Personal reflection: • What was my role in the team? • What worked well on Ideation/Prototype/ test? What failed on Ideation/Prototype/ test? • What would I improve next time in my team's work? • What learning would you take away from this challenge? • Are you a design thinker? Justify the Answer. Team reflection: • What was the team's strategy to solve the challenge? • What worked well on team/Collaboration?	Define the design challenge . Facilitate the students to do design challenge	Discuss the design ideas, discuss structures and strengths, and even sketch ideas before you begin. Build your design Reflection the thought to the questions in the work sheet

After the class

Outcome: Students can ideate and make a thing and test it.
Student understand the mind-set of design thinking

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 5P3 - Design Thinking and Innovation Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	2	30	1	60	40	100

Introduction to Design Thinking LRI Assessment, Introduction to Design Thinking, Understanding the Mindsets-Empathy, Optimism, Embrace Ambiguity, Make it, Learn from Failure, Iterate, Create Confidence, Creativity Convergent & Divergent Thinking	[6]
Design Thinking Methodology The 5 Stages of the Design Thinking Process-Empathise, Define (the problem), Ideate, Prototype, and Test.	[6]
Ideation tools & exercises. Sample Design Challenge, Introduction to the Design Challenge Themes, Storytelling and Tools for Innovation	[6]
Empathize-Understand customers: Empathy Maps, Empathise-Step into customers shoes Customer Journey Maps, Define-Analysis & Drawing Inferences from Research	[6]
The Design Challenge: Define the Design Challenge, Prototyping & Iteration- Feasibility Study, Testing-Documentation and the Pitching.	[6]
Total Hours:	30

Text Book(s):	
1.	Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School - IdrisMootee.
Reference(s):	
1.	1. Zero to One: Note on Start-Ups, or How to Build the Future
2.	2. The Lean Startup: How Constant Innovation Creates Radically Successful Businesses
3.	3. Start with Why: How Great Leaders Inspire Everyone to Take Actions.

***SDG:9 - Industry Innovation and Infrastructure**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 CG 0P4	Career Skill Development IV	Category	L	T	P	Credit
		CG	0	0	2	1λ

Objectives

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

Pre-requisites

- Basic knowledge of Arithmetic and Logical Reasoning

Course Outcomes

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

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

Mapping with Programme Outcomes

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

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Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
60 CG 0P4 - Career Skill Development IV								
Common to All Branches								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	0	0	2	30	1λ	100	00	100

Verbal & Analytical Reasoning Seating Arrangements – Analytical Reasoning (PUZZELS) – Machin Input and Output - Coded Inequality – Eligibility Test	[6]
Quantitative Aptitude - Part – 4 Permutation and Combination - Probability - Quadratic Equation - Geometry – Clock – Calendar — Logarithmic.	[6]
Non-Verbal Reasoning Series Completion of Figures — Classification — Courting of Figure — Figure Matrix — Embedded Figure – Complete Figure – Paper Cutting And Folding – Mirror Images And Water Images.	[6]
Quantitative Aptitude - Part – 5 Mensuration of Area, Volume and Surface Area in 2D and 3D Shapes – 2D Shapes – Square, Rectangle, Triangle, Circle, Etc. - 3D Shapes — Cube, Cuboid , Sphere , Cone , Etc.	[6]
Data Interpretation and Analysis Data Interpretation Based on Text - Data Interpretation Based on Tabulation, Pie Chart, Bar Graph, and Line Graph — Venn Diagram - Data Sufficiency.	[6]
Total Hours:	**30**

Text Book(s):	
1.	Data Interpretation and Analysis Data interpretation Based on text - Data interpretation Based on Tabulation, Pie chart, Bar graph, And Line graph — Venn Diagram - Data sufficiency.
2.	Crouse W. H., and Anglin D. L., "Automotive Mechanics", 10th Edition, McGraw Hill Education Private Limited, New Delhi, 2017.
Reference(s):	
1.	Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals", The Good Heart — Will Cox Company Inc, USA, 2012.
2.	Abhijit Guha, 'Quantitative Aptitude', McGraw Hill Education, 6th Edition, 2016
3.	Dinesh Khattar, 'Quantitative Aptitude For Competitive Examinations', Pearson Education (2020)
4.	Anne Thomson, 'Critical Reasoning: A Practical Introduction' Lexicon Books, 3rd Edition, 2022. Warszaw

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 3 – Good Health and Well Being**
*****SDG 7 – Affordable and Clean Energy**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Verbal & Analytical Reasoning**	
1.1	Seating Arrangements 1 1.2 Analytical Reasoning (Puzzels)	1
1.2	Machine Input And Output	1
1.3	Coded Inequality	1
1.4	Eligibility Test	1
1.5	Vehicle Aerodynamics	2
2.0	**Quantitative Aptitude - Part – 4**	
2.1	Permutation And Combination	1
2.2	Probability	1
2.3	Quadratic Equation - Geometry	1
2.4	Clock – Calendar	1
2.5	Logarithmic	2
3.0	**Non-Verbal Reasoning**	
3.1	Series Completion Of Figures – Classification	1
3.2	Courting Of Figure – Figure Matrix	1

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3.3	Embedded Figure – Complete Figure	1
3.4	Paper Cutting And Folding	1
3.5	Mirror Images And Water Images	2
4.0	**Quantitative Aptitude - Part – 5**	
4.1	Mensuration Of Area, Volume	1
4.2	Mensuration Of Volume	1
4.3	Surface Area In 2D And 3D Shapes	1
4.4	2D Shapes – Square, Rectangle, Triangle, Circle, Etc.	1
4.5	3D Shapes – Cube, Cuboid , Sphere , Cone , Etc	2
5.**0**	**Data Interpretation and Analysis**	
5.1	Data Interpretation Based On Text	1
5.2	Data Interpretation Based On Tabulation, Pie Chart	1
5.3	Bar Graph , And Line Graph	1
5.4	Venn Diagram	1
5.5	Data Sufficiency	2
	Total	**30**

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215
(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted in 2024-2025)

SIXTH SEMESTER

S. No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 BT 601	Biopharmaceutical Technology	2	40	60	100	45	100
2	60 BT 602	Bioprocess Technology	2	40	60	100	45	100
3	60 BT 603	Computer Aided Drug Design	2	40	60	100	45	100
4	60 BT 604	Immunology and Immunoterchnology	2	50	50	100	45	100
5	60 MY 003	Startups and Entrepreneurship	2	100	-	100	-	100
6	60 BT E2*	Professional Elective – II	2	40	60	100	45	100
7	60 OE L0*	Open Elective – III	2	40	60	100	45	100
PRACTICAL								
8	60 BT 6P1	Computer Aided Drug Design Laboratory	3	60	40	100	45	100
9	60 BT 6P2	Bioprocess Technology Laboratory	3	60	40	100	45	100
10	60 BT 6P3	Design Thinking and Product Development Laboratory	3	60	40	100	45	100
11	60 CG 0P5	Comprehension Test	-	100	-	100	-	100
12	60 CG 0P6	Internship	-	100	-	100	-	100

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

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

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SEMESTER VI

60 BT 601	Biopharmaceutical Technology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To recognize the sources of drugs and basic concepts in pharmacology
- To be familiar with the drug manufacturing facilities and quality control
- To gain knowledge on the concepts of biotransformation of drugs
- To understand the concepts of dosage forms
- To understand the biopharmaceutical quality assurance

Pre-requisites

- Biology / Biochemistry

Course Outcomes

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

CO1	Comprehend the pharmacological categories, sources, routes of administration and different modes of drug delivery	Understand
CO2	Experiment with drug manufacturing facility, importance of quality assurance and various methods of coating pharmaceutical dosage forms	Understand
CO3	Examine with the concepts of pharmacokinetics, clearance and bioavailability of drugs	Apply
CO4	Categorize pharmaceutical dosage forms and its routes of applications	Apply
CO5	Survey the role of quality assurance and regulatory affairs in biological evaluation of pharmaceutical dosage forms	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech. Biotechnology								
60 BT 601 – Biopharmaceutical Technology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Introduction to Pharmacology* Drug- Definition, Classification - Physiochemical Properties - Pharmaceutical Substances of Plant, Animal and Microbial Origin - Routes of Administration of Drug - Controlled Drug Delivery Systems.	[9]
The Drug Manufacturing Process* The Manufacturing Facility — Cleaning, Decontamination and Sanitation (CDS). Documentation — Specifications- Records - Compression and Granulation of Tablets - Coating of Pharmaceutical Dosage Forms- Film Coating: Modified Release Film Coating- Coating Procedure and Equipment. Quality Control and Practice.	[9]
Pharmacokinetics and Biotransformation Basic Concepts of Pharmacokinetics: Absorption - Mechanism of Drug Absorption - Distribution - Biotransformation of Drug - Non Synthetic and Synthetic Reaction. Elimination - Organ Clearance - Hepatic Clearance - Renal Clearance - Bioavailability and Bioequivalence	[9]
Pharmaceutical Dosage Forms Definition of Dosage forms, Classification of Dosage Forms -Solid Unit Dosages – Tablets, Capsules, Pills, Troches, Cachets, Liquids — Solutions, Lotions, Suspension, Elixirs, Emulsions, Inhalations and Inhalants Semi-Solid — Ointments, Creams, Gels. Extracts- Tinctures and Fluid extracts.	[9]
Biopharmaceuticals Quality Assurance The Role of FDA (Food and Drug Administration Process) - Role of Centre for Biological Evaluation and Research (CBER) - Role of Centre for Drug Evaluation and Research - Global Harmonization of Regulatory Affairs - European Medicine Evaluation Agency (EMEA) - Indian Pharmacopeia (IP) - United States Pharmacopeia (USP).	[9]
Total Hours:	**45**

Text Book(s):	
1.	Remington., "The Science and Practice of Pharmacy". Lippincott Williams and Wilkins, 20th Edition, 2001.
2.	Gary Walsh., "Biopharmaceuticals", John Wiley & Sons Ltd, UK, 2nd Edition, 2003.
Reference(s):	
1.	Goodman & Gilman's., "The Pharmacological Basis of Therapeutics",11th Edition, Mc Graw-Hill Medical Publishing Division New York, 2006
2.	Gunter Jagschies., Eva Lindskog, Karol Lacki., Parrish Galliher., "Biopharmaceutical Process: Development, Design and Implementation of Manufacturing Processes", Elsevier Publications, 2018
3.	Gary Walsh., "Biopharmaceuticals: Biochemistry and Biotechnology", 2nd Edition, Wiley, 2013.
4.	Kenneth E. Acis., Vincent L. Wu., "Biotechnology and Biopharmaceutical Manufacturing, Processing and Preservation", Drug Manufacturing Technology Series-Vol.2, CRC Press, 2020

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

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Introduction to Pharmacology**	
1.1	Drug- Definition, Classification	1
1.2	Physiochemical Properties of Drugs	1
1.3	Pharmaceutical Substances of Plant, Animal	2
1.4	Pharmaceutical Substances of Microbial Origin	1
1.5	Routes of Administration of Drug	2
1.6	Controlled drug delivery systems	2
2.0	**The Drug Manufacturing Process**	
2.1	The Manufacturing Facility; Cleaning, Decontamination and Sanitation (CDS)	1

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2.2	Documentation, Specifications, Records	1
2.3	Compression and Granulation of Tablets	2
2.4	Coating of Pharmaceutical Dosage Forms-; Film Coating, Modified Release Film Coating	2
2.5	Coating Procedure and Equipment	1
2.6	Quality Control and Practice	2
3.0	**Pharmacokinetics and Biotransformation**	
3.1	Basic Concepts of Pharmacokinetics	1
3.2	Absorption - Mechanism of Drug Absorption	2
3.3	Distribution of Drugs	1
3.4	Biotransformation of Drug-Non Synthetic and Synthetic Reaction	2
3.5	Elimination of Drugs	1
3.6	Organ Clearance- Hepatic Clearance, Renal Clearance	1
3.7	Bioavailability and Bioequivalance	1
4.0	**Pharmaceutical Dosage Forms**	
4.1	Definition of Dosage Forms	1
4.2	Classification of Dosage Forms	1
4.3	Solid Unit Dosages – Tablets, Capsules, Pills, Troches, Cachets	1
4.4	Liquids – Solutions, Lotions, Suspension, Elixirs, Emulsions, Ointments	2
4.5	Semi-Solid – Ointments, Creams, Gels	1
4.6	Inhalations and Inhalants	1
4.7	Extracts: Tinctures and Fluid Extracts	2
5.0	**Biopharmaceuticals Quality Assurance**	
5.1	The Role of FDA (Food and Drug Administration Process)	1
5.2	Role of Centre for Biological Evaluation and Research (CBER)	2
5.3	Role of Centre for Drug Evaluation and Research	1
5.4	Global Harmonization of Regulatory Affairs	1
5.5	European Medicine Evaluation Agency (EMEA)	2
5.6	Indian Pharmacopeia (IP)	1
5.7	United States Pharmacopeia (USP).	1

Course Designer(s)

1. Dr.S.Sidhra – sidhra@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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60 BT 602	Bioprocess Technology	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To learn the product development and recovery in bioprocess technology
- To design a bioreactors and the strategy of scale up reactor for commercial prospects
- To develop and predict the construction of ancillaries for fermenter system
- To enable the knowledge of fluid behaviour and analyse the biodynamic property
- To understand the important concepts of software's in monitoring and validation of Bioprocess Technology

Pre-requisites

- Heat and Mass Transfer, Chemical Reaction Engineering and Biochemical Thermodynamics

Course Outcomes

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

CO1	Enumerate the historical development, types of fermentation process and bio product recovery	Apply
CO2	Design a kinetic parameters of cell growth of structured and unstructured model	Apply
CO3	Apply the concept of design and construction of reactor with its controlling strategies	Apply
CO4	Determine the scale up of the bioreactors with respect to mixing and power consumption	Analyze
CO5	Simulate and validate the protocol of bioprocess technology through soft wares	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 602 - Bioprocess Technology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	1	0	60	4	40	60	100

Introduction to Bioprocess Technology Introduction to Bioprocessing - General Requirements and Types of Fermentation Processes: Designing of Media for Fermentation Process, Aerobic and Anaerobic Fermentation Process - Bio-Product Recovery Process: Filtration, Sedimentation, Centrifugation, Precipitation, and Cell disruption, Chromatography, Crystallization, Lyophilisation and Drying.	[9]
Fermentation Kinetics Medium Requirements for Fermentation Processes - Batch Growth, Balanced Growth, Effect of Substrate Concentration - Monod Model - Determining Cell Kinetic Parameters from Batch Data; Kinetics of Cell Growth- Structured and Unstructured Models. Growth Associated (Primary) and Non-Growth Associated (Secondary) Product Formation Kinetics.	[9]
Process Design and Control of Bioreactors* Bioreactor Design and Construction - Reactor Engineering in Perspective; Types of Reactors (Batch, Fed Batch and Continuous). Design of Stirrers and Impellers; Principles and Strategies for Control of Bioreactors (Feedback, Feed forward, Adaptive and Statistical, Fuzzy Logic Control). Bioprocess Design for Plant and Animal Cell Reactor.	[9]
Rheology, scale up and Hear Mass Transfer Newtonian and Non Newtonian Fluids - Effect of Scale on Oxygenation, Mixing, Sterilization, Nutrient Availability and Supply. Bioreactor Scale- up Based on Constant Power Consumption per Volume, Mixing Time, Impeller Tip Speed (Shear), Oxygen Transfer in Bioreactors, Measurement of Volumetric Mass Transfer Coefficient, Scale-up Criteria for Bioreactors Based on Oxygen Transfer.	[9]
Simulation in Bioprocess Technology Simulation Techniques (Software) - Reactor Design (AutoCAD, ANSYS Fluent,) and Evaluation of Design of Experiments (DOE), Steady State Material and Energy Balance Programs (FLOWTRAN) - Dynamic Simulation of the Bioreactor; Simulation of CSTR in Continuous and Batch reactor Using MATLAB. Application of Modelling and Simulation in Bioprocess Industries.	[9]
Total Hours: 45+ 15 (Toturial)	**60**

Text Book(s):	
1.	Michael L. Shuler, Fikret Kargi, and Matthew DeLisa, “Bioprocess Engineering: Basic Concepts”, 3rd Edition, Prentice Hall, Upper Saddle River, NJ, 2017
2.	Pauline M. Doran, Ross Carlson, and Kate Morrissey. “Bioprocess Engineering Principles”, 3rd Edition., Academic Press Inc., 2024.
Reference(s):	
1.	Shijie Liu, “Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design”, 1st Edition, Elsevier, Amsterdam, Netherlands, 2016
2.	Peter F Stanbury, Allan Whitaker and Stephen J Hall, “Principles of Fermentation Technology”, 3rd Edition, Butterworth-Heinemann, 2016.
3.	Jens Nielsen, John Villadsen, and Gunnar Lidén, “Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists”, 2nd Edition, Springer, Berlin, Germany, 2017.
4.	Shijie Liu, “Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design”, 1st Edition, Elsevier, Amsterdam, Netherlands, 2016.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Bioprocess Technology**	
1.1	Introduction to Bioprocessing: Historical Development of Bioprocess Technology.	1
1.2	General Requirements and Types of Fermentation Processes.	1
1.3	Designing of Media for Fermentation Process	2
1.4	Aerobic and Anaerobic Fermentation Process.	1
1.5	Bio-product Recovery Process: Filtration	1

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1.6	Bio-Product Recovery Process: Sedimentation	1
1.7	Bio-Product Recovery Process: Centrifugation and Cell Disruption.	2
1.8	Bio-Product Recovery Process: Chromatography, Crystallization.	2
1.9	Bio-Product Recovery Process – Drying Methods.	1
2.0	**Fermentation Kinetics**	
2.1	Medium Requirements for Fermentation Processes.	1
2.2	Batch Growth, Balanced Growth, Effect of Substrate Concentration.	2
2.3	Monod Model - Effect of Substrate Concentration and Specific Growth of Micro Organisms	2
2.4	Determining Cell Kinetic Parameters from Batch Data.	2
2.5	Kinetics of Cell Growth- Structured and Unstructured Models	2
2.6	Growth Associated (primary) and Non-Growth Associated (Secondary) Product Formation Kinetics.	3
3.0	**Process Design and Control of Bioreactors**	
3.1	Bioreactor Design and Construction	2
3.2	Reactor Engineering in Perspective. Types of Reactors (Batch, Fed Batch and Continuous).	2
3.3	Design of Stirrers and Impellers	2
3.4	Principles and Strategies for Control of Bioreactors - (Feedback, Feed Forward, Adaptive and Statistical).	2
3.5	Principles and Strategies for Control of Bioreactors - (Statistical, Fuzzy Logic Control).	1
3.6	Bioprocess Design for Plant and Animal Cell Reactor.	3
4.0	**Rheology, Scale up and Hear Mass Transfer****	
4.1	Newtonian and Non Newtonian Fluids.	2
4.2	Effect of Scale on Oxygenation, Mixing, Sterilization.	1
4.3	Effect of Scale on Nutrient Availability and Supply.	1
4.4	Bioreactor Scale up Based on Constant Power Consumption Per Volume.	2
4.5	Bioreactor Scale up based Mixing Time, Impeller tip Speed (shear), Oxygen Transfer in Bioreactors.	2
4.6	Bioreactor Scale up Based on Measurement of Volumetric Mass Transfer Coefficient.	2
4.7	Bioreactor Scale up Based on Scale-up Criteria for Bioreactors Based on Oxygen Transfer.	2
5.0	**Simulation in Bioprocess Technology**	
5.1	Simulation techniques(Software): Advance Simulation Software, Reactor Design (Autocad, ANSYS) Fluent,)	1
5.2	Simulation Techniques Evaluation of Design of Experiments (DOE)	2
5.3	Steady State Material and Energy Balance Programs (FLOWTRAN);	2
5.4	Dynamic Simulation of the Bioreactor.	2
5.5	Simulation of CSTR in Continuous Reactor using MATLAB	2
5.6	Simulation of CSTR in Batch Reactor using MATLAB	2
5.7	Application of Modelling and Simulation in Bioprocess Industries	1

Course Designer(s)

1. Ms.R.Krishnaveni - rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 603	Computer Aided Drug Design	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To understand the process of drug discovery
- To learn the elements of small molecules and representations
- To impart knowledge on the approaches of modeling molecular dynamics
- To understand the concepts involved in Ligand-based and Structure-based drug design
- To apply the acquired rational drug designing Knowledge for in silico Biology applications

Prerequisite

- Biochemistry, Molecular Biology and Bioinformatics Concepts

Course Outcomes

CO1	Acquire the knowledge about protein structure prediction methods, structure visualizations and their importance	Remember
CO2	Explore the basics of bioinformatics, chemo-informatics and how useful for drug designing and discovery process	Understand
CO3	Illuminate the principle and applications of molecular dynamics simulation	Apply
CO4	Explore the concept and SAR, QSAR and their importance in ligand optimization	Apply
CO5	Comprehend the principle, types and various applications of computer aided drug designing and discovery process	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT 603 – Computer Aided Drug Design

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

Drug Discovery Process Targets: Enzymes, Membrane Proteins, DNA And RNA; Target Identification and Validation: Computational Analysis of Nucleic Acid Sequence, Protein Sequence and Structure, Expression Databases and Functional Pathway Data Contained in Databases; Lead Molecule, Lead Identification: from Trial and Error to High Throughput Screening, Assay Development and Qualities of Screening Assay; Lead Optimization: Functional Assays; Pre-Clinical Drug Development.	[9]
Chemoinformatics Small Molecules in Drug Discovery, Chemical Structures and Representations, Chemical Databases and Data Sources, Reaction Databases; Search Methods: Representation and Substructure Search; Descriptors, Physical and Chemical Data, Applications of Chemoinformatics in Drug Discovery – Compound Selection, i*n-Silico* ADMET.	[9]
Molecular Mechanics & Dynamics Molecular Structure, Conformation, Energy Minimization, Quantum Mechanics: Ab *Initio* Methods, Semi-Empirical Methods, Born-Oppenheimer Approximation for Force Field Calculation, Classical Force Fields; Algorithms for Energy Minimization: Simplex, Steepest Descent, Conjugate Gradients; Molecular Mechanics: Algorithms — Verlet Leap Frog & Beeman, Approximations — Periodic Boundary Conditions (PBC), Stochastic Boundary Conditions (SBC); Molecular Dynamics Using Simple Models.	[9]
Analog Based Drug Design Pharmacophores 3D Database Searching, Conformation Searches, Deriving and using 3D Pharmacophore, Constrained Systematic Search, Genetic Algorithm, Clique Detection Techniques, Maximum Likelihood Method; Structure Activity Relationship: Physiochemical Properties (Descriptors) — LogP, Number of Rotatable Bonds, Polar Surface Area, Substituents and Stereochemistry, QSAR: COMFA, COMSIA.	[9]
Structure Based Drug Design* Docking: Definition, Target and Ligand Format Conversion; Searching Methods in Docking: Searching Conformational Space — Before and During Docking, Incremental Docking; Score, Scoring Methods / Functions: Empirical, Force Field, Knowledge, Consensus Scoring; Factors Affecting Docking Score; Software's; Role of Hbonds in Target - Drug Interaction; *de Novo* Drug Design: Principle and Types of Design Methods - Connection Methods, Sequential Grow, Fragment Placements, Virtual Screening	[9]
Total Hours :	**45**

Textbook(s):

1. Norman, P., Ruud, K., Saue, T., "Principles and Practices of Molecular Properties: Theory, Modelling, and Simulations", Wiley, 1st Edition, 2018.
2. Roy, K., Kar, S., Das, R.N., "A Primer on QSAR/QSPR Modelling Fundamental Concepts", Springer Briefs in Molecular 1st Edition Science, , 2015.

Reference(s):

1. Gundertofte, K., Jorgensen, F. S., "Molecular Modelling and Prediction of Bioactivity, Springer, 1st Edition, 2000
2. Höltje, H.D., Folkers, G., Mannhold, R., Kubinyi, H., Timmerman, H., Molecular Modelling - Basic Principles and Application", 3rd Edition,Wiley-VCH, 2008
3. Jensen, J.H., "Molecular Modeling Basics", 1st Edition, CRC Press, 2010.
4. Andrew R. Leach "Molecular Modelling – Principles and Applications"; 2nd Edition, Pearson Education Ltd., UK,2010.

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

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Drug Discovery Process**	
1.1	Targets: Enzymes, Membrane Proteins, DNA and RNA	1
1.2	Target Identification and Validation	1

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1.3	Computational Analysis of Nucleic Acid Sequence, Protein Sequence and Structure	1
1.4	Expression Databases and Functional Pathway Data Contained in Databases	1
1.5	Lead Molecule	1
1.6	Lead Identification: from Trial and Error to High Throughput Screening	1
1.7	Assay Development and Qualities of Screening Assay	1
1.8	Lead Optimization	1
1.9	Functional Assays; Pre-Clinical Drug Development	1
2.0	**Chemoinformatics**	
2.1	Small Molecules in Drug Discovery	1
2.2	Chemical Structures and Representations	1
2.3	Chemical Databases and Data Sources	1
2.4	Reaction Databases; Search Methods	1
2.5	Representation and Substructure Search	1
2.6	Descriptors	1
2.7	Physical and Chemical Data	1
2.8	Applications of Chemo Informatics in Drug Discovery	1
2.9	*In-Silico* ADMET	1
3.0	**Molecular Mechanics & Dynamics**	
3.1	Molecular Structure, Conformation	1
3.2	Quantum Mechanics: Ab-Initio Methods, Semi-Empirical Methods	1
3.3	Born-Oppenheimer Approximation For Force Field Calculation	1
3.4	Classical Force Fields;	1
3.5	Algorithms for Energy Minimization: Simplex, Steepest Descent, Conjugate Gradients	1
3.6	Molecular Mechanics: Algorithms – Verlet Leap Frog & Beeman, Approximations	1
3.7	Periodic Boundary Conditions (PBC)	1
3.8	Stochastic Boundary Conditions (SBC)	1
3.9	Molecular Dynamics Using Simple Models and Continuous Potentials	1
4.0	**Analog Based Drug Design**	
4.1	Pharmacophores 3D Database Searching, Conformation Searches	1
4.2	Deriving and Using 3D Pharmacophore	1
4.3	Constrained Systematic Search, Genetic Algorithm	1
4.4	Clique Detection Techniques, Maximum Likelihood Method	1
4.5	Structure Activity Relationship: Physiochemical Properties (Descriptors)	1
4.6	Logp, Number of Rotatable Bonds	1
4.7	Polar Surface Area, Substituents and Stereochemistry	1
4.8	QSAR: COMFA, COMSIA	2
5.0	**Structure Based Drug Design**	
5.1	Docking: Definition, Target and Ligand Format Conversion	1
5.2	Searching Methods in Docking	1
5.3	Searching Conformational Space – Before and During Docking	1
5.4	Incremental Docking; Score, Scoring Methods/Functions	1
5.5	Empirical, Force Field, Knowledge, Consensus Scoring	1
5.6		
5.7	Role Of Hbonds in Target-Drug Interaction	1
5.8	*de Novo* Drug Design: Principle and Types of Design Methods- Connection Methods, Sequential Grow, Fragment Placements	1
5.9	Virtual Screening	1

Course Designer(s)

1. Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 604	Immunology and Immunotechnology	Category	L	T	P	Credit
		PC	2	0	2	3

Objectives

- To learn the basic concepts of immune response towards various antigens in mammalian host system
- To impart the knowledge of various cells involved in immunity
- To study the mechanism and reactions of immunity towards infectious diseases
- To comprehend the interaction of immune cells during transplantation procedures
- To emphasize their significance in developing therapeutic modalities for immunological disorders of human beings

Pre-requisites

- Biochemistry, Cell Biology and Microbiology

Course Outcomes

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

CO1	Interpret the features of cells, tissues, organs of immune system and nature of antigens	Apply
CO2	Analyze the developmental behaviour of B cells and features of antigen and antibody interaction	Apply
CO3	Explore various stages in development of T cells and biology of antigen processing and presentation.	Apply
CO4	Identify the immune response against infectious diseases and immune deficiency diseases	Apply
CO5	Justify the mechanism of transplant acceptance, rejection and functions of tumor antigen	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 604 – Immunology and Immunotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	2	0	2	60	3	50	50	100

Immune System An Overview of the Immunology - Classification of the Immune ResponseClonal Selection Theory. Cells and Tissues of the Immune System - Haematopoiesis: Origin and Differentiation of Lymphocytes and Phagocytic Cells - Immunogens and Antigens- Haptens - Adjuvants.	[6]
Humoral Immunity* Development - Maturation - Activation and Differentiation of B-Lymphocytes. Antibody: Structure - Classes and Subclasses. Antigen and Antibody Interaction. Complement Pathways — Classical and Alternate Complement Pathway.	[6]
Cellular Immunity * Thymus Derived (T) Lymphocytes: Classification and Stages of Development- T Cell Receptor - Major Histocompatibility Complex – Structure, Classification; Mechanism of Phagocytosis - The Cell Biology of Antigen Processing and Presentation.	[6]
Immunity to Infections and Hypersensivity Reactions Injury and Inflammation; Immune Responses to Infections - Immunity to Viruse & Bacteria — Cytokines — Tolerance - Allergy and Hypersensitivity - Immunization.	[6]
Transplantation and Autoimmunity Transplantation - Types - Immunological Mechanisms of Graft Rejection - Immunological Strategies to Prevent Graft Rejection - Role of Immune Suppressive Drugs - Autoimmunity - Autoimmune Diseases.	[6]
Hands on: 1. Blood Collection and Separation - Serum and Plasma from Whole Blood 2. Identification of Blood Grouping and Rh Typing 3. Preparation of Blood Smear and Identification of Blood Cells. 4. Determination of Haemoglobin. 5. Total WBC Using Haemocytometer 6. Total RBC Count Using Haemocytometer 7. Ouchterlony Double Immune Diffusion (ODID) Test. 8. Immunoelectrophoresis.	[30]
Total Hours: 30 + 30 (Practical)	**60**

Text Book(s):

1. Owen, J., Punt, J and Strandford, S. “Kuby Immunology”, 7th Edition., W. H. Freeman Publication, New York, USA, 2012.
2. Talwar, G. P. and Gupta, S. K. A., “Handbook of Practical and Immunology” CBS Publishers & Distributors, New Delhi, 2004.

Reference(s):

1. Abbas, K. A., Litchman, A. H. and Pober, J. S., “Cellular and Molecular Immunology”, 4th Edition., W. B. Saunders Co.,Pennsylvania, USA, 2005..
2. Roitt, I., Brostoff, J. and David, M., “Immunology”, 6th Edition., Mosby publishers Ltd., New York, USA, 2001.
3. Tizard, R.I.,“Immunology”, 4 th Edition., Saunders College Publishing, Chennai Microprint Pvt. Ltd., Chennai, 2004.
4. Ravi, M., And Paul, S.F.D., “A Practical Manual for Basic Immune Techniques”, Samanthi Publications Pvt. Ltd, Chennai, 2008

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

Passed in BoS Meeting held on 21/05/2024
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Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Immune System**	
1.1	An Overview of the Immunology	2
1.2	Classification of the Immune Response	
1.3	Clonal Selection Theory	
1.4	Cells and Tissues of the Immune System	2
1.5	Haematopoiesis: Origin and Differentiation of Lymphocytes and Phagocytic Cells	
1.6	Primary and Secondary Lymphoid Organs	2
1.7	Immunogens and Antigens - Haptens, Adjuvants	
2.0	**Humoral Immunity**	
2.1	Development – Maturation - Activation and Differentiation of B-Lymphocytes	2
2.2	Antibody: Structure	1
2.3	Antibody: Classes and Subclasses	
2.4	Antibody Diversity	
2.5	Antigen and Antibody Interaction	1
2.6	Complement Pathways	2
2.7	Classical and Alternate Complement Pathway	
3.0	**Cellular Immunity**	
3.1	Thymus Derived (T) Lymphocytes	2
3.2	Classification and Stages of Development	
3.3	T Cell Receptor	
3.4	Major Histocompatibility Complex - Structure	2
3.5	Classification and Genetic Organization of MHC	
3.6	Mechanism of Phagocytosis	1
3.7	The Cell Biology of Antigen Processing and Presentation	1
4.0	**Immunity to Infections and Hypersensivity Reactions**	
4.1	Injury and Inflammation.	1
4.2	Immune Responses to Infections	
4.3	Immunity to Viruse, Bacteria, Immunity Fungi and Parasites	1
4.4	Cytokines - Immunosuppression	1
4.5	Tolerance; Allergy and Hypersensitivity	1
4.6	AIDS and Other Immuno Deficiencies	1
4.7	Immunization	1
4.8	Vaccines	
5.0	**Transplantation and Autoimmunity**	
5.1	Transplantation: Types	1
5.2	Immunological Mechanisms of Graft Rejection	1
5.3	Immunological Strategies to Prevent Graft Rejection	1
5.4	Role of Immune Suppressive Drugs	1
5.5	Autoimmunity	1
5.6	Mechanism – Autoimmune Diseases	1
Practical:		
1.	Blood Collection and Separation - Serum and Plasma from Whole Blood	4
2.	Identification of Blood Grouping and Rh Typing.	3
3.	Preparation of Blood Smear and Identification of Blood Cells	4
4.	Determination of Haemoglobin	4

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5.	Total WBC using Haemocytometer	4
6.	Total RBC Count using Haemocytometer	4
7.	Ouchterlony Double Immune Diffusion (ODID) Test	3
8.	Immunoelectrophoresis	4

Course Designer(s)

1. Dr. K. Syed Zameer Ahmed - syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

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

Objectives

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

Pre-requisites

- Basic knowledge of reading and writing in English

Course Outcomes

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

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

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
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BOS- Chairman

Syllabus

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

Introduction to Entrepreneurship & Entrepreneur Meaning and Concept of Entrepreneurship, The History of Entrepreneurship Development, Myths of Entrepreneurship, Role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management and Future of Entrepreneurship. The Entrepreneur: Meaning, The Skills Required to Be An Entrepreneur, The Entrepreneurial Decision Process, Role Models, Mentors and Support System.Innovation and Creativity, Types of Innovations, Innovations in Current Scenario	[6]
Problem-Opportunity Identification, Customers Discovery and Competitive Advantage Understanding the Problem and Opportunity, Define Problem using Design Thinking Principles and Validate Problem. Exploring Market types and Estimating the Market Size, Knowing your Customer and Consumer, Customer Segmentation and Creating Customer Personas. Importance of Value Proposition, Value Proposition Canvas, Developing Problem-Solution Fit, Competition Analysis, Blue Ocean Strategy, Competitive Positioning and Understanding Unique Selling Points.	[6]
Business Model and Build your MVP Introduction to Business Model and Types, Lean Approach, 9 Block Lean Canvas Model, Riskiest Assumptions to Business Models. Prototyping, Building a Minimum Viable Product, Hypothesis Testing and MVP Validation, MVP Iteration-Importance of Build - Measure — Learn Approach	[6]
Business Plan, Financial Feasibility and Managing Growth Business Planning: Components of Business Plan- Sales Plan, People Plan and Financial Plan, Preparing a Business Plan. Financial Planning: Types of Costs, Preparing the Financial Plan using Financial Template, Understanding Basics of Unit Economics and Analyzing Growth and the Financial Performance	[6]
Go to Market Strategies and Funding Introduction to Go to Market Strategies, Start-Up Branding and its Elements, Selecting the Right Channel, Creating Digital Presence, Building Customer Acquisition Strategy. Choosing a Form of Business Organization Specific to your Venture, Identifying Sources of Funds: Debt & Equity, Map the Start-Up Lifecycle to Funding Options, Build an Investor Ready Pitch Deck.	[6]
Total Hours:	**30**

Text Book(s):	
1.	Stephen Key, “One Simple Idea for Startups and Entrepreneurs: Live Your Dreams and Create Your Own Profitable Company” 1st Edition, Tata Mc Grawhill Company, New Delhi, 2013.
2.	Charles Bamford and Garry Bruton, “Entrepreneurship: The Art, Science, and Process for Success”, 2nd Edition, Tata Mc Grawhill Company, New Delhi, 2016.
Reference(s):	
1.	Philip Auerswald, “The Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy”, Oxford University Press, 2012.
2.	Janet Kiholm Smith; Richard L. Smith Richard T. Bliss, “Entrepreneurial Finance: Strategy, Valuation and Deal Structure, Stanford Economics and Finance”, 2011.
3.	Edward D. Hess, “Growing an Entrepreneurial Business: Concepts and Cases”, Stanford Business Books, 2011.
4.	Ignite program, wadhwani platform, Entrepreneurship, NPTEL online course By Prof. C Bhaktavatsala Rao | IIT Madras

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Entrepreneurship & Entrepreneur**	
1.1	Meaning and Concept of Entrepreneurship and the History of Entrepreneurship Development	1
1.2	The Entrepreneur: Meaning, the Skills Required to be an Entrepreneur, The Entrepreneurial Decision Process,	1

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1.3	Myths of Entrepreneurship, How to Become a Successful Entrepreneur - Dr Romesh Wadhwani (Platform on Boarding)	1
1.4	Role Models, Mentors and Support System- Masterclass on my Story - Joshua Salins	1
1.5	Role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management and Future of Entrepreneurship	1
1.6	Innovation and Creativity, Types of Innovations, Innovations in Current Scenario, Concepts of Entrepreneurial Thinking, General Enterprising Tendency Test	1
2.0	**Problem-Opportunity Identification, Customers Discovery and Competitive Advantage**	
2.1	Understanding the Problem and Opportunity, Define Problem using Design Thinking Principles and Validate Problem. Case Study and Fireside Chat — Desi Hangover	1
2.2	Identifying a Problem for Practice Venture and Filling Problem Statement Canvas (Handout Week 1 - Class Activity)	1
2.3	Customer and Markets Discovery , Knowing your Customer and Consumer, Customer Segmentation and Exploring Market Types and Estimating the Market Size. Case Study and Fireside Chat – Verloop	1
2.4	Creating Customer Personas & Market Estimation (Handout Week 2 - Class Activity)	1
2.5	Importance of Value Proposition, Introduce Value Proposition Canvas, Developing Problem-Solution Fit. Case Study and Fireside Chat – Honey Twigs	1
2.6	Competition Analysis, Blue Ocean Strategy, Competitive Positioning and understanding Unique Selling Points. Case Study and Fireside Chat on Inzpira Fill Value Proposition Canvas (Handout Week 3 - Class Activity) and Competition Analysis Framework (Handout Week 5 - Class Activity) **Briefing On Assignment 1 - Milestone 1**	1
3.0	**Business Model and Build your MVP**	
3.1	Introduction to Business Model and Types. Case Study and Fireside Chat — NUOS	1
3.2	Lean Approach, 9 Block Lean Canvas Model, Riskiest Assumptions to Business Models	1
3.3	Class Activity- Fill Lean Canvas For You Idea And Understand Revenue Model (Handout Week 6)	1
3.4	Prototyping, Meaning of MLP , Difference Between MLP and MVP, How to Build an MLP? Different Types MLP that you Can Build. Case Study and Fireside Chat — KNORISH	1
3.5	Hypothesis Testing and MVP Validation, MVP Iteration-Importance of Build - Measure — Learn Approach	1
3.6	Class Activity- Fill MVP Framework (Handout Week 7) and Learn Validation	1
4.0	**Business Plan, Financial Feasibility and Manging Growth**	
4.1	Business Planning: Components of Business Plan- Sales Plan, People Plan and Financial Plan, Preparing a Business Plan. Case Study and Fireside Chat – Bodh Gems	1
4.2	Financial Planning: Types of Costs, Preparing the Financial Plan using Financial Template (Handout Week 9)	1
4.3	Class Activity - Starting up Costs, COGS, Sales Plan and People Plan Template.	1
4.4	Class Activity - One Year P&L Projection, Breakeven Analysis, Five Year Projection	1
4.5	Understanding Basics of Unit Economics and Analyzing Growth and the Financial Performance	1
4.6	Class Activity - Financial Template - Unit Economics (Handout Week 12)	1
5.0	**Go to Market Strategies and Funding**	
5.1	Introduction to Go to Market Strategies, Start-up Branding and its Elements, Selecting the Right Channel	1
5.2	Creating Digital Presence, Building Customer Acquisition Strategy.	1
5.3	Class Activity: Handout Week 10 - Create your GTM Strategy	1
5.4	Choosing a Form of Business Organization Specific to your Venture	1

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5.5	Identifying Sources of Funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options	1
5.6	Class Activity - Visit Relevant GOI Websites, Other Sites to Help Students Explore Funding Opportunities and **Briefing on Final Submission of the Pitch Deck** Build an Investor Ready Pitch Deck, What Should you Cover in your Pitch Deck? Art of Pitching and Story telling	1

Course Designer(s)

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 6P1	Computer Aided Drug Design Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To understand the process of drug discovery
- To learn the elements of small molecules and representations
- To impart knowledge on the approaches of modeling molecular dynamics
- To understand the concepts involved in Ligand-based and Structure-based drug design
- To apply the acquired rational drug designing Knowledge for in silico Biology applications

Pre-requisites

- Biochemistry, Molecular Biology and Bioinformatics concepts

CO1	Comprehend the process of drug discovery pipeline.	Apply
CO2	Represent and prepare small molecules for drug design	Apply
CO3	Apply appropriate mathematical and statistical methods defining molecular dynamic simulation	Apply
CO4	Relate structural and functional data for molecule-based drug design	Analyse
CO5	Prepare and define active site for structure-based drug design	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology–Autonomous R2022

B.Tech - Biotechnology

60 BT 6P1 – Computer Aided Drug Design Laboratory

Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Constructing Computational Model of a Molecule
2. Template Detection, Alignment and 3D Modelling using SBDD Approach (HHpred, I-TASSER)
3. To Minimize a Molecule to Obtain a Stable Conformer using Avogadro Tool.
4. To Calculate the Distances between the Ligand and a Particular Aminoacid of a Given Protein using PyMol.
5. Absorption and Distribution Property Prediction in Drug Designing Process*****
6. Calculate the Binding Site and Prediction of Cavity using CASP
7. Drug-Receptor Interaction using Autodock / Autodock Vina and Virtual Screening by SWISS ADME*****
8. Performs Biomolecular Simulation Programs using GROMACS

Design Experiments:

9. Perform a Design Experiment on Bio molecular, Protein-Protein Interactions using Autodock / Arguslab
10. Built Pharmacophore Models on Common Active Molecules using Pharmer as a Design Experiment

Lab manual:

1. "Lab Manual Computer- Aided Drug Design Laboratory", Department of Biotechnology, KSRCT.

***SDG 3 – Good Health and Well Being**

Course Designer(s)

1. Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 6P2	Bioprocess Technology Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To understand the industrial requirement of fermentation process for bio-product
- To study the different factors affecting the yield and biomass of product
- To empower the knowledge of mixed flow reactor and its estimation of KLa value
- To illustrate the various unit operation involved in product development
- To demonstrate the aspects of modelling and simulation in Bioprocess Technology

Pre-requisites

- Protein and Enzyme Engineering Laboratory

Course Outcomes

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

CO1	Handle the techniques of media optimization and determine the Kla for bioprocess.	Apply
CO2	Illustrate the concept of microbial growth and its thermal death kinetics.	Apply
CO3	Demonstrate the kinetics of mixed flow reactor and the role of Kla through sodium oxidation method.	Apply
CO4	Determine the biomass coefficient of yeast and demonstrate the simulation software for bioreactor.	Apply
CO5	Demonstrate the production of industrial enzymes through modelling in the system.	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022							
B. Tech- Biotechnology							
60 BT 6P2 – Bioprocess Technology Laboratory							
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**	
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Media Optimization – Plackett Burman Design using Artificial Neural Network (MATLAB)
2. Determination of Kla Value by Gassing Out Method
3. Evaluation of Parameters on Monod Model for Growth of Microorganism
4. Thermal Death Kinetics of Microorganisms
5. Determination of Kla by Sodium Supplied Oxidation Method
6. Determination of Yield and Biomass Coefficient of Yeast on Glucose.
7. Modelling of Batch, Fed Batch and Continuous Using MATLAB
8. Solid State Fermentation Process of Production of Industrial Enzymes**

Design Experiments:

9. Extraction and Production of protease enzyme activity from microbial source***

10. Production of secondary metabolites in synthetic media using fermenter

Lab Manual

1.	"Bioprocess Technology Lab Manual", Department of Biotechnology, KSRCT.

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 3 – Good Health and Well Being**
*****SDG 7 – Affordable and Clean Energy**

Course Designer(s)

1. Ms.R.Krishnaveni– rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 CG 0P5	Comprehension Test*	Category	L	T	P	Credit
		CG	0	0	2	1$

Objectives

- To evaluate the knowledge gained in core courses relevant to the programme of study
- To assess the technical skill in solving complex engineering problems

Prerequisite

- Fundamental knowledge in all core subjects

Course Outcomes

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

CO1	Infer knowledge in their respective programme domain	Apply
CO2	Attend interviews for career progression	Apply
CO3	Exhibit professional standards to solve engineering problems	Apply
CO3	Promote holistic approach to problem solving	Apply
CO5	Examine the competency of graduates in specific programme domain	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

The overall knowledge of the candidate in various courses he/she studied shall be evaluated with multiple choice questions.

***SDG:4- Quality Education**

Passed in BoS Meeting held on 21/05/2024
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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215
(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted in 2024-2025)

SEVENTH SEMESTER

S. No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60HS 002	Engineering Economics and Financial Accounting	2	40	60	100	45	100
2	60 BT 701	AI for Biotechnology	2	40	60	100	45	100
3	60 BT 702	Downstrea m Processing	2	40	60	100	45	100
4	60 BT E3*	Professional Elective – III	2	40	60	100	45	100
5	60 BT E4*	Professional Elective – IV	2	50	50	100	45	100
6	60 AC 001	Research Skill Development	2	40	60	100	45	100
7	60 AB 00*	NCC/NSS/NSO/YRC/RRC/Fine Arts	2	50	50	100	45	100
PRACTICAL								
8	60 BT 7P1	Biological Data Analysis Laboratory	3	60	40	100	45	100
9	60 BT 7P2	Downstream Processing Laboratory	3	60	40	100	45	100
10	60 BT 7P3	Project Work - Phase 1	3	100	-	100	-	100
11	60 CG 0P6	Internship	-	100	-	100	-	100

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

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 HS 002	Engineering Economics and Financial Accounting	Category	L	T	P	Credit
		HS	3	0	0	3

Objectives

- To know about the economic principles underlying demand, supply, and market structure
- To understand the concept related to types of business organization and types of banking
- To know about concepts in financial accounting and capital budgeting
- To understand the different methods of pricing and appraisal of projects
- To know the application of break-even analysis in engineering projects

Pre-requisites

- NIL

Course Outcomes

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

CO1	Apprehend the basic concepts of economics, demand, supply, and market structure	Understand
CO2	Comprehend the forms of business organization and functions of commercial and central bank	Understand
CO3	Comprehend the basis of financial accounting and capital budgeting techniques	Understand
CO4	Apply different types of pricing strategies and comprehensive project feasibility in diverse business	Apply
CO5	Apply break even analysis in engineering projects and business	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	25	25	35
Understand	35	25	45
Apply	-	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to CIVIL, EEE, ECE, CSE, IT, AI&DS, CSE(AIML), EE(VLSI D&T), BT, FT								
60 HS 002 – Engineering Economics and Financial Accounting								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Basic Economics Definition of Economics – Nature and Scope of Economics, Basic Concepts of Economics, Factors of Production - Definition of Demand – Law of Demand, Exception to Law of Demand, Factors Affecting Demand, Elasticity of Demand, Demand Forecasting – Definition of Supply – Factors Affecting Supply, Elasticity of Supply – Market Structure – Perfect Competition, Imperfect Competition – Monopoly, Duopoly, Oligopoly, and Bilateral Monopoly.	[9]
Organization and Business Financing* Forms of Business – Sole Proprietorship, Partnership, Joint Stock Company, Cooperative Organization, State Enterprise - Mixed Economy - Money and Banking – Kinds of Banking, Functions of Commercial Banks and Central Bank – Definition of Monetary Policy and its Types — Types of financing - Short Term Borrowing, Long Term Borrowing - Internal Generation of Funds – External Commercial Borrowings.	[9]
Financial Accounting and Capital Budgeting The Balance Sheet and Related Concepts – The Profit and Loss Statement and Related Concepts – Financial Ratio Analysis – Definition of Working Capital – Types, Factors – Definition of Capital Budgeting - Techniques – Average Rate of Return, Payback Period, Net Present Value, Profitability Index Method and Internal Rate of Return.	[9]
Cost Analysis Types of Costing – Traditional Costing Approach - Activity Based Costing - Fixed Cost – Variable Cost – Marginal Cost – Cost Output Relationship in the Short Run and in Long Run – Pricing Practice – Full Cost Pricing – Marginal Cost Pricing – Going Rate Pricing – Bid Pricing – Pricing for a Rate of Return – Project Appraisal - Appraisal process, - Cost Benefit Analysis – Feasibility Reports — Technical Feasibility, Economic Feasibility, Financial Feasibility, Managerial Feasibility, Operational Feasibility.	[9]
Break Even Analysis Basic Assumptions –Break-Even Chart – Profit Zone in Break-Even Chart, Loss Zone in Break-Even Chart, Angle of Incidence — Managerial Use of Break-Even Analysis, Applications of Break-Even Analysis in Engineering Projects.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Khan M.Y., Jain P.K., " Financial Management", 8rd Edition, McGraw Hill Education, 2018.
2.	Maheshwari K.L., Varshney R.L., "Managerial economics", 22nd Edition, S Chand and Co., New Delhi, 2018.
Reference(s):	
1.	Samuelson P.A., " Economics - An Introductory", 16th Edition, New Age Publications, New Delhi, 2019.
2.	Barthwal R.R., " Industrial Economics - An Introductory", 4th Edition, New Age Publications, New Delhi, 2021.
3.	Bhattacharyya S. K., John Deardon, "Accounting for Management Text and Cases", 3rd Edition, S Chand Publication, 2018.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basic Economics**	
1.1	Definition of economics – Nature and Scope of Economics	1
1.2	Basic Concepts of Economics, Factors of Production	1
1.3	Definition of Demand – Law of Demand	1
1.4	Exception to Law of Demand	1
1.5	Factors Affecting Demand, Elasticity of Demand	1
1.6	Demand Forecasting	1
1.7	Definition of Supply – Factors Affecting Supply, Elasticity of Supply	1

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1.8	Market Structure – Perfect Competition, Imperfect Competition	1
1.9	Monopoly, Duopoly, Oligopoly, and Bilateral Monopoly	1
2.0	**Organization and Business Financing**	
2.1	Forms of Business – Sole Proprietorship, Partnership	1
2.2	Joint Stock Company, Cooperative Organization, State Enterprise	1
2.3	Mixed Economy - Money and banking	1
2.4	Kinds of Banking	1
2.5	Functions of Commercial Banks and Central Bank	1
2.6	Definition of Monetary Policy and its Types	1
2.7	Types of Financing	1
2.8	Short Term Borrowing, Long Term Borrowing	1
2.9	Internal Generation of Funds, External Commercial Borrowings	1
3.0	**Financial Accounting and Capital Budgeting**	
3.1	The Balance Sheet and Related Concepts	1
3.2	The Profit and Loss Statement and Related Concepts	1
3.3	Financial Ratio Analysis	2
3.4	Definition of Working Capital – Types, Factors	2
3.5	Definition of Capital Budgeting - Techniques	1
3.6	Average Rate of Return, Payback Period	1
3.7	Net Present Value, Profitability Index Method and Internal Rate of Return	1
4.0	**Cost Analysis**	
4.1	Types of Costing - Traditional Costing Approach - Activity Based Costing	1
4.2	Fixed Cost – Variable Cost – Marginal Cost	1
4.3	Cost Output Relationship in the Short Run and in Long Run	1
4.4	Pricing Practice – Full Cost Pricing	1
4.5	Marginal Cost Pricing, Going Rate Pricing	1
4.6	Bid Pricing, Pricing for a Rate of Return	1
4.7	Project Appraisal - Appraisal Process - Cost Benefit Analysis	1
4.8	Feasibility Reports -— Technical Feasibility, Economic Feasibility	1
4.9	Financial Feasibility, Managerial Feasibility, Operational Feasibility	1
5.0	**Break Even Analysis**	
5.1	Basic Assumptions – Break-Even Chart	2
5.2	Profit Zone in Break-Even Chart, Loss Zone in Break-Even Chart	2
5.3	Angle of Incidence	1
5.4	Managerial Use of Break-Even Analysis	2
5.5	Applications of Break-Even Analysis in Engineering Projects	2
	Total	**45**

Course Designer(s)

1. Mr.V.S.Vijayachander - vijayachander@ksrct.ac.in
2. Dr.E.kalaivani - kalaivanie@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 701	AI for Biotechnology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To identify problems where artificial intelligence techniques are applicable
- To apply selected basic AI techniques; judge applicability of more advanced techniques
- To participate in the design of systems that act intelligently and learn from experience
- To provide a basic understanding of machine learning on molecular data
- To learn how to use deep learning for understanding biophysical systems

Pre-requisites

- Bioinformatics concepts

Course Outcomes

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

CO1	Develop semantic-based and context-aware systems to acquire, organize process, share and use the knowledge embedded in multimedia content	Understand
CO2	Research will aim to maximize automation of the complete knowledge lifecycle and achieve semantic interoperability between Web resources and services	Understand
CO3	Predict the interaction of drug-like molecules with protein.	Apply
CO4	Apply molecular descriptor properties for new ligand molecule	Apply
CO5	Apply deep learning in a genetics, drug discovery, and medical diagnosis applications	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology–Autonomous R2022								
B.Tech - Biotechnology								
60 BT 701 – AI for Biotechnology								
Semester	Hours/Week			TotalHrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

The Fundamentals of Machine Learning* Machine Learning Landscape, Types of Machine Learning Systems — Supervised / Unsupervised Learning, Main Challenges of Machine Learning - Insufficient Quantity of Training Data, Testing and Validating	[9]
Deep Learning Principles Linear Models, Multilayer Perceptrons, Training Models, Validation, Regularization, Hyperparameter Optimization, Other Types of Models - Convolutional Neural Networks, Recurrent Neural Networks	[9]
Machine Learning with DeepChem* Deepchem Datasets, Training a Model to Predict Toxicity Of Molecules, Case Study, Training An MNIST Model - The MNIST Digit Recognition Dataset-A Convolutional Architecture for MNIST.	[9]
Machine Learning for Molecules* Molecule and Molecular Bonds, Molecular Graphs, Molecular Conformations, Chirality of Molecules, Featurizing a Molecule, SMILES Strings and Rdkit, Extended-Connectivity Fingerprints, Molecular Descriptors.	[9]
Deep Learning for Genomics and Medicine* DNA, RNA, and Proteins, Micro RNAs and Short Interfering RNA (siRNA) , Transcription Factor Binding, A Convolutional Model for Transcription Factor (TF) Binding, Chromatin Accessibility, RNA Interference, Computer-Aided Diagnostics, Probabilistic Diagnoses with Bayesian Networks, Electronic Health Record Data, Deep Radiology, X-Ray Scans and CT Scans, Histology, MRI Scans.	[9]
Total Hours:	**45**

Textbook(s):

1. Deep learning for the life sciences: Applying deep learning to genomics, microscopy, drug discovery, and more, by Ramsundar, B., Eastman, P., Walters, P., and Pande, V, 2019, O'Reilly Media, Inc., Sebastopol, California, USA.

Reference(s):

1. Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, Agenda Item 65/36 - Annexure - 32 Proceedings of the 65th Academic Council (17.03.2022) 694 and techniques to build intelligent systems, by Aurélien Géron, 2019, O'Reilly Media, Inc., Sebastopol, California, USA

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**The Fundamentals of Machine Learning**	
1.1	Machine Learning Landscape	1
1.2	Types of Machine Learning Systems	2
1.3	Supervised / Unsupervised learning	2
1.4	Main Challenges of Machine Learning	2
1.5	Insufficient Quantity of Training Data	1
1.6	Testing and Validating	1
2.0	**Deep Learning Principles**	
2.1	Linear Models	1
2.2	Multilayer Perceptrons	2
2.3	Training Models & Validation	3
2.4	Regularization & Hyperparameter Optimization	1
2.5	Other Types of Models - A Convolutional Architecture for MNIST	2
3.0	**Machine Learning with DeepChem**	

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Approved in Academic Council Meeting held on 25/05/2024

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3.1	Deepchem Datasets	1
3.2	Training a Model to Predict	1
3.4	Toxicity of Molecules	1
3.5	Case Study	1
3.6	Training an MNIST Model	1
3.7	The MNIST Digit Recognition Dataset	2
3.8	A Convolutional Architecture for MNIST	1
4.0	**Machine Learning for Molecules**	
4.1	Molecule and Molecular Bonds	1
4.2	Molecular Graphs, Molecular Conformations	1
4.3	Chirality of Molecules	2
4.4	Featurizing a Molecule	1
4.5	SMILES Strings and Rdkit	1
4.6	Extended-Connectivity Fingerprints	2
4.7	Molecular Descriptors	1
5.0	**Deep Learning for Genomics and Medicine**	
5.1	DNA, RNA, and Proteins	1
5.2	Micro RNAs and Short Interfering RNA (siRNA)	1
5.4	Transcription Factor Binding	1
5.5	A Convolutional Model for Transcription Factor (TF) Binding	1
5.6	Chromatin Accessibility, RNA Interference,	1
5.7	Computer-Aided Diagnostics, Probabilistic Diagnoses with Bayesian Networks	1
5.8	Electronic Health Record Data, Deep Radiology, X-Ray Scans and CT Scans,	1
5.9	Histology, MRI Scans	1

Course Designer(s)

1. Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 702	Downstream Processing	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To learn various unit operations and their applications in downstream processing of bioproducts
- To provide knowledge on downstream processing economics
- To emphasis the need for separation techniques in downstream processing
- To acquire knowledge in recovery, purification and formulation of bioproducts of commercial interest.
- To understand the final purification strategies adopted in industrial operations

Pre-requisites

- Basic knowledge in Unit operations, Fluid mechanics, Chemical kinetics and Bioprocess Engineering

Course Outcomes

CO1	Comprehend cost cutting strategies and bioproduct release kinetics	Apply
CO2	Interpret the design and principle of filtration and centrifugation	Apply
CO3	Identify suitable unit operation for bioproduct recovery and concentration	Apply
CO4	Demonstrate and apply the principles and operation of chromatographic Techniques	Apply
CO5	Discuss the operational requirements of industrial crystallizers and lyophilizer	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

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

B. Tech - Biotechnology

60 BT 702 – Downstream Processing

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

Introduction to downstream and intracellular product release Introduction to Downstream Processing - Characteristics of Biomolecules - Economics of Downstream Processing - Cost Cutting Strategies- Physico Chemical Basis of Bioseparation - Cell Disruption Methods: Mechanical, Chemical and Enzymatic Process; Pretreatment and Stabilization of Bioproducts. **Case studies**.	**[9]**
Primary separation and isolation Principle of Batch Filtration - Pretreatment of Fermentation Broth, Industrial Filters: Plate and Frame Filter Press, Leaf Filter, Continuous Filtration: Rotary Drum Filter - Calculations in Batch and Continuous Filtration - Centrifugation: Principle and Types of Industrial Centrifuges - Scale Up of Centrifugation. **Case studies.**	**[9]**
Product recovery and concentration* Adsorption: Isotherms, Batch, Continuous Operations- Principle of Aqueous Two Phase and Supercritical Fluid Extraction - Membrane Separation Processes: Microfiltration, Ultrafiltration, Reverse Osmosis and Dialysis, Precipitation of Proteins by Different Methods. **Case studies**	**[9]**
Product purification by chromatography* Principle and Practice, Ion Exchange, Size Exclusion, Bioaffinity, Hydrophobic Interaction, Reverse Phase, Pseudo Affinity Chromatography, High Performance Liquid Chromatography, Flash Chromatography and Gas Chromatographic Separation Techniques. **Case studies**.	**[9]**
Final product purification and polishing Crystallization: Nucleation, Crystal Growth, Crystal Size Distribution, Kinetics of Crystallization, Industrial Crystallizers, Recrystallization; Drying - Drying Terminologies, Drying Curve, Industrial Dryers, Freeze Drying Principles and Applications. **Case studies.**	**[9]**
Total Hours	**45**

Text book(s):

1.	Belter P. A., Cussler E.L. and Wei-Houhu, "Bioseparations - Downstream Processing For Biotechnology", Wiley Interscience Pub.,
2.	Roger.G, Harrison, Paul Todd, Scott R.Rudge and Demetri P.Petrides, "Bioseperation Science and Engineering" OxfordUniversityPress, Newyork , 2015.

Reference(s):

1. .	R.O. Jenkins, (Ed.), Product Recovery in Bioprocess Technology – Biotechnology, Open Learning Series,Butterworth- Heinemann,1992.
2.	Raja Ghosh (2006) Principles of Bio separation engineering, World Scientific Publishing Co Pvt ltd
3.	Ladisch, M.R., (2001), Bio separation Engineering: Principles, Practice and Economics, Wiley, Interscience
4.	Sivasankar B., "Bioseparations - Principles and Techniques", Prentice Hall of India Private Limited, New Delhi, 2006.
5.	Nooralabettu Krishna Prasad, "Downstream Process Technology - A New Horizon in Biotechnology", PHI Learning Private Limited,New Delhi, 2012.

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

Course Contents and Lecture Schedule

S. No	Topic	No. of Hours
1.0	**Introduction to Downstream and Intracellular Product Release**	
1.1	Introduction to Downstream Processing	1
1.2	Characteristics of Biomolecules	1
1.3	Economics of Downstream Processing &Cost Cutting Strategies	1
1.4	Physico Chemical Basis of Bioseparation	2
1.5	Cell Disruption Methods: Mechanical, Chemical and Enzymatic Methods	2
1.6	Pretreatment and Stabilization of Bioproducts	2

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2.0	**Primary Separation and Isolation**	
2.1	Principle of Batch Filtration	1
2.2	Pretreatment of Fermentation Broth	1
2.3	Industrial Filters: Plate and Frame Filter Press, Leaf Filter	1
2.4	Continuous Filtration: Rotary Drum Filter	1
2.5	Calculations in Batch and Continuous Filtration	2
2.6	Centrifugation: Principle and Types of Industrial Centrifuges	1
2.7	Scale up of Centrifugation	1
2.8	Case Studies	1
3.0	**Product Recovery and Concentration**	
3.1	Adsorption: Isotherms	1
3.2	Batch, Continuous Operations	1
3.3	Aqueous Two- Phase Extraction	1
3.4	Supercritical Fluid Extraction	1
3.5	Membrane Separation Processes: Microfiltration, Ultrafiltration	1
3.6	Reverse Osmosis and Dialysis,	1
3.7	Precipitation of Proteins by Different Methods	2
3.8	Case Studies	1
4.0	**Product Purification by Chromatography**	
4.1	Principle and Practice of Ion Exchange Chromatography	1
4.2	Size Exclusion Chromatography	1
4.3	Bioaffinity Chromatography	1
4.4	Hydrophobic Interaction Chromatography	1
4.5	Reverse Phase Chromatography & Pseudo Affinity Chromatography	1
4.6	High Performance Liquid Chromatography	1
4.7	Gas Chromatography	1
4.8	Flash Chromatography	1
4.9	Case Studies	1
5.0	**Final Product Purification and Polishing**.	
5.1	Crystallization: Nucleation, Crystal Growth, Crystal Size Distribution, Kinetics Of Crystallization	2
5.2	Industrial Crystallizers	1
5.3	Drying - Drying Terminologies & Drying Curve	2
5.4	Industrial Dryers	1
5.5	Freeze Drying Principles and Applications	2
5.6	Case Studies	1

Course Designer(s)

1. Dr.S.Poornima - spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 AC 001	Research Skill Development	Category	L	T	P	Credit
		AC	1	0	0	0

Objectives

- To identify research problems, formulate hypotheses, collect data and test hypotheses
- To prepare and submit quality manuscripts and understand peer review process
- To utilize software tools for effective manuscript preparation and visualization of research data
- To familiarize different journal metrics and author-level quality indicators
- To protect creative works, inventions, and branding elements using IPR

Pre-requisites

- NIL

Course Outcomes

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

CO1	Develop structured scientific approach to plan and execute research work	Apply
CO2	Comply with the journal requirements to publish research findings effectively	Understand
CO3	Apply various software tools during the manuscript preparation	Apply
CO4	Select suitable journals to publish the work using different publication metrics	Analyse
CO5	Apply the appropriate form of IP protection to a specific invention or creation	Apply

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

One review at end of the semester

Parameters	Weightage (Marks)
Research Problem Identification (Research gap, SDG, Objectives)	10
Literature Review preparation (Clarity, Number and quality of sources)	20
Patent Draft/ Manuscript Preparation (Structure, Content)	20
Use of software tools (Plagiarism, Reference Management, etc.,)	10
Journal Identification (Aim & scope of the journal, journal metrics)	10
Presentation & Viva voce	30
Total	**100**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
60 AC 001 – Research Skill Development								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	1	0	0	15	0	100	-	100

Research - Scientific Approach* Types of Research - Identification and Clarification of the problem - Formulating hypothesis, Selection of sample and tools of data collection - Testing the hypothesis - Conclusion	[3]
Manuscript Preparation* Structure of a manuscript - Types of manuscript - Graphical abstract - Highlights - Literature Review - Citation - Reference style - Plagiarism — Journal selection - Peer review process	[3]
Research Toolkit* Software Tools for Writing enhancement - Literature review - Reference management - Data analysis and visualization - Drawing - Plagiarism	[3]
Research Publication Metrics* Journal Index: Scopus - Web of Science - SCI - UGC Care - Q Journal; Journal Metrics: Impact Factor, Cite Score; Quality Indicators: h-index - i-10 index - citations	[3]
Intellectual Property Rights* Patents - Industrial Designs - Copyright - Trademarks - Geographical Indications - Trade Secrets	[3]
Total Hours:	**15**

Reference(s):

1.	Kothari, C.R. and Gaurav Garg, “Research Methodology: Methods and Techniques”, New Age International Publishers, 2023
2.	Chawla H S., “Introduction to Intellectual Property Rights”, CBS Publishers and Distributors Private Limited, 2019

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Research - Scientific Approach**	
1.1	Types of Research - Identification and Clarification of the problem - Formulating hypothesis	2
1.2	Selection of sample and tools of data collection - Testing the hypothesis - Conclusion	1
2	**Manuscript Preparation**	
2.1	Structure of a manuscript - Types of manuscript - Graphical abstract - Highlights	1
2.2	Literature Review	1
2.3	Citation - Reference style – Plagiarism, Journal selection - Peer review process	1
3	**Research Toolkit**	
3.1	Software Tools for Writing enhancement	1
3.2	Literature review, Reference management	1
3.3	Data analysis and visualization – Drawing, Plagiarism	1
4	**Research Publication Metrics**	
4.1	Journal Index: Scopus - Web of Science - SCI - UGC Care - Q Journal;	1
4.2	Journal Metrics: Impact Factor, Cite Score	1
4.3	Quality Indicators: h-index - i-10 index - citations	1
5	**Intellectual Property Rights**	
5.1	Patents	1
5.2	Industrial Designs - Copyright	1
5.3	Trademarks - Geographical Indications - Trade Secrets	1

Course Designer(s)

1. Dr.M.Kathirselvam - mkathirselvam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 AB 001	National Cadet Corps (Air Wing)	Category	L	T	P	Credit
		HS	2	0	2	3

Objectives

- To designed especially for NCC Cadets to educate basic military knowledge
- To develop character, camaraderie, discipline, secular outlook
- To inculcate spirit of adventure, sportsman spirit
- To teach selfless service amongst cadets by working in teams
- To learning military subjects including weapon training and motivate them to join in tri-services

Pre-requisites

- NIL

Course Outcomes

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

CO1	Display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion	Remember
CO2	Demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Remember
CO3	Illustrate various forces and moments acting on aircraft	Understand
CO4	Outline the concepts of aircraft engine and rocket propulsion	Understand
CO5	Design, build and fly chuck gliders/model airplanes and display static models	Create

Mapping with Programme Outcomes

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

3 - Strong; 2 - Medium; 1 - Some

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
60 AB 001 - National Cadet Corps (Air Wing)								
Common to ALL Branches								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	**2**	**0**	**2**	**60**	**3**	**50**	**50**	**100**

NCC Organisation and National Integration NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform — Promotion of NCC cadets — Aim and Advantages of NCC Training- NCC Badges of Rank- Honors‟ and Awards – Incentives for NCC cadets by Central and State govt. History and Organization of IAF- Indo-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.	[12]
Drill and Weapon Training Basic Physical Training- Various Exercises for Fitness (with Demonstration)- Food- Hygiene and Cleanliness. Drill- Words of Commands- Position and Commands- Sizing and Forming- Saluting- Marching- Turning on the march and wheeling- Saluting on the march- Side pace, Pace forward and to the rear- Marking time- Drill with arms- Ceremonial drill- Guard mounting.(WITH DEMONSTRATION)	[12]
Principles of Flight Laws of Motion- Forces Acting on Aircraft- Bernoulli‟s Theorem- Stalling-Primary Control Surfaces- Secondary Control Surfaces- Aircraft Recognition.	[12]
Aero Engines Introduction of Aero Engine- Types of Engine- Piston Engine- Jet Engines- Turboprop Engines- Basic Flight Instruments- Modern Trends.	[12]
Aero Modeling * History of Aero modeling- Materials used in Aero Modeling- Types of Aero Models — Static Models- Gliders-Control Line models- Radio Control Models- Building and Flying of Aero Models.	[12]
Total Hours	60

Text Book(s):	
1.	“National Cadet Corps- A Concise handbook of NCC Cadets”, Ramesh Publishing House, New Delhi, 2014.
2.	Crouse W. H., and Anglin D. L., “Automotive Mechanics”, 10th Edition, McGraw Hill Education Private Limited, New Delhi, 2017.
Reference(s):	
1.	“Cadets Handbook – Common Subjects SD/SW”, published by DG NCC, New Delhi.
2.	“Cadets Handbook- Specialized Subjects SD/SW”, published by DG NCC, New Delhi.
3.	“NCC OTA Precise”, published by DG NCC, New Delhi.

Course Designer(s)

1. Sqn Ldr V.R.SADASIVAM - sadasivam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 AB 002	National Cadet Corps (Army Wing)	Category	L	T	P	Credit
		HS	2	0	2	3

Objectives

- Develop character, camaraderie
- Inculcate discipline, secular outlook
- Enrich the spirit of adventure, sportsman spirit
- Ideals of selfless service amongst cadets by working in teams
- Improve qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets

Pre-requisites

- NIL

Course Outcomes

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

CO1	Display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Understand
CO2	Demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turn out, develop the quality of immediate and implicit obedience of orders.	Understand
CO3	Basic knowledge of weapons and their use and handling.	Understand
CO4	Aware about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Understand
CO5	Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles	Create

Mapping with Programme Outcomes

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
60 AB 002 - National Cadet Corps (Army Wing)								
Common to ALL Branches								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	**2**	**0**	**2**	**60**	**3**	**50**	**50**	**100**

NCC Organization & National Integration* NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and Advantages of NCC Training- NCC Badges of Rank- Honors' and Awards – Incentives for NCC Cadets by Central and State govt. National Integration - Unity in Diversity- Contribution of Youth in Nation Building- National Integration Council- Images and Slogans on National Integration.	[12]
Basic Physical Training & Drill Basic Physical Training — Various Exercises for Fitness (with Demonstration) -Food — Hygiene and Cleanliness .Drill- Words of Commands- Position and Commands- Sizing and Forming- Saluting- Marching- Turning on the March and Wheeling- Saluting on the March- Side Pace, Pace Forward and to the Rear- Marking Time- Drill with Arms- Ceremonial Drill- Guard Mounting.(WITH DEMONSTRATION)	[12]
Weapon Training Main Parts of a Rifle Characteristics of .303 Rifle- Characteristics of .22 Rifle- Loading and Unloading – Position and Holding, Safety Precautions – Range Procedure- MPI and Elevation- Group and Snap Shooting- Long/Short Range Firing(WITH PRACTICE SESSION) - Characteristics of 5.56mm Rifle- Characteristics of 7.62mm SLR- LMG- Carbine Machine Gun – Pistol.	[12]
Social Awareness and Community Development Aims of Social Service-Various Means and Ways of Social Services- Family Planning — HIV and AIDS- Cancer its Cause and Preventive Measures- NGO and their Activities- Drug Trafficking- Rural Development Program - MGNREGA-SGSYJGSY-NSAP-PMGSY- Terrorism and Counter Terrorism- Corruption — Female Foeticide -Dowry –Child Abuse- RTI Act- RTE Act- Protection of Children from Sexual Offences Act- Civic Sense and Responsibility	[12]
Specialized Subject (Army) Basic Structure of Armed Forces- Military History – War Heroes- Battles of Indo-Pak War- Param Vir Chakra- Career in The Defence Forces- Service Tests and Interviews.	[12]
Total Hours	60
Text Book(s):	

1.	"National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.
Reference(s):	
1.	"Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.
2.	"Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3.	"NCC OTA Precise", published by DG NCC, New Delhi.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**NCC Organization & National Integration**	
1.1	NCC Organization	1
1.2	History of NCC and NCC Organization	1
1.3	NCC Training and NCC Uniform	1
1.4	Promotion of NCC cadet, Aim and Advantages of NCC Training	1
1.5	NCC badges of Rank, Honors' and Awards, Incentives for NCC Cadets by Central and State govt	1
1.6	National Integration, Unity in Diversity	1
1.7	Contribution of Youth in Nation Building	1
1.8	National Integration Council	1
1.9	Images and Slogans on National Integration	1

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

2.0	**Basic Physical Training & Drill**	
2.1	Basic Physical Training – Various Exercises for Fitness (with Demonstration)-	1
2.2	Drill- Words of Commands.	1
2.3	Position and Commands- Sizing and Forming-	1
2.4	Saluting- Marching- Turning on the March and Wheeling-	2
2.5	Saluting on the March- Side Pace, Pace Forward and to The Rear- Marking Time-	2
2.6	Drill with Arms- Ceremonial Drill- Guard Mounting.(WITH DEMONSTRATION)	2
3.0	**Weapon Training Main Parts ofa Rifle**	
3.1	Characteristics of .303 Rifle	1
3.2	Characteristics of .22 Rifle	1
3.3	Loading and Unloading, Position and Holding Safety Precautions	2
3.4	Range Procedure, MPI and Elevation-	1
3.5	Group and Snap Shooting Long/Short Range Firing (WITH PRACTICE SESSION)	2
3.6	Characteristics of 5.56 Mm Rifle	1
3.7	Characteristics of 7.62mm	1
4.0	**Social Awareness and Community Development**	
4.1	Aims of Social Service, Various Means and Ways of Social Services	1
4.2	Family Planning , HIV and AIDS	1
4.3	Cancer its Cause and Preventive Measures	1
4.4	NGO and their Activities, Drug Trafficking	1
4.5	Rural Development Programmes MGNREGA, SGSY, JGSY, NSAP, PMGSY	1
4.6	Terrorism and Counter Terrorism, Corruption	1
4.7	Female Foeticide, Dowry, Child Abuse, RTI Act, RTE Act	1
4.8	Protection of Children from Sexual Offences Act	1
4.9	Civic Sense and Responsibility	1
5.0	**Specialized Subject (Army)**	
5.1	Basic Structure of Armed Forces	1
5.2	Military History, War Heroes	1
5.3	Battles of Indo - Pak War	1
5.4	Param Vir Chakra,	1
5.5	Career in The Defence Forces	2
5.6	Service Tests and Interviews.	2

Course Designers

1. Lt.E.Chandra Kumar - chandrakumar@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 7P1	Biological Data Analysis Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To introduce students to basic biostatistics concepts and techniques for organizing and visualizing biological data
- To familiarize students with hypothesis testing methods including T-tests, F-test, and Chi-square test
- To teach students to conduct analysis of variance (ANOVA) for comparing means across different groups
- To provide students with skills to perform regression analysis for modelling relationships between variables
- To enable students to utilize advanced data analysis tools like Minitab®, Design Expert®, and MATLAB® for various biological applications

Pre-requisites

- Knowledge on Basic Mathematics, Probability and Statistics

Course Outcomes

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

CO1	Apply biostatistical methods for organizing data, computing descriptive measures, and creating statistical visualizations to analyze biological datasets effectively	Apply
CO2	Analyze hypotheses and perform statistical tests such as one-sample T-test, paired sample T-test, F-test, and Chi-square test to evaluate significance and draw conclusions from biological data	Analyze
CO3	Evaluate variance using one-way ANOVA and two-way ANOVA techniques to assess differences between groups and analyze experimental designs effectively	Evaluate
CO4	Create and interpret regression models including single linear regression and multiple linear regression to predict and understand relationships within biological datasets	Create
CO5	Design experiments using tools like Minitab®, Design Expert®, and MATLAB® to optimize experimental conditions, solve systems of ODEs, and interpolate data in biological research	Create

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	20	-	30	30
Analyze	20	05	30	30
Evaluate	10	10	20	20
Create	-	10	20	20
Total	50	25	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT 7P1 - Biological Data Analysis Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Introduction to Biostatistics - Organizing data, Descriptive Measures, Statistical Visualization*
2. Testing of Hypothesis - One Sample T-test, Paired sample T-test
3. Testing of Hypothesis - F-test, Chi-square test
4. Analysis of Variance - One-way ANOVA, Two-way ANOVA
5. Regression Analysis - Single Linear Regression
6. Multiple Linear Regression
7. Factor and discriminant Analysis

Design Experiments:

8. Minitab® - Placket Burmann Design**
9. Design Expert® - Response Surface Methodology**
10. MATLAB® - solving systems of ODE's and interpolation of data**

Lab manual:

1.	Biological Data Analysis Laboratory Lab manual, Department of Biotechnology, KSRCT.

***SDG 4: Quality Education**
****SDG 9: Industry, Innovation, and Infrastructure**

Course Designer(s)

1. Dr. Rengesh Balakrishnan – rengeshbalakrishnan@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 7P2	Downstream Processing Laboratory	Category	L	T	P	Credit
		PC	0	0	3	1.5

Objectives

- To acquire knowledge on purification strategies of bioproducts
- To design separation processes for the recovery and purification of bioproducts.
- To provide hands on knowledge on bioproduct concentration and recovery
- To understand the working principle of various unit operations involved in bioseparation
- To demonstrate sequence of downstream processing operations for bioproduct recovery

Pre-requisites

- Unit operations, Fluid mechanics, Heat and Mass transfer Operations, Bioprocess Engineering

Course Outcomes

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

CO1	Determine cell disruption kinetics for intracellular release kinetics by ultrasonication and know the principle of solid-liquid separation techniques	Apply
CO2	Execute and verify the adsorption isotherms and understand leaching characteristics	Apply
CO3	Discuss the principle of ammonium sulphate, isoelectric and aqueous two-phase extraction methods forrecovery	Apply
CO4	Analyze separation of biomolecules by chromatographic techniques	Analyze
CO5	Demonstrate the operating procedure of freeze dryer and final purification strategies	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B. Tech - Biotechnology

60 BT 7P2 – Downstream Processing Laboratory

Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	0	0	3	45	1.5	60	40	100

List of Experiments:

1. Studies on Cell Disruption by Ultrasonication*
2. Design of Thickener for Batch Sedimentation
3. Solid-Liquid Separation by Centrifugation
4. Product Recovery by Leaching
5. Adsorption Studies - Verification of Freundlich Isotherm
6. Aqueous Two-Phase Extraction of Biomolecules
7. Enzyme Purification by Isoelectric Precipitation and Acetone Precipitation
8. Studies on Ammonium Sulphate Precipitation

Design Experiments:

9. Studies on Product Purification by Chromatographic Techniques*
10. Product Polishing by Freeze Drying

Lab manual:

1.	Downstream Processing Lab manual, Department of Biotechnology, KSRCT.

***SDG 09 – Industry, Innovation and Infrastructure**

Course Designer(s)

1. Dr. S. Poornima – spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 7P3	Project Work - Phase I	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To prepare the students to adapt to the research environment
- To understand how projects are executed in a research laboratory
- To learn practical aspects of research on their domain
- To train students in the art of data interpretation
- To practice the students to analyze the results and thesis writing

Pre-requisites

- NIL

Course Outcomes

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

CO1	Identify the problem and select a topic of the research	Apply
CO2	Competence in research design and planning	Apply
CO3	Create, analyse and critically evaluate different technical solutions	Apply
CO4	Interpret the obtained research data and conclude the experiment	Analyse
CO5	Develop skills of project management, report writing, problem solving, communication and interpersonal.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Review I (R1)			Review II (R2)		Review III (R3)			Total (R1+R2+R3)		Internal
Literature Survey	Topic Identification & Justification	Work Plan	Approach	Conclusion	Demo-Existing System	Presentation	Report	Total		
10	10	10	20	20	10	10	10	100		100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B. Tech- Biotechnology								
60 BT 7P3 – Project Work – Phase I								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA		Total
VII	0	0	4	60	2	100		100

Methodology:

- Three reviews have to be conducted by the committee that constitutes minimum of three members oneof which should be guide.
- Research problem should be selected.
- Students have to collect and bound about 50 research papers related to their work.
- Objectives and title of the work has to be finalized at the end of the Project Work – Phase I.
- Preliminary Implementation can be done if possible.
- Report has to be prepared as per the format and submitted by the students
- Internal evaluation has to be done for 100 marks

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215
(An Autonomous Institution affiliated to Anna University)

B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted in 2024-2025)

EIGHTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment*	End Semester Exam**	Max. Marks	End Semester Exam	Total
THEORY								
1	60 BT E5*	Professional Elective V	2	40	60	100	45	100
PRACTICAL								
2	60 BT 8P1	Project Work - Phase II	2	60	40	100	45	100
3	60 CG 0P6	Internship	-	100	-	100	-	100

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

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT 8P1	Project Work - Phase II	Category	L	T	P	Credit
		PC	0	0	4	8

Objectives

- To prepare the students to adapt to the research environment
- To understand how projects are executed in a research laboratory
- To learn practical aspects of research on their domain
- To train students in the art of data interpretation
- To practice the students to analyze the results and thesis writing

Pre-requisites

- Project Work Phase I

Course Outcomes

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

CO1	Identify the problem and select a topic of the research.	Apply
CO2	Competence in research design and planning.	Apply
CO3	Create, analyse and critically evaluate different technical solutions.	Apply
CO4	Interpret the obtained research data and conclude the experiment.	
CO5	Develop skills of project management, report writing, problem solving, communication and interpersonal.	

Mapping with Programme Outcomes

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

Assessment Pattern

Internal Assessment (60)					End Semester (40)
Items	Review 1	Review 2	Review 3	Publication*	
Marks	5	10	15	30	40
	Total internal marks 60				

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

K.S.Rangasamy College of Technology – Autonomous R2022								
B. Tech - Biotechnology								
60 BT 8P1 – Project Work – Phase II								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	0	0	16	240	8	60	40	100

Methodology:

- Three reviews have to be conducted by the committee that constitutes minimum of three members oneof which should be guide.
- Research problem should be selected.
- Students have to collect and bound about 50 research papers related to their work.
- Objectives and title of the work has to be finalized at the end of the Project Work - Phase I.
- Preliminary Implementation can be done if possible.
- Report has to be prepared as per the format and submitted by the students
- Internal evaluation has to be done for 100 marks

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 CG 0P6	Internship	Category	L	T	P	Credit
		CG	0	0	0	1/2/3#

Objectives

- To expose the students to understand the processes at industry and R&D
- To identify the existing and evolving problems at industry
- To solve the problems at industry and environment need
- To prepare the report of solved problems for further action
- To summarize the data in a presentation mode

Pre-requisites

- NIL

Course Outcomes

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

CO1	Identify the root cause and problem-solving process	Understand
CO2	Design the experiment from literature survey	Analyze
CO3	Execute and trouble shoot through pilot study	Apply
CO4	Interpret the raw and calculated data to conclude the problem	Apply
CO5	Writing the reports and documenting the data for publication	Analyze

Mapping with Programme Outcomes

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

ELECTIVE I

60 BT E11	Bioresource Technology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To make the students to understand about the bio resource and its sustainable utilization
- To familiarize the bioenergy production methods though cost effective methods
- To understand the role of microorganisms in bioenergy production
- To equip the students to use the resource wisely through advanced technologies
- To facilitate the students to adopt the sophisticated technology for bio resource management

Pre-requisites

- Environmental Biology and Microbiology

Course Outcomes

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

CO1	Explore the different types of bioresources and the roles of bioprospecting, ecotourism and biodiversity policies.	Understand
CO2	Analyze the cell growth and the kinetics of product formation and enzymatic conversions	Apply
CO3	Design a bioreactor for efficient bio-energy production and scaling-up procedures.	Apply
CO4	Interpret and analyse the optimization yield, recycle and minimize the waste generation	Apply
CO5	Elucidate the concepts of activated sludge, digestion, biodegradation and bio filtration.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E11- Bioresource Technology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Introduction to Bioresources Bioresources and its Types - Availability of Different Organic Wastes - Characteristics of Solid and Liquid Wastes - Consumptive Use: Logging, Fishing, Quarrying and Non-Consumptive use: Bioprospecting, Ecotourism, Research - Biodiversity Policies: Importance of Natural Resources Economic Development Policies, Environmental and Natural Resources Policies.	[9]
Microbial Resources Cell Growth and Product Formation Kinetics, Enzymatic Conversion and Treatment of Cellulose and Lignocelluloses - Algal Cultivation and Harvesting for Microbial Fuel Cells - Biocatalysis - Biopolymers - Biosurfactants.	[9]
Bioenergy and its Economic Analysis Different Bioenergy Generation Processes: Biomethanation — Biohydrogen — Bioethanol - Biodiesel – Bioreactor Design for Bio-Energy - Comparative Analysis on Different Bioenergy Generation Processes - Scaling up Problems - Economic Analysis of the Process.	[9]
Natural Resource Management and Conservation Sustainable Yield Management - Reduction and Minimization of Waste - Recycling of Solid, Liquid and Gaseous Wastes - Integrated Development Planning and Integrated Coastal Zone Management - Environmental Impact Assessments - Protected Area Systems - Community Based Natural Resource - Remote Sensing and Gis.	[9]
Bioresource Utilisation* Activated Sludge - Aerobic and Anaerobic Digestion - Biodegradation of Toxic Compounds - Biofiltration - Biological Nutrients Removal - Bioremediation – Biosorption and Bioleaching of Heavy Metals — Constructed Wetlands for Industrial Effluents - Membrane Technology.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Ashok Pandey., “Concise Encyclopedia of Bioresource Technology”, CRC Press, 2009.
2.	Goodbody, I., and Thomas-Hope, E., “Natural Resource Management for Sustainable Development ofthe Caribbean”, Canoe Press, University of the West Indies, Mona, 2002.
Reference(s):	
1.	Cunningham W., and Saigo B., “Environmental Science, A Global Concern”, McGraw Hill, New York,2001.
2.	Sangeetha, Jeyabalan, Thangadurai, D, “Industrial Biotechnology: Sustainable Production and Bioresourceutilization”, Apple Academic Press, 2016.
3.	Yoram Krozer, Michael Narodoslawsky “Economics of Bioresources: Concepts, Tools, Experiences” Springer International Publishing, 2019
4.	Ashok Pandey., Christian Larroche, Ram Sarup Singh., Reeta Rani Singhania, “Biomass, Biofuels, Biochemicals: Advances in Enzyme Technology”, Elsevier Science Publishing, 2019.

***SDG 6: Clean Water and Sanitation**

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Introduction to Bioresources**	
1.1	Bioresources and its types	1
1.2	Availability of Different Organic Wastes	1
1.3	Characteristics of Solid and Liquid Wastes	1
1.4	Consumptive use: Logging, Fishing, Quarrying	1
1.5	Non-Consumptive use: Bioprospecting, Ecotourism,	1
1.6	Research - Biodiversity Policies: Importance of Natural Resources Economic Development Policies,	2

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Approved in Academic Council Meeting held on 25/05/2024

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1.7	Environmental and Natural Resources Policies.	2
2.0	**Bioenergy**	
2.1	Different Bioenergy Generation Processes:	2
2.2	Biomethanation	1
2.3	Biohydrogen, Bioethanol, Biodiesel	2
2.4	Bioreactor Design for Bio-Energy	1
2.5	Comparative Analysis on Different Bioenergy Generation Processes	1
2.6	Scaling up Problems - Economic Analysis of the Process.	2
3.0	**Microbial Resources**	
3.1	Cell Growth and Product Formation Kinetics,	2
3.2	Enzymatic Conversion and Treatment of Cellulose and Lignocelluloses	1
3.3	Algal Cultivation.	2
3.4	Harvesting for Microbial Fuel Cells	1
3.5	Biocatalysis	1
3.6	Biopolymers	1
3.7	Biosurfactants	1
4.0	**Natural Resource Management and Conservation**	
4.1	Sustainable Yield Management	1
4.2	Reduction and Minimization of Waste	1
4.3	Recycling of Solid, Liquid and Gaseous Wastes	2
4.4	Integrated Development Planning and Integrated Coastal Zone Management	1
4.5	Environmental Impact Assessments	1
4.6	Protected Area Systems	1
4.7	Community Based Natural Resource	1
4.8	Remote Sensing and GIS	1
5.0	**Bioresource Utilisation**	
5.1	Activated Sludge - Aerobic and Anaerobic Digestion	1
5.2	Biodegradation of Toxic Compounds	1
5.3	Biofiltration	1
5.4	Biological Nutrients Removal	2
5.5	Bioremediation	1
5.6	Biosorption and Bioleaching of Heavy Metals	1
5.7	Constructed Wetlands for Industrial Effluents - Membrane Technology	2

Course Designer (s)

1. Dr.S.Sidhra – sidhra@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E12	Intellectual Property Rights	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To familiarize graduates with the fundamental concepts, principles, and significance of Intellectual Property Rights (IPR) in various industries and sectors.
- To equip graduates with both technical and legal expertise required to effectively navigate and contribute to the complex field of Intellectual Property Rights
- To deepen graduates' understanding of the unique challenges, ethical considerations, and regulatory frameworks surrounding the patenting of biotechnological innovations
- To enable graduates to utilize and leverage IPR databases effectively for research, patent searches, and analysis
- To educate graduates on biosafety protocols, regulations, and ethical considerations relevant to biotechnological research and development

Pre-requisites

- NIL

Course Outcomes

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

CO1	Characterize the basic concepts of the types of IPR and their importance.	Apply
CO2	Appraise the knowledge on various organizations involved in IPR maintenance.	Apply
CO3	Categorize on the patent law and procedures for filing a patent	Understand
CO4	Comprehend the various database of IPR.	Apply
CO5	Identify the biological safety cabinets and biosafety guidelines.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT E12 – Intellectual Property Rights

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

Introduction to Intellectual Property Rights* IPR: Definition, Role and Importance - Types of IPR: Patents, Trademarks, Trade secrets, Copyright and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications - Protection of GMO's IPR In R&D.	[9]
Theories and Conventions Indian Theory - Constitutional Aspects of Property, Constitutional Protection of Property and IP - Western Theory - Locke's Labour, Hegel's Personality and Marxian Theory - Berne Convention, Universal Copyright Convention, the Paris Convention, TRIPS, the WIPO and the UNESCO.	[9]
Patent Filing Patent Law - Rights under Patent Law and its Limitations - Patent Requirements - Ownership and Transfer - Patentable and Non patentable inventions - Patent Application Process and Granting of Patent - Patent Infringement and Litigation - International Patent Law - Double Patenting, Patent Searching - Patent Cooperation Treaty - New developments in Patent Law.	[9]
IPR Database Patent Database - National, International, Country-Wise Patent Searches (USPTO, EPO), Patent Scope (WIPO, IPO) - Commercial and Free Patent Databases - Search Tools and Functions - Database for Trademark and Industrial Design - Data Security, Confidentiality, Privacy - International Aspects of Computer and Online Crime.	[9]
Cyber Law and IPR Cyber Law and IPRs - Understanding Copy Right in Information Technology - Software - Copyrights Vs Patents Debate- Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy –Patents - Understanding Patents - European Position on Computer Related Patents - Legal position of U.S. on Computer Related Patents - Indian Position on Computer Related Patents –Trademarks - Trademarks in Internet	[9]
Total Hours:	**45**

Text Book(s):

1.	Gopalakrishnan N.S. and Ajitha T.G, "Principles of Intellectual Property", 2nd Edition, Eastern Book Company, 2014.
2.	BAREACT, Indian Patent Act, 1970, Acts and Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi,2007.

Reference(s):

1.	Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S.Viswanathan Printers and Publishers Pvt. Ltd., 1998..
2.	Tzotzos, G.T., "Genetically modified organisms - A guide to Biosafety", CAB International, Walling ford, U.K. 213p.1995.

***SDG 6: Industry, Innovation and Infrastructure**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Intellectual Property Rights**	
1.1	IPR: Definition, Role and Importance	1
1.2	Types of IPR: Patents	1
1.3	Trademarks	1
1.4	Trade secrets	1
1.5	Copyright and Related Rights	1
1.6	Industrial Design	1
1.7	Traditional Knowledge	1
1.8	Geographical Indications	1

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BOS- Chairman

1.9	Protection of GMO's IPR In R&D	1
2.0	**Theories and Conventions**	
2.1	Indian Theory - Constitutional Aspects of Property	1
2.2	Constitutional Protection of Property and IP	2
2.3	Western Theory - Locke's Labour	1
2.4	Hegel's Personality and Marxian Theory	1
2.5	Berne Convention, Universal Copyright Convention	1
2.6	Paris Convention	1
2.7	TRIPS	1
2.8	WIPO and the UNESCO	1
3.0	**Patent Filing**	
3.1	Patent Law - Rights under Patent Law and its Limitations	1
3.2	Patent Requirements - Ownership and Transfer	1
3.3	Patentable and Non patentable inventions	1
3.4	Patent Application Process and Granting of Patent	1
3.5	Patent Infringement and Litigation	1
3.6	International Patent Law - Double Patenting	1
3.7	Patent Searching	1
3.8	Patent Cooperation Treaty	1
3.9	New developments in Patent Law	1
4.0	**IPR Database**	
4.1	Patent Database - National, International	1
4.2	Country-Wise Patent Searches (USPTO, EPO)	1
4.3	Patent Scope (WIPO, IPO)	2
4.4	Commercial and Free Patent Databases	1
4.5	Search Tools and Functions	1
4.6	Database for Trademark and Industrial Design	1
4.7	Data Security, Confidentiality	1
4.8	Privacy - International Aspects of Computer and Online Crime	1
5.0	**Cyber Law and IPR**	
5.1	Cyber Law and IPRs - Understanding Copy Right in Information Technology	1
5.2	Software - Copyrights Vs Patents Debate- Authorship and Assignment Issues	2
5.3	Copyright in Internet - Multimedia and Copyright issues	1
5.4	Software Piracy –Patents - Understanding Patents	1
5.5	European Position on Computer Related Patents - Legal position of U.S. on Computer Related Patents	2
5.6	Indian Position on Computer Related Patents –Trademarks - Trademarks in Internet	2

Course Designer(s)

1. Dr.M.Nithya – nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E13	Cancer Biotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To impart knowledge on fundamentals of cancer biology.
- To determine the root cause and identifications of various cancer.
- To understand various molecular tools for diagnosis and treatment of cancer.
- To evaluate the origin and metastatic colonization and angiogenesis of cancer.
- To describe the various diagnostic and treatment procedure for the cancer disease.

Pre-requisites

- Basic Knowledge on Cell Biology, Genetics and Molecular Biology.

Course Outcomes

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

CO1	Describe the cancer, modulation of cell cycle and importance of diets in cancer	Understand
CO2	Illustrate the mechanism of chemical and physical agents causing carcinogenesis	Apply
CO3	Experiment with the importance of DNA damage and cross link repair and activation of kinases.	Apply
CO4	Organize the clinical significance of invasion and heterogeneity of metastatic colonization	Apply
CO5	Identify the various form of diagnostic tools and therapy in cancer research	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E13 – Cancer Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Fundamentals of Cancer Biology Introduction to Human Cancers - Regulation of Cell Cycle- Check Points - Mutations that Cause Changes in Signal Molecules - Effects on Receptor, Signal Switches - Tumour Suppressor Genes - P53 - Rb, Brca1 and Brca1; Oncogenes / Proto Oncogene - Modulation of Cell Cycle in Cancer - Different Forms of Cancers - Diet and Cancer.	[9]
Carcinogenesis Theory of Carcinogenesis - Chemical Carcinogenesis - Metabolism of Carcinogenesis - Principles of Physical Carcinogenesis - Ultraviolet Radiation - X-Ray Radiation- Mechanisms of Radiation Carcinogenesis.	[9]
Molecular Cell Biology of Cancer* Tumor Genetics: - DNA Damage and Repair: Damage during Replication and Crosslink Repair - Signal Targets and Cancer - Activation of Kinases; Oncogenes - Identification of Oncogenes - Retroviruse and Oncogenes - Detection of Oncogenes. Molecular Mechanisms of Apoptosis - Cell Proliferation - Growth Factors Related to Transformation - Telomerases.	[9]
Cancer Metastasis Clinical Significances of Invasion - Heterogeneity of Metastatic Phenotype - Metastatic Cascade - Metastatic Colonization - Angiogenesis - Basement Membrane Disruption - Three Step Theory of Invasion - Proteinases and Tumour Cell Invasion.	[9]
New Molecules for Cancer Therapy (Cancer Screening, Diagnosis and Therapy) Advances in Cancer Detection - Biochemical Assays - Tumor Markers - Molecular Tools for Early Diagnosis of Cancer - Different Forms of Therapy — Chemotherapy - Radiation Therapy - use of Signal Targets Towards Therapy of Cancer; Modern Therapy - Gene Therapy - Drug Therapy - Immunotherapy - Nanotherapy.	[9]
Total Hours	**45**

Text Book(s):	
1.	Robin Hesketh., "Introduction to Cancer Biology Cambridge", University Press 2013.
2.	Kewal K., Jain, "Applications of Biotechnology in Oncology", Springer, New York. 2013.
Reference(s):	
1.	Tannock I., and Hill. R.P., "The Basic Science of Oncology", 3rd Edition. McGraw-Hill, 1998
2.	Stella Pelengaris and Michael Khan. The Molecular Biology of Cancer, 2nd Edition. Wiley — Blackwell, 2013
3.	Francesco Pezzella, MahvashTavassoli, and David Kerr, "Oxford Textbook of Cancer Biology", Oxford University Press, 2019
4.	David J., Kerr, Francesco Pezzella, Mahvash Tavassoli, David Kerr, "Cancer Biology" Oxford University Press, 2019

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Fundamentals of Cancer Biology**	
1.1	Introduction to Human Cancers	1
1.2	Regulation of Cell Cycle- Check Points	1
1.3	Mutations that Cause Changes in Signal Molecules; Effects on Receptor - Signal Switches	2
1.4	Tumour Suppressor Genes - P53, Rb, BRCA1 and BRCA1	1
1.5	Oncogenes / Proto-Oncogene	2
1.6	Modulation of Cell Cycle in Cancer, Different Forms of Cancers	1
1.7	Diet and Cancer	1
2.0	**Carcinogenesis**	
2.1	Theory of Carcinogenesis	2
2.2	Chemical Carcinogenesis	2

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

2.3	Metabolism of Carcinogenesis	2

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2.4	Principles of Physical Carcinogenesis	2
2.5	Ultraviolet Radiation, X-Ray Radiation-Mechanisms of Radiation Carcinogenesis	1
3.0	**Molecular Cell Biology of Cancer**	
3.1	Tumor Genetics: - DNA Damage and Repair	2
3.2	Damage During Replication and Crosslink Repair	1
3.3	Signal Targets and Cancer, Activation of Kinases	1
3.4	Oncogenes, Identification of Oncogenes, Retroviruse and Oncogenes Detection of Oncogenes	2
3.5	Molecular Mechanisms of Apoptosis	1
3.6	Cell Proliferation: Growth Factors Related to Transformation - Telomerases	2
4.0	**Cancer Metastasis**	
4.1	Clinical Significances of Invasion	2
4.2	Heterogeneity of Metastatic Phenotype	1
4.3	Metastatic cascade - Metastatic Colonization	2
4.4	Angiogenesis - Basement Membrane Disruption	2
4.5	Three Step Theory of Invasion	1
4.6	Proteinases and Tumour Cell Invasion	1
5.0	**New Molecules for Cancer Therapy (Cancer Screening, Diagnosis and Therapy)**	
5.1	Advances in Cancer Detection	2
5.2	Biochemical Assays, Tumor Markers	2
5.3	Molecular Tools for Early Diagnosis of Cancer	2
5.4	Different Forms of Therapy- Chemotherapy, Radiation Therapy, use of Signal Targets Towards Therapy of Cancer;	2
5.5	Modern Therapy - Gene Therapy - Drug Therapy – Immunotherapy - Nano Therapy	1
5.6	Application of eNose	2

Course Designer(s)

1. Dr. K. Syed Zameer Ahmed - syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E14	Biosensors	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Utilize the various concepts and terminologies of measurement system
- Utilize the working principles of transducers
- Analyse the physiology of human sensory systems
- Utilize the working principles of biological sensors
- Learn the modern sensors for medical diagnosis

Pre-requisites

- Biomedical Engineering

Course Outcomes

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

CO1	Summarize the principles of various biosensors sensors used in medical diagnosis.	Remember
CO2	Illustrate the working principles of transducers.	Understand
CO3	Explain the physiological functions of human sensory systems.	Understand
CO4	Distinguish various modern biosensors used in medical diagnosis.	Analyse
CO5	Evaluate the advancements in the field of biosensors.	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E14 - Biosensors								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Introduction to Biosensors General Configuration of Biosensor - Generations of Biosensors - Basic Principle and Instrumentation of Different Biosensors: Electrochemical, Optical, Acoustic, Piezoelectric, and Calorimetric Biosensors - Biological Recognition Systems: Enzyme, Antibody, Nucleic Acid, Cell, and Tissue - Properties of Ideal Materials for Biosensors - Classes of Materials for Biosensors.	[9]
Biological Sensors Study of Biological Sensors in the Human Body - Neuronal Mechanism: Pacinian and it's Functions – Chemoreceptor - Hot and Cold Receptors - Baro Receptors - Sensors for Smell - Sensors for Sound - Sensors for Vision - Sensors for Osmolality and Taste – Immune Based Sensors – Enzymatic Sensors**.**	[9]
Principles of Transducers Classification of Transducers - Characteristics for Selection of Transducers - Resistive Transducers: RTD and Strain Gauge — Thermistor — Working and Construction of Piezoelectric Effect Transducer and Hall Effect Transducer – Capacitive Transducers and Inductive Transducers.	[9]
Modern Biosensors in Medical Diagnosis* Biocatalysts Based Biosensor - Enzyme Immobilisation - Glucose Biosensor - Bio Affinity-Based Biosensor - Microorganism Based Biosensors - Advantages and Limitations of Biosensor.	[9]
Advancement in Biosensors** Introduction, Working, Principle and Result Analysis of Optical biosensors for Measurement of Blood Glucose Level – Introduction of Smart Sensors, Working and its Application - Lab on a chip- Introduction, Advantages and Disadvantages – Construction and Application of eNose.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Eds. Inamuddin., Tauseef Ahmad Rangreez., Mohd Imran Ahamed., Abdullah M. Asiri., "Biosensors – Materials and Applications**",** Materia**l** Research Forum, 2019.
2.	Sawhney A.K., "A Course in electrical and electronic measurements and instrumentation", 19th ed., Dhanpat Rai & Co (P) Ltd, 2014
Reference(s):	
1.	Fung, Y.C., "Biomechanics", Springer - Verlag, New York, 1981.
2.	Rushika Patel., "Biosensing: Methods, Applications and Technology", Nova, 2023.

***SDG 3 – Good Health and Well Being**

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Biosensors**	
1.1	General Configuration of Biosensor	1
1.2	Generations of Biosensors	1
1.3	Basic Principle and Instrumentation of Different Biosensors	2
1.4	Biological Recognition Systems: Enzyme, Antibody, Nucleic Acid, Cell, and Tissue	2
1.5	Properties of Ideal Materials for Biosensors	1
1.6	Classes o Materials for Biosensors	2
2.0	**Biological Sensors**	
2.1	Study of Biological Sensors in the Human Body	1
2.2	Neuronal Mechanism: Pacinian and it's Functions	1
2.3	Chemoreceptor	1

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2.4	Hot and Cold Receptors	1

2.5	Baro Receptors	1
2.6	Sensors for Smell, Sound and Vision	1
2.7	Sensors for Osmolality and Taste	1
2.8	Immune Based Sensors	1
2.9	Enzymatic Sensors	1
3.0	**Principles of Transducers**	
3.1	Classification of transducers	1
3.2	Characteristics for selection of transducers	1
3.3	Resistive transducers: RTD and Strain Gauge	1
3.4	Thermistor	1
3.5	Working and Construction of Piezoelectric Effect Transducer	1
3.6	Working and Construction of Hall Effect Transducer	2
3.7	Capacitive Transducers	1
3.8	Inductive Transducers	1
4.0	**Modern Biosensors in Medical Diagnosis**	
4.1	Biocatalysts Based Biosensor	2
4.2	Enzyme Immobilisation	2
4.3	Glucose Biosensor	1
4.4	Bio Affinity Based Biosensor	2
4.5	Microorganism Based Biosensors	1
4.6	Advantages and Limitations of Biosensor	1
5.0	**Advancement in Biosensors**	
5.1	Fiber Optic Sensors	2
5.2	Introduction of Smart Sensors	1
5.3	Working and its Application of Smart Sensors	1
5.4	Introduction to Lab on a chip	2
5.5	Advantages and Disadvantages of Lab on a chip	1
5.6	Application of eNose	2

Course Designer(s)

1. Ms.K.Abinayaa – abinayaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E15	Genomics and Proteomics	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To know the overview of genome and genetic analysis
- To learn the implication of genome sequencing by learning the techniques
- To impart idea on tools available for proteomic and genomic approaches
- To have wide knowledge on applications of functional genomics and proteomics
- To update the latest development in the field of genetics

Pre-requisites

- Bioinformatics

Course Outcomes

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

CO1	Acquire knowledge on genome sequence and structure through genetic mapping, analysis and its expression	Understand
CO2	Detail the precise order of nucleotides by sequencing methods and it leads to predict mutations.	Understand
CO3	Analyze the information of gene expression and similarity among protein sequences and mine data from different database.	Apply
CO4	Handle the functional genomics in disease diagnosis and probe the interaction among proteins and ligands.	Apply
CO5	Interpret and analyze the proteins with reference to 2D, IEF, MALDI-TOF and protein mass Fingerprinting	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	20	46
Apply	-	20	20
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E15 - Genomics and Proteomics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Structural Genomics* Overview of Genome - Genome Sequence Acquisition and Analysis - Genetic Elements that Control Gene Expression: Constitutive and Inducible Gene Expression - Genetic Analysis: Linkage Mapping and Analysis - High Resolution Chromosome Maps - Physical Mapping: Hybrid Mapping Strategies, Sequence Specific Tags (SST), Sequence-Tagged Sites (STS) and ISH.	[9]
DNA Sequencing Variations in Sequencing Methods - Ladder, Fluorescent, Shotgun, Transposon-Mediated, Automated Sequencing - Finding Genes and Mutations, Genome Wide Measurement of Gene Expression, Parallel Signature Sequencing, Implications of DNA and Genome Sequencing.	[9]
Functional Genomics and its Application* Comparative Genomics of Mitochondrial Genome and Eukaryotes, Orthologs and Paralogs, Serial Analysis of Gene Expression (SAGE), SAGE Adaptation for Downsized Extracts (SADE), GEO Dataset Analysis - Role of Genomics in Polygenic Disorders, Functional Genomic Analysis using Forward and Reverse Genetics - Pharmacogenomics.	[9]
Proteomics Overview of Analytical Proteomics, Analytical Protein and Peptide Separations, Protein Digestion Techniques, SALSA: an Algorithm for Mining Specific Features of Tandem MS Data - Applications of Proteomics - Mining Proteomes - Protein Expression Profiling - Identifying Protein-Protein Interactions and Protein Complexes - Protein Modifications and Mapping Protein - New Directions in Proteomics.	[9]
Tools for Proteomics and Genomics Isolation of DNA, RNA and Protein - Denaturing and Agarose Gel Electrophoresis – Western Blotting – Southern Blotting –Electroelution – Functional Genomic Tools, Structural Proteomic Tools.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Sandor S., "Genomics and Proteomics: Functional and Computational Aspects", 1st Edition, Springer, 2013.
2.	Primrose S.B and Twyman R., "Principles of Genome Analysis and Genomics", Blackwell Publishers,3rdEdition, 2007.
Reference(s):	
1.	Sandor Suhai, "Genomics and Proteomics", Springer US, 2007.
2.	Saraswathy N, P Ramalingam, "Concepts and Techniques in Genomics and Proteomics", Elsevier Science, 2011.
3.	Devarajan Thangadurai, Jeyabalan Sangeetha, "Genomics and Proteomics", Apple Academic Press, 2015.
4.	Daniel C. Liebler and John R. Yates, "Introduction to Proteomics", Humana press, New Jersey, 2002.

*SDG 3 – Good Health and Well Being

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Structural Genomics**	
1.1	Overview of Genome - Genome Sequence Acquisition and Analysis	2
1.2	Genetic Elements that Control Gene Expression: Constitutive and Inducible Gene Expression	2
1.3	Genetic Analysis: Linkage Mapping And Analysis	1
1.4	High Resolution Chromosome Maps	1
1.5	Physical Mapping: Hybrid Mapping Strategies	1
1.6	Sequence Specific Tags (SST)	1
1.7	Sequence-Tagged Sites (STS) and ISH	1

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2.0	**DNA Sequencing**	
2.1	Variations in Sequencing Methods - Ladder	2
2.2	Fluorescent, Shotgun	2
2.3	Transposon-Mediated, Automated Sequencing	1
2.4	Finding Genes and Mutations	1
2.5	Genome Wide Measurement of Gene Expression	1
2.6	Parallel Signature Sequencing	1
2.7	Implications of DNA and Genomes Sequencing	1
3.0	**Functional Genomics and its Application**	
3.1	Comparative Genomics of Mitochondrial Genome and Eukaryotes	2
3.2	Orthologs and Paralogs	1
3.3	Serial Analysis of Gene Expression (SAGE)	1
3.4	SAGE Adaptation for Downsized Extracts (SADE)	2
3.5	GEO Dataset Analysis	1
3.6	Role of Genomics in Polygenic Disorders	1
3.7	Functional Genomic Analysis using Forward and Reverse Genetics	1
4.0	**Proteomics**	
4.1	Overview of Analytical Proteomics, Analytical Protein and Peptide Separations	1
4.2	Protein Digestion Techniques	1
4.3	SALSA: an Algorithm for Mining Specific Features of Tandem MS Data	1
4.4	Applications of Proteomics	1
4.5	Mining Proteomes	1
4.6	Protein Expression Profiling - Identifying Protein	1
4.7	Protein Interactions and Protein Complexes	1
4.8	Protein Modifications and Mapping Protein - New Directions in Proteomics	1
5.0	**Tools for Proteomics and Genomics**	
5.1	Isolation of DNA, RNA and Protein	1
5.2	Denaturing and Agarose Gel Electrophoresis	2
5.3	Western Blotting	1
5.4	Southern Blotting –Electroelution	2
5.5	Functional Genomic Tools	1
5.6	Structural Proteomic Tools	2

Course Designer(s)

1. Dr.M. Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E16	Food Biotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To gain basic knowledge in select various aspects of food processing principles, equipments and food engineering operations in food industries
- To interpret the characteristics of various for preservation techniques
- To recognize and label the role of various agencies applied in food processing
- To gain knowledge in various aspects of Food processing and its importance for industrial applications
- To take up higher studies in the area of Food technology and to become an entrepreneur

Pre-requisites

- Basics of Biology, Microbiology and Biochemistry

Course Outcomes

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

CO1	Illustrate the basic concepts of food processing technology and quality improvement.	Apply
CO2	appraise the types of various food processing techniques in milk and milk products.	Apply
CO3	Categorize vegetables, fruits and processing of meat.	Understand
CO4	Comprehend the different operations involved in food conversion.	Apply
CO5	Identify the Sensory evaluation of food quality and various organizations dealing with inspection and food safety standards.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E16 – Food Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Principles of Food Processing Principles and Methods of Food Preservation; Thermal Processing of Food - 12D Concept - Blanching - Pasteurisation Canning; Freezing - Evaporation - Dehydration - Radiation, Pulse Electric Field - Ultra High Pressure - Modern Technology for Food Packaging: Modified Atmosphere Storage and Packing, Vacuum Packaging, Food Additives, Food Colours, Food Packaging, Preservation by Chemical Methods and its Limitations.	[9]
Food Engineering Operations Properties of Foods and Processing Theory - Liquid, Solid and Gases: Density, Specific Gravity, Viscosity, Surface Activity, Rheology and Texture, Effects of Temperature, Flavour. Storage and Transport, Raw Material Preparative Operation - Theory and Equipment's Used: Cleaning, Grading, Peeling. Food Conversion Operation - Size Reduction, Mixing, Emulsification, Filtration, Membrane Separation, Extraction, Crystallization.	
Application of Food Processing* Technology of Milk and Milk Products - Processing of Market Milk: Types of Milk Products: Paneer, Butter, Ice Cream, Vegetables and Fruits Processing Technology - Jam, Jelly, Squash, Sauce and Fruit Juice Powders. Recent Trends in Meat Processing - Post-Mortem Changes- Meat Tenderization - Poultry Processing. Baking Technology: Bread, Cake and Biscuit Preparation, Enzyme Engineering.	[9]
Fermentation Technology Food Fermentation - General Principles - Culture Maintenance. Production Process of Fermented Foods - Cheese, Yoghurt, Sauerkraut, Pickles; Industrial Production of Alcoholic Beverages: Beer and Wine - Non-Alcoholic Beverages - Tea. Oriental Fermented Foods. Microorganisms as Food: Probiotics and Prebiotics, Single Cell Protein - Applications of Enzymes In Food Processing.	[9]
Food Quality and Management Sensory Evaluation of Food Quality: Appearance, Textural, Flavour Factors - Nine Hedonic Scale - Food Safety - Organizations Dealing with Inspection, Certification and Quality Assurance, Food Safety Standards: WHO, FPO, MMPO, HACCP, GMP, FSSAI, Codex.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Wulf Cruger and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing Corporation, New Delhi. 2003.
2.	Pierre-Yves Bouthyette, "Fermentation Technologies", 2nd Edition, Rai University, Ahmedabad, 2005.
Reference(s):	
1.	Presscott, D. "Industrial Microbiology", CBS Publishers, New Delhi. 1999.
2.	Peter F. Stanbury, Allan Whitaker and Stephen J, Hall, "Principles of Fermentation Technology", 3rd Edition, Butterworth-Heinemann Publishers, 2017.
3.	Arindam Kuila and Vinay Sharma, "Principles and Applications of Fermentation Technology", Wiley Publications, 2019.
4.	Modi, H.A., " Fermentation Technology", Vol-2, Pointer Publishers, 2015.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Principles of Food Processing**	
1.1	Principles and Methods of Food Preservation	1
1.2	Thermal Processing of Food - 12D Concept	1
1.3	Blanching - Pasteurisation ,Canning	1
1.4	Freezing - Evaporation - Dehydration - Radiation	1
1.5	Pulse Electric Field - Ultra High Pressure	1
1.6	Modern Technology for Food Packaging	1

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1.7	Modified Atmosphere Storage and Packing	1
1.8	Vacuum Packaging, Food Additives, Food Colours, Food Packaging	1
1.9	Preservation by Chemical Methods and its Limitations	1
2.0	**Food Engineering Operations**	
2.1	Properties of Foods And Processing Theory - Liquid, Solid and Gases	1
2.2	Density, Specific Gravity, Viscosity, Surface Activity	2
2.3	Rheology and Texture	1
2.4	Effects of Temperature, Flavour	1
2.5	Storage and Transport, Raw Material Preparative Operation	1
2.6	Theory and Equipment's Used: Cleaning, Grading, Peeling	1
2.7	Food Conversion Operation - Size Reduction, Mixing	1
2.8	Food Conversion Operation - Emulsification, Filtration, Membrane Separation, Extraction, Crystallization	1
3.0	**Application of Food Processing**	
3.1	Technology of Milk and Milk Products	1
3.2	Processing of Market Milk	1
3.3	Types of Milk Products: Paneer, Butter, Ice Cream	1
3.4	Vegetables and Fruits Processing Technology - Jam, Jelly, Squash, Sauce and Fruit Juice Powders	1
3.5	Recent Trends in Meat Processing	1
3.6	Post-Mortem Changes- Meat Tenderization	1
3.7	Poultry Processing	1
3.8	Baking Technology: Bread, Cake and Biscuit Preparation	1
3.9	Enzyme Engineering	1
4.0	**Material Balances and Data Consistency**	
4.1	Fermentation Technology	1
4.2	Food Fermentation – General Principles	1
4.3	Culture Maintenance	2
4.4	Production Process of Fermented Foods-Cheese,	1
4.5	Industrial Production of Alcoholic Beverages: Beer and Wine	1
4.6	Non-Alcoholic Beverages – Tea	1
4.7	Oriental Fermented Foods	1
4.8	Microorganisms as Food: Probiotics And Prebiotics, Single Cell Protein	1
5.0	**Food Quality and Management**	
5.1	Sensory evaluation of food quality: appearance, textural, flavour factors	1
5.2	Nine hedonic scale - Food safety	2
5.3	Organizations dealing with inspection	1
5.4	Certification and quality assurance	1
5.5	Food safety standards: WHO, FPO	1
5.6	Food safety standards: MMPO, HACCP	2
5.7	Food safety standards: GMP, FSSAI, Codex	1

Course Designer(s)

1. Dr.M. Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Elective II

60 BT E21	Bioreactor Design	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To comprehend the basics of bioreactor hydrodynamics and fluid rheology.
- To identify the heat and mass transfer principles in bioreactors
- To recognize the process stability analysis and control of bioreactors
- To study about the scale up methods and mechanical aspects of reactor design.
- To apprehend the applications of bioreactors in various biochemical operations

Pre-requisites

- Basic knowledge in Fluid flow, Heat and Mass transfer, Chemical Reaction Engineering and Bioprocess Engineering

Course Outcomes

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

CO1	Comprehend the basics of bioreactors and rheological behavior of culture broth	Understand
CO2	Recognize the significance of heat and mass transfer principles in bioreactor operations	Apply
CO3	Comprehend the criteria for bioreactor analysis and online control of bioreactors	Apply
CO4	Apprehend the bioreactor geometry and challenges in bioreactor scale up	Apply
CO5	Review the bioreactor design and principles in various bioprocessing applications	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E21 - Bioreactor Design								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Introduction to Bioreactors Introduction — Components of Bioreactor; Modes of Bioreactor- Batch, Continuous and Fed Batch Reactors; General Types of Bioreactors, Rheology of Culture Broths-Factors Affecting Broth Viscosity; Ungassed Newtonian Fluids, Gassed Fluids, Improving Mixing in Fermenters. Hydrodynamic Regime, Power Dissipation and Gas Holdup in Bioreactors.	[9]
Heat and Mass Transfer in Bioreactors Mass Transfer in Bioreactors- Oxygen Requirements of Microbial Cultures Oxygen Mass Transfer Fundamentals- Oxygen Transfer by Aeration and Agitation, Determination of Mass Transfer Coefficient; Heat Transfer in Bioreactors- Relationship Between Heat Transfer, Cell Concentration and Stirring Conditions.	[9]
Analysis and Control of Bioreactor Analysis of Bioreactor Dynamics - Process Stability of Microbial Reactors - Analysis of Mixed Microbial Population - Microbial Reactors with and Without Cell Recycle. Monitoring, On-Line Measurements & Computer Control of Bioreactors.	[9]
Scale Up of Bioreactors* Bioreactor Geometry, Constants and Variables. Scale Up of Bioreactor – Criteria for Scale Up, scale up Parameters and Scale up Methods. Mechanical Aspects of Reactor Design.	[9]
Applications of Bioreactors Photo-Bioreactors - Mammalian and Plant Cell Bioreactors - Inverse Fluid Flow Units - Microbial and Mammalian Cell Hollow Fiber Reactor - Centrifugal Field Reactors. Bioreactors Used for Immobilized Cells and Enzymes, Bioreactors in Waste Water Treatment.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Stanbury F P, Whitaker A and Hall S G., “Principles of Fermentation Technology”, Aditya Books, Pvt, Ltd., NewDelhi, 2013.
2.	Bailey, J. E. and Ollis, D. F., "Biochemical Engineering Fundamentals", 2nd Edition, Tata McGraw-Hill, New Delhi, 2010.
Reference(s):	
1.	Pauline Doran ,Bioprocess Engineering Principles, Academic Press, London, 2015.
2.	Carl-Fredrik Mandenius., “Bioreactors : design, operation and novel applications”, Wiley-VCH Verlag GmbH & Co,2016
3.	Michael L Shuler and Fikret Kargi., Bioprocess Engineering: Basic Concepts, Prentice-Hall of India Pvt Ltd, 2008
4.	Panda., T, Bioreactors analysis and design, Tata McGraw Hill, New Delhi, New York, 2011

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Bioreactors**	
1.1	Introduction – Components of Bioreactor	1
1.2	Modes of Bioreactor- Batch, Continuous and Fed Batch Reactors	1
1.3	General Types of Bioreactors	1
1.4	Rheology of Culture Broths-Factors Affecting Broth Viscosity	1
1.5	Ungassed Newtonian Fluids, Gassed Fluids	2
1.6	Improving Mixing in Fermenters	1
1.7	Hydrodynamic Regimes	1
1.8	Power Dissipation and Gas Holdup in Bioreactors	1
2.0	**Heat and Mass Transfer in Bioreactors**	
2.1	Mass Transfer in Bioreactors	1
2.2	Oxygen Requirements of Microbial Cultures and Oxygen Mass Transfer Fundamentals	2

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2.3	Oxygen Transfer by Aeration and Agitation	1
2.4	Determination of Mass Transfer Coefficient	2
2.5	Heat Transfer in Bioreactors	1
2.6	Relationship Between Heat Transfer, Cell Concentration and Stirring Conditions.	2
3.0	**Analysis and Control of Bioreactor**	
3.1	Analysis of Bioreactor Dynamics	2
3.2	Process Stability of Microbial Reactors	1
3.3	Analysis of Mixed Microbial Population	2
3.4	Microbial Reactors With and Without Cell Recycle	1
3.5	Monitoring- On-Line Measurements	2
3.6	Computer Control of Bioreactors	1
4.0	**Scale Up of Bioreactors**	
4.1	Bioreactor Geometry, Constants and Variables	2
4.2	Scale up of Bioreactor – Criteria For Scale Up	1
4.3	Scale Up Parameters	1
4.4	Scale Up Methods	3
4.5	Mechanical Aspects of Reactor Design.	2
5.0	**Applications of Bioreactors**	
5.1	Photo-Bioreactors	1
5.2	Mammalian and Plant Cell Bioreactors	1
5.3	Inverse Fluid Flow Units	1
5.4	Microbial and Mammalian Cell Hollow Fiber Reactor	1
5.5	Centrifugal Field Reactors	1
5.6	Bioreactors Used for Immobilized Cells and Enzymes	1
5.7	Bioreactors in Waste Water Treatment.	2
5.8	Case Studies	1

Course Designer(s)

1. Dr.S. Poornima - spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E22	Bioethics and Biosafety	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn about Intellectual Property and related Rights.
- To provide knowledge on patent law and patent application process
- To disseminate knowledge on copy right and trade mark registration process
- To learn various database for the search of patent
- To summarize the need for biosafety and their management

Pre-requisites

- NIL

Course Outcomes

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

CO1	Review the types of IPR, various conventions for the protection of intellectual property rights.	Understand
CO2	Formulate a patent according to the patent law and procedures for filing a patent.	Understand
CO3	Assess the procedure for applying copy right and trade mark	Apply
CO4	Practice the database for searching the patents	Apply
CO5	Investigate the role of GMOs and LMOs and their risk assessment and management.	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E22- Bioethics and Biosafety								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Overview of Intellectual Property Rights IPR: Definition, Role and Importance - Types of IPR: Patents, Trademarks, Trade Secrets, Copyright and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications Indian Theory- Constitutional Protection of Property and IP, Western Theory- Paris Convention, 1883, The Berne Convention, 1886, The Universal Copyright Convention, 1952, The WIPO Convention, 1967,The Patent Co-Operation Treaty, 1970, The TRIPS Agreement, 1994.	[9]
Patents* Patent Law, New developments in Patent Law. Patent Requirements - Ownership and Transfer – Patentable and Non Patentable Inventions - Patent Application Process and Granting of Patent - Restoration of lapsed Patent, Surrender and Revocation of Patent, Patent Infringement,	[9]
Copy Rights and Trade Marks* Copy Right -Fundamental of Copy Right Law, Registration Procedure, Terms and Conditions for the Grant of Copy Right, Extent of Rights Exception to Copy Right Protection, Licence of Copyright, Infringement. Trade Mark-Procedure for Registration of Trademark, Acquisition of Trade Mark Rights, Purpose and Function of Trademarks.	[9]
IPR Database Patent database National, International, Country-Wise Patent Searches (USPTO, EPO), PATENT Scope (WIPO, IPO) - Commercial and Free Patent Databases - Search Tools and Functions - Database for Trademark and Industrial Design - Data Security, Confidentiality, Privacy - International Aspects of Computer and Online Crime.	[9]
Biosafety* Introduction to Biological Safety Cabinets - Primary Containment for Biohazards - Biosafety Levels - Biosafety Levels of Specific Microorganisms - Biosafety Guidelines - Government of India; Definition of GMOs & LMOs - Roles of Institutional Biosafety Committee, GMO Applications in Food And Agriculture - Environmental Release of Gmos - Risk Analysis, Risk Assessment, Risk Management and Communication.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Gopalakrishnan N.S., and Ajitha T.G,, “Principles of Intellectual Property”, 2nd Edition, Eastern Book Company,2014.
2.	Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited (2019).
Reference(s):	
1.	Subbaram N.R., “Handbook of Indian Patent Law and Practice “, S.Viswanathan Printers and Publishers Pvt.Ltd., 1998.
2.	Tzotzos, G.T., “Genetically modified organisms - A guide to Biosafety”, CAB International, Walling ford, U.K.213p.1995
3.	R.O. Jenkins., (Ed.), Product Recovery in Bioprocess Technology — Biotechnology, Open Learning Series, Butterworth-Heinemann, 1992.
4.	Harrison, R.G., Todd, P., Rudge, S.R., and Petrides, D.P. Handbook of Biosafety Science and Engineering. 2 nd Edition. Oxford University Press (2015).

***SDG 6: Industry, Innovation and Infrastructure**

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Overview of Intellectual Property Rights**	
1.1	IPR: Definition; Role and Importance	1
1.2	Types Of IPR: Patents;Trademarks, Trade Secrets, Copyright and Related Rights - Industrial Design - Traditional Knowledge - Geographical Indications	2
1.3	Indian Theory- Constitutional Protection of Property and IP,	1

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1.4	Western Theory- Paris Convention, 1883, The Berne Convention, 1886,	1
1.5	The Universal Copyright Convention, 1952, The WIPO Convention, 1967,	2
1.6	The Patent Co-Operation Treaty, 1970, The TRIPS Agreement, 1994.	2
2.0	**Patents**	
2.1	Patent Law; New Developments In Patent Law	1
2.2	Patent Requirements - Ownership and Transfer	2
2.3	Patentable and Non Patentable Inventions	2
2.4	Patent Application Process and Granting of Patent	2
2.5	Restoration of Lapsed Patent; Surrender and Revocation of Patent - Patent Infringement	2
3.0	**Copy Rights and Trade Marks**	
3.1	Copy Right; Fundamental of Copy Right Law	1
3.2	Registration Procedure; Terms and Conditions for the Grant of Copy Right	2
3.3	Extent of Rights Exception to Copy Right Protection	1
3.4	Licence of Copyright; Infringement.	2
3.5	Trade Mark - Procedure for Registration of Trademark	2
3.6	Acquisition of Trade Mark Rights; Purpose and Function of Trademarks	1
4.0	**IPR Database Patent database**	
4.1	National, International, Country-Wise Patent Searches (USPTO, EPO),	1
4.2	Patent Scope (WIPO, IPO)	2
4.3	Commercial and Free Patent Databases, Search Tools and Functions	1
4.4	Database for Trademark and Industrial Design	1
4.5	Data Security, Confidentiality, Privacy	2
4.6	International Aspects of Computer and Online Crime.	2
5.0	**Bioresource Utilisation**	
5.1	Introduction to Biological Safety Cabinets	1
5.2	Primary Containment for Biohazards - Biosafety Levels	2
5.3	Biosafety Levels of Specific Microorganisms	1
5.4	Biosafety Guidelines - Government of India; Definition of GMOs & LMOs	1
5.5	Roles of Institutional Biosafety Committee	2
5.6	GMO Applications in Food and Agriculture	2

Course Designer(s)

1. Dr.S.Sidhra – sidhra@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E23	Stem Cell Technology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To familiarize the basic knowledge on embryology and developmental biology.
- To learn the different developmental phases of stem cells and establishment of stem cell banks.
- To develop the skills in the area of stem cell research and its applications.
- To widen the knowledge about the isolation.
- To develop the culturing procedure and applications of stem cells to treat diseases.

Pre-requisites

- Basic Knowledge on Cell Biology and Immunology

Course Outcomes

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

CO1	Highlight the origin, types, sources, characterization and applications of stemcells.	Understand
CO2	Illuminate the sources, properties and challenges in establishing the human embryonic stem cell banks	Apply
CO3	Interpret the isolation neural stem cells, preparation of complete neuroculture and Immunolabeling procedures.	Apply
CO4	Identify the novel stem cell based gene therapy and genetically engineered stem cells in animal cloning.	Apply
CO5	Validate the role of stem cells in cellular assay, drug discovery and haematopoietic stem cell Transplantation	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E23 - Stem Cell Technology								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Introduction to Stem Cells Introduction to Stem Cells - Embryogenesis - Differentiation and Types of Stem Cells - Origin and Characterization of Human Stem Cells and Its Applications- Plasticity of Human Somatic Stem Cells- Sources of Stem Cells: Cord Blood and Bone Marrow-Scientific and Technical Obstacles of Novel Human Stem Cell Based Therapy - Stem Cell Marker.	[9]
Human Embryonic Stem Cell * Sources for Human Embryonic Stem Cells (HESC) - Growing of HESC In Laboratory-Animal Stem Cells - Current Advantages and Limitations of HESC and Human Somatic Cells - Properties of Embryonic Stem Cells - Developments Regarding Establishment of Human Stem Cell Banks and Registries - Regulations in European Member and Non-European Countries Regarding Hesc Research.	[9]
Isolation and Identification of Stem Cells Neural Diseases - Preparation of Complete Neuroculture, Culturing and Subculturing Human Neurospheres - Differentiation of Human Neurospheres and Neurons, Astrocytes and Oligodendrocytes-Immuno-Labelling Procedure- Mesenchymal Stem Cells - Retinal Stem Cells - Bone Marrow.	[9]
Stem Cell Therapy Novel Stem Cell Based Gene Therapy - Genetically Engineered Stem Cells - Stem Cells and Animal Cloning - Transgenic Animals and Stem Cells- Stem Cell Therapy, Cell Protection - Stem Cell in Cellular Assays for Screening - Stem Cell Based Drug Discovery and Toxicological Studies - Hematopoietic Stem Cell Transplantation.	[9]
Applications of Stem Cells Clinical Applications of Hematopoietic Stem Cells from Cord Blood - Treatment of Neural Diseases such as Parkinson's Disease, Huntington's Disease and Alzheimer's Disease- Treatment of Cardiac Arrest-Repair of Damaged Organs Such as The Liver and Pancrease - Application of Stem Cells in Bone Regeneration.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Robert Lanza and Antony Atala., "Essentials of stem cell biology" 3rd Edition, Elesvier academic press, 2014.
2.	Jane E., Bottenstein. "Neural Stem Cells, Development and Transplantation", Springer India Pvt. Ltd.New Delhi, 2010.
Reference(s):	
1.	Gary S Stein et al., "Human stem cell Technology and Biology" a Research guide and Laboratory manualWiley - Blackwell (2011)
2.	Thomas C.G. Bosch., "Stem Cells, from Hydra to Man", Springer India Pvt. Ltd., New Delhi, 2009.
3.	Raul Delgado-Morales., "Stem Cell Genetics for Biomedical Research: Past, Present and Future", Springer International Publishing, 2018.
4.	Aditya Bharadwaj., "Global Perspectives on Stem Cell Technologies", Springer International Publishing, 2017.

***SDG 6: Clean Water and Sanitation**

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Introduction to Stem Cells**	
1.1	IPR: Definition; Role and Importance	
1.2	Types Of IPR: Patents;Trademarks, Trade Secrets, Copyright and Related Rights - Industrial Design - Traditional Knowledge - Geographical Indications	2
1.3	Indian Theory- Constitutional Protection of Property and IP	1
1.4	Western Theory- Paris Convention, 1883, The Berne Convention, 1886	1
1.5	The Universal Copyright Convention, 1952, The WIPO Convention, 1967	2

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1.6	The Patent Co-Operation Treaty, 1970, The TRIPS Agreement, 1994	2
1.7	Stem Cell Marker	1
2.0	**Human Embryonic Stem Cell**	
2.1	Sources for Human Embryonic Stem Cells (Hesc)	1
2.2	Growing of Hesc in Laboratory-Animal Stem Cells	2
2.3	Current Advantages and Limitations of Hesc and Human Somatic Cells	2
2.4	Properties of Embryonic Stem Cells	2
2.5	Developments Regarding Establishment of Human Stem Cell Banks and Registries	1
2.6	Regulations in European Member and Non-European Countries Regarding HESC Research	1
3.0	**Isolation and Identification of Stem Cells**	
3.1	Neural Diseases	1
3.2	Preparation of Complete Neuroculture	2
3.3	Culturing and Subculturing Human Neurospheres	1
3.4	Differentiation of Human Neurospheres And Neurons, Astrocytes and Oligodendrocytes	2
3.5	Immuno-Labelling Procedure	1
3.6	Mesenchymal Stem Cells-Retinal Stem Cells-Bone Marrow	2
4.0	**Stem Cell Therapy**	
4.1	Novel Stem Cell Based Gene Therapy	2
4.2	Genetically Engineered Stem Cells	1
4.3	Stem Cells and Animal Cloning-Transgenic Animals and Stem Cells	1
4.4	Stem Cell Therapy Vs Cell Protection	2
4.5	Stem Cell in Cellular Assays for Screening	2
4.6	Stem Cell Based Drug Discovery and Toxicological Studies-Hematopoietic Stem Cell Transplantation	1
5.0	**Applications of Stem Cells**	
5.1	Clinical Applications of Hematopoietic Stem Cells from Cord Blood	2
5.2	Treatment of Neural Diseases Such as Parkinson's Disease, Huntington's Disease and Alzheimer's Disease	2
5.3	Treatment of Cardiac Arrest	2
5.4	Repair Of Damaged Organs Such as The Liver and Pancreas	2
5.5	Application of Stem Cells in Bone Regeneration	1

Course Designer(s)

1. Dr.K. Syed Zameer Ahmed – syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E24	Marine Biotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To provide the knowledge about the marine diversity
- To know about the marine microbes and the aquatic animals
- To impart the biomedical importance of marine organisms.
- To learn the bioproducts derived from marine biodiversity
- To understand the environmental impacts of the aquatic biotechnology

Pre-requisites

- Biodiversity and its conservation

Course Outcomes

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

CO1	Enlighten the different habitats of marine biodiversity and its nutrient requirements.	Understand
CO2	Describe the aquaculture related to artificial insemination, eye stalk ablation, transgenic fish technology andthe role of probiotic bacteria in aquaculture.	Understand
CO3	Substantiate the use of bioactive compounds from different marine organisms.	Apply
CO4	Identify the marine sources that produces the biopolymers, biomaterials, antifouling compounds and bio potential use of halophile bacteria.	Apply
CO5	Discuss the bioremediation using microbes, environmental risks and benefits	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	20	46
Apply	-	20	20
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E24 - Marine Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Introduction to Marine Biodiversity Marine Microbial Diversity: Symbiotic, Free-Living, Biofilm, Proximity to Ocean Surface or Sediments: Euphotic, Mesopelagic, Bathopelagic, Benthos - Concentration of Nutrients and Growth Substrates: Oligotrophic, Mesotrophic, Eutrophic, Algal Blooms - Hydrothermal Vents: Vent Biodiversity - Applications of Marine Bioactive Components and Extremozymes. Merits and Demerits of Marine Biodiversity.	[9]
Marine Aquaculture Shellfish and Crustacean Culture: Shrimps, Edible Mussels, Pearl Oyster, Crabs, Fish Aquaculture: Artificial Insemination, Eye Stalk Ablation Transgenic Fish Technology, Transgenic Fishes With Growth Hormone (GH) And Antifreeze Genes, Development of Healthy Fish Diets, Probiotics Bacteria and Their Importance In Aquaculture, Vaccines for Aquaculture.	[9]
Biomaterials and Bioprocessing Polymers and Biomaterials: Properties and Production of an Agarose - Agar - Alginates - Carrageenan's - Chitin - Chitosan - Carotene — Heparin: Marine Flavorings - Environmentally Friendly Antifouling Compounds, Bio Potential Use of Halophile Organisms. Application of Marine Biomaterials in Different Field.	[9]
Biomedical Importance of Marine Organisms* Marine Pharmacology: Pharmaceutical and Bioactive Natural Products - Microalgae as a Source of Bioactive Molecules - New Antibiotics and Medicines from Marine Organisms — Uncultivable Bacteria, Occurrence, Characteristics and Exploitation.	[9]
Environmental Impacts of Aquatic Biotechnology** Application Environment Factors in Aquatic Biotechnology, Control of Oil Spills and Bioremediation-Genetically Engineered Marine Organisms- Sea Weeds for Removal of Heavy Metal Pollutants Introduction of Coral Bleaching - Biosphere Reserve - Gulf of Mannar, Impact of Invasive Organisms, Environmental and Economic Risks and Benefits. Recent Techniques for of Oil Spills Control.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Bright Singh I.S, Somnath Pai S., Rosamma Philip and Mohan Das A., "Aquaculture Medicine", 1ST Edition, Paico Printing Press, India, 2003.
2.	Advances in Biochemical Engineering/Biotechnology- Marine Biotechnology I &II ; Y. LeGal, R. Ulber,Springer Verlag BerlinHeidelberg, 2005.
Reference(s):	
1.	Attaway, D. H., Zaborsky, O. R. (Ed.), "Marine Biotechnology: Volume I, Pharmaceuticals and Bioactive Natural Products", NewYork, USA, 1993.
2.	Y.K. Lee and S. Salminen, "Handbook of probiotics and prebiotics", 2nd Edition, Wiley, A John Wiley and sons publication,2009.
3.	Antonio Trincone, "Grand Challenges in Marine Biotechnology", Springer International Publishing, 2018
4.	Se-Kwon Kim, "Encyclopedia of Marine Biotechnology", Wiley publisher, 2020

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Marine Biodiversity**	
1.1	Marine Microbial Diversity: Symbiotic, Free-Living to Ocean Surface or Sediments	1
1.2	Marine Microbial Diversity: Biofilm, Proximity to Ocean Surface or Sediments	1
1.3	Euphotic, Mesopelagic, Bathopelagic	1
1.4	Benthos - Concentration of Nutrients and Growth Substrates	1
1.5	Oligotrophic, Mesotrophic, Eutrophic, Algal Blooms	1

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1.6	Hydrothermal Vents: Vent Biodiversity	2

1.7	Applications of Marine Bioactive Components and Extremozymes.	1
1.8	Merits and Demerits of Marine Biodiversity	1
2.0	**Marine Aquaculture**	
2.1	Shellfish and Crustacean Culture: Shrimps, Edible Mussels, Pearl Oyster, Crabs	2
2.2	Fish Aquaculture: Artificial Insemination	2
2.3	Eye Stalk Ablation Transgenic Fish Technology	1
2.4	Transgenic Fishes With Growth Hormone (GH) and Antifreeze Genes, Development of Healthy Fish Diets.	2
2.5	Probiotics Bacteria and Their Importance in Aquaculture, Vaccines for Aquaculture.	2
3	**Biomedical Importance of Marine Organisms***	
3.1	Marine Pharmacology: Pharmaceutical and Bioactive Natural Products	2
3.2	Microalgae as a Source of Bioactive Molecules	2
3.3	New Antibiotics and Medicines From Marine Organisms	2
3.4	Uncultivable Bacteria, Occurrence, Characteristics and Exploitation.	2
3.5	Uncultivable Bacteria, Characteristics and Exploitation	1
4.0	**Biomaterials and Bioprocessing**	
4.1	Polymers and Biomaterials: Properties and Production.	2
4.2	Agarose, Agar, Alginates - Carrageenan's	2
4.3	Chitin ,Chitosan, Carotene –Heparin	2
4.4	Marine Flavourings - Environmentally Friendly Antifouling Compounds	1
4.5	Bio Potential use of Halophile Organisms	1
4.6	Application of Marine Biomaterials in Different Field.	1
5.0	**Electric and Autonomous Vehicles**	
5.1	Application Environment Factors in Aquatic Biotechnology,	1
5.2	Control of Oil Spills and Bioremediation-Genetically Engineered Marine Organisms.	2
5.3	Sea Weeds for Removal of Heavy Metal Pollutants Introduction of Coral Bleaching	1
5.4	Biosphere Reserve - Gulf of Mannar, Impact of Invasive Organisms	2
5.5	Environmental and Economic Risks and Benefits.	1
5.6	Recent Techniques for of Oil Spills Control.	2

Course Designer(s)

1. R. Krishnaveni - rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E25	Computational Biology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To study the basic concepts and role of computation in biology
- To learn about the importance of biological databases and analyze complex biological networks
- To study the principles and algorithms behind sequence alignment methods
- To explain the computational methods for protein structure prediction and Drug design
- To understand the concepts of machine learning tools and its application for biological analysis

Pre-requisites

- Basic knowledge of biology and genetics

Course Outcomes

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

CO1	Comprehend the basic structure of biological macromolecules	Remember
CO2	Acquire the knowledge of biological databases and its importance	Understand
CO3	Experiment with sequence analysis such as pair wise and multiple sequence alignment	Apply
CO4	Make use of secondary and tertiary structure of proteins for drug design	Apply
CO5	Examine application of the machine learning approaches in computational biology and potential applications in drug discovery	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech – Biotechnology								
60 BT E25- Computational Biology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Basics of Biology * Biomolecules of Life - Structure and Composition of DNA, RNA & Protein- Protein Structure Basics -Primary- Secondary and Tertiary Structure of Protein: Role of Computation in biology: NGS	[9]
Biological Databases Concept of Relational Database- Data Archiving- Data Mining: Primary Databases-NCBI-EMBL- DDBJ: Structure Databases-PDB: Graph Theory and Network Properties: Analysis of Gene Regulatory Networks and Metabolic Networks	[9]
Sequence Analysis Pairwise Alignment Tools-Dot Matrix Analysis: Dynamic Programming-Smith Waterman and Needleman Wunsch Algorithm: Heuristic Methods- BLAST, FASTA: Multiple Sequence Alignment Methods-Progressive Alignment (Clustal): RASMOL, PYMOL: Phylogenetic Analysis	[9]
Structure Analysis and Drug Design ** Protein Secondary Prediction-Chou Fasman Method- GOR Method: Tertiary Structure Prediction Homology Modelling: Ab initio Modelling: Computer Aided Drug Design:Hydrophobicity Profiling-Kyte-Doolittle, Hopp-Woods:Hydrophobicity Plots and. Interpretation: Contact Maps-Types of Contact Maps (Binary, Distance)-Methods for Generating Contact Maps: Long and Short Range Contacts.	[9]
Machine Learning, Genomics and Proteomics Techniques, Applications Artificial Neural Networks in Protein Secondary Structure Prediction - Hidden Markov Models for Gene Finding - Decision Trees, Support Vector Machines: Introduction to Systems Biology and Synthetic Biology: Microarray Analysis - DNA Computing: Bioinformatics Approaches for Drug Discovery - Assembling the Genome: STS Content Mapping for Clone Contigs - Functional Annotation: Peptide Mass Fingerprinting	[9]
Total Hours:	**45**

Text Book(s):	
1.	Rout, R. K., Umer, S., Sheikh, S., & Sangal, A. L. (Eds.)," Artificial Intelligence Technologies for Computational Biology", CRC Press 2022.
2.	Roy, Sanjiban Sekhar, and Y. H. Taguchi, eds.," Handbook of Machine Learning Applications for Genomics". Springer, 2022.
Reference(s):	
1.	Aluru, S. (Ed.)., "Bioinformatics Algorithms: Techniques and Applications." 2nd Edition. CRC Press, Boca Raton, Florida, USA,2019.
2.	Raman, K.," An introduction to computational systems biology: systems-level modelling of cellular networks", Chapman and Hall/CRC,2021.
3.	Alon, U., "An introduction to systems biology: design principles of biological circuits". Chapman and Hall/CRC,2019.
4.	Voit, E., "A first course in systems biology". Garland Science,2017.

***SDG 15 – Life on Land**
****SDG 9 – Industry, Innovation, and Infrastructure**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basics of Biology**	
1.1	Biomolecules of life - Structure and Composition of DNA	2
1.2	Structure and Composition of RNA	2
1.3	Structure and Composition of Protein	1
1.4	Protein Structure Basics -Primary- Secondary and Tertiary Structure of Protein	2
1.5	Role of Computation in BIOLOGY: NGS	2
2.0	**Biological Databases**	
2.1	Concept of Relational Database- Data Archiving- Data Mining	2

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2.2	Primary Databases-NCBI-EMBL- DDBJ	2
2.3	Structure Databases-PDB	2
2.4	Graph Theory and Network Properties	1
2.5	Analysis of Gene Regulatory Networks and Metabolic Networks	2
3.0	**Sequence Analysis**	
3.1	Pairwise Alignment Tools-Dot Matrix Analysis	2
3.2	Dynamic PROGRAMMING-Smith Waterman and Needleman Wunsch Algorithm	2
3.3	Heuristic Methods- BLAST, FASTA	2
3.4	Multiple Sequence Alignment Methods-Progressive Alignment (Clustal)	2
3.5	RASMOL, PYMOL :Phylogenetic Analysis:	1
4.0	**Structure Analysis and Drug Design**	
4.1	Protein Secondary Prediction-Chou Fasman Method	1
4.2	Protein Secondary Prediction- GOR Method	1
4.3	Tertiary Structure Prediction	1
4.4	Homology Modelling	1
4.5	Ab initio Modelling	1
4.6	Computer Aided Drug Design	2
4.7	Hydrophobicity Profiling-Kyte-Doolittle, Hopp-Woods:Hydrophobicity Plots and. Interpretation	1
4.8	Contact Maps-Types of Contact Maps (Binary, Distance)-Methods for Generating Contact Maps: Long and Short Range Contacts.	1
5.0	**Machine learning, Genomics and Proteomics Techniques, Applications**	
5.1	Artificial Neural Networks in Protein Secondary Structure Prediction - Hidden Markov Models for Gene Finding	1
5.2	Decision Trees, Support Vector Machines	1
5.3	Introduction to Systems Biology and Synthetic Biology	1
5.4	Microarray Analysis - DNA Computing	2
5.5	Bioinformatics Approaches for Drug Discovery - Assembling the Genome	1
5.6	STS Content Mapping for Clone Contigs - Functional Annotation	2
5.7	Peptide Mass Fingerprinting	1

Course Designer(s)

1. Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E26	Organic Farming for Sustainable Agriculture	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To impart the principles and importance of organic farming for sustainable agriculture
- To learn about the soil fertility and manures
- To learn the production technology of organic compost and to practice the its design criteria.
- To provide the better understanding about organic standard certificates
- To discuss about the future perspectives of organic farming

Pre-requisites

- Biology

Course Outcomes

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

CO1	Recognize the principles, various types of farming and the challenges for organic agriculture.	Understand
CO2	Comprehend the various components of soil fertility and the technique manage the soil fertility	Apply
CO3	Exemplify the production of organic compost and the method of its spreading.	Apply
CO4	Comprehend the history and development of organic standards and certification	Apply
CO5	Analyse the future perspective of organic farming for sustainable agriculture	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E26 - Organic Farming for Sustainable Agriculture								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	40	60	100

Overview of Organic Farming Origin and Principles for Organic Farming - Indian Agriculture Before the Green Revolution - The Green Revolution - Impact of Green Revolution on the Environment - Types of Farming: Pure Organic, Integrated and Mixed Farming System - Needs and Challenges for Organic Agriculture- Key Indicators of Sustainable Agriculture.	[9]
Soil Fertility and Production of Organic Compost* Components of Soil Fertility - Physical, Chemical and Biological - Managing Soil Fertility in Organic Farming Systems - Organic Manures: Farmyard, Compost Sheep and Goat, Poultry, Oil-Cakes, Sewage, Sludge and Sullage Manure. Composting - Importance of Composting - Method of Spreading Compost - Microbes Involved in Composting - Design Criteria - Rate and Time of Application - Kinetics of Composting - Type And Amount of Compost - Practical Method of Making Compost.	[9]
Sustainable Agriculture SWOT Analysis of Organic Farming- Sustainable Agriculture- Key Indicators of Sustainable Agriculture- Organic Farming and Climate Change	[9]
Organic Standards and Certification History and Development of Organic Standards and Certification - Organic Standards Setting Processes - Conformity Assessment Processes (International Verification Processes) - Key Challenges for the Future of Organic Regulation.	[9]
Perspectives of Organic Farming Economic Management in Organic Agriculture - Understanding the Market for Organic Food-Supply Chain Management — Social Responsibility in Organic Agriculture: Learning, Collaboration and Regulation - Organic Fertilizer:Supplementary Nutrient Source for Rice, Sugarcane, Sorghum and Banana - Marketing of Organic Products- Pest Management	[9]
Total Hours:	**45**

Text Book(s):	
1.	Gupta, M., Organic agriculture development in India. ABD publishers, Jaipur, India (2004).
2.	Kristensen, P., Taji, A. and Reganold, J., "Organic Agriculture: A Global Perspective", CSIRO Press, Victoria, Australia, 2006.
Reference(s):	
1.	APEDA Guidelines for Production of Organic Rice in India, Agricultural and Processed Food Products Export Development Authority, New Delhi (2001).
2.	Yadav, A.K. Organic Agriculture (Concept, Scenario, Principals and Practices), National Centre of Organic Farming Department of Agriculture and Cooperation, Ministry of Agriculture, Govt of India, CGO-II, Kamla Nehru Nagar Ghaziabad, 201 001, Uttar Pradesh (2015).
3.	Shiva, V., Pande, P. and J. Singh Principles of Organic Farming: Renewing the Earth's Harvest. Navdanya, New Delhi (2004).

***SDG 9 – Industry Innovation and Infrastructure**
****SDG 3 – Good Health and Well Being**

Course Content and Lecture Schedule

S.No	Topic	No. of Hours
1	**Overview of Organic Farming**	
1.1	Origin and Principles of Organic Farming - Indian Agriculture before the Green Revolution	2
1.2	The Green Revolution - Impact of Green Revolution on the Environment	2
1.3	Types of Farming: Pure Organic, Integrated and Mixed Farming System	2
1.4	Needs and Challenges for Organic Agriculture	1
1.5	Key Indicators of Sustainable Agriculture.	2

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2	**Soil Fertility and Production of Organic Compost**	
2.1	Components of Soil Fertility - Physical, Chemical and Biological	1
2.2	Managing Soil Fertility in Organic Farming Systems	1
2.3	Organic Manures: Farmyard, Compost Sheep And Goat, Poultry, Oil-Cakes, Sewage, Sludge and Sullage Manure.	2
2.4	Composting - Importance of Composting - Method of Spreading Compost	1
2.5	Microbes Involved in Composting - Design Criteria - Rate and Time of Application	2
2.6	Kinetics Of Composting - Type and Amount of Compost	1
2.7	Practical Method of Making Compost.	1
3	**Sustainable Agriculture**	
3.1	SWOT Analysis of Organic Farming	2
3.2	Sustainable Agriculture	2
3.3	Key Indicators of Sustainable Agriculture	2
3.4	Organic Farming and Climate Change	3
4	**Organic Standards and Certification**	
4.1	History and Development of Organic Standards and Certification	2
4.2	Organic Standards Setting Processes	2
4.3	Conformity Assessment Processes (International Verification Processes)	2
4.4	Key Challenges for The Future of Organic Regulation	2
5	**Perspectives of Organic Farming**	
5.1	Economic Management in Organic Agriculture	1
5.2	Understanding the Market for Organic Food-Supply Chain Management	2
5.3	Social Responsibility in Organic Agriculture: Learning, Collaboration and Regulation	2
5.4	Organic Fertilizer	1
5.5	Supplementary Nutrient Source for Rice, Sugarcane, Sorghum and Banana	2
5.6	Marketing of Organic Products	2
5.7	Pest Management	2

Course Designer(s)

1. Dr.Swathy J S - swathy@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Elective III

60 BT E31	Translational Biotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To provide a solid foundation in molecular and cellular biology, genomics, and proteomics
- To introduce the process of translational research and development, including clinical trials and biomarker discovery
- To educate on advanced technologies and tools in translational biotechnology
- To explain the industrial and commercial aspects of biotechnology
- To explore emerging trends and future directions in biotechnology

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Demonstrate understanding of molecular biology, genomics, and proteomics in translational biotechnology.	Understand
CO2	Develop skills to design and conduct translational research and clinical trials.	Apply
CO3	Gain proficiency in advanced biotechnological tools and technologies.	Apply
CO4	Acquire knowledge about the biotechnology industry and commercialization processes.	Apply
CO5	Critically analyze and evaluate emerging biotechnological trends and their societal impacts	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	-	-	34
Understand	20	20	46
Apply	40	40	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E31- Translational Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Fundamentals of Translational Biotechnology Introduction to Translational Biotechnology- Definition and Scope-Historical Development and Evolution-Key Concepts and Terminologies- Molecular and Cellular Biology-Structure and Function of DNA, RNA, and Proteins-Gene Expression and Regulation--Cell Signaling Pathways- Genomics and Proteomics- Human Genome Project and its Implications--Genomic and Proteomic Technologies-Applications in Biotechnology.	[9]
Translational Research and Development* Principles of Translational Research-From Bench to Bedside: The Translational Research Process-Phases of Clinical Trials- Regulatory Bodies and Ethical –Considerations-Biomarkers and Diagnostics-Discovery and Validation of Biomarkers-Development of Diagnostic Tools and Techniques- Case Studies in Diagnostic Innovations-Drug Discovery and Development-High-Throughput Screening Techniques-Lead Optimization and Preclinical Studies-Clinical Development and Regulatory Approval.	[9]
Advanced Technologies in Translational Biotechnology Therapeutics and Biologics-Monoclonal Antibodies-Gene Therapy and Cell Therapy-RNA-based Therapeutics-Medical Devices and Diagnostics-Development and Innovation in Medical Devices-Advanced Diagnostic Technologies-Point-of-Care Testing and Devices-Bioinformatics and Computational Biology-Bioinformatics Tools and Resources-Computational Modeling and Simulations in Biotechnology-Data Analysis and Interpretation.	
Industrial and Commercial Aspects Biotechnology Industry and Market Trends-Overview of the Biotechnology Industry in India-Market Analysis and Current Trends-Intellectual Property Rights and Patent Laws-Biotechnology Entrepreneurship-Business Models and Strategies in Biotechnology-Funding and Venture Capital-Case Studies of Successful -Biotechnology Startups-Manufacturing and Quality Control-Biomanufacturing Processes-Quality Control and Assurance-Good Manufacturing Practices (GMP) and Regulatory Standards	[9]
Emerging Trends and Future Directions Emerging Technologies in Biotechnology-CRISPR and Gene Editing Technologies-Synthetic Biology and its Applications-Nanobiotechnology-Personalized Medicine-Principles of Personalized Medicine-Pharmacogenomics and Tailored Therapies-Precision Medicine and its Applications-Ethics, Society, and Policy-Ethical Issues in Biotechnology-Societal Impact and Public Perception-Policy and Regulatory Challenges in Biotechnology	[9]
Total Hours:	**45**

Text Book(s):	
1.	Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter “Molecular Biology of the Cell", 6th Edition, Garland Science, (2014).
2.	Martin Wehling, "Principles of Translational Science in Medicine: From Bench to Bedside", 2nd Edition, Academic Press, 2021
Reference(s):	
1.	David W. Mount, "Bioinformatics: Sequence and Genome Analysis", 2nd Edition, Cold Spring Harbor Laboratory Press, 2004.
2.	Shreefal Mehta, "Commercializing Successful Biomedical Technologies: Basic Principles for the Development of Drugs, Diagnostics and Devices", 1st Edition, Cambridge University Press, 2008.
3.	Tatsuya Hata and Yuichiro Harada, "Emerging Technologies in Biopharmaceuticals: The Future of Biomedical Innovation", 1st Edition, Elsevier, 2021.

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Translational Biotechnology**	
1.1	Definition and Scope-Historical Development and Evolution-Key Concepts and Terminologies	2

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Approved in Academic Council Meeting held on 25/05/2024

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1.2	Molecular and Cellular Biology	1

1.3	Structure and Function of DNA, RNA, and Proteins	1
1.4	Gene Expression and Regulation	1
1.5	Cell Signaling Pathways	2
1.6	Genomics and Proteomics- Human Genome Project and its Implications	1
1.7	Genomic and Proteomic Technologies-Applications in Biotechnology	1
2.0	**Translational Research and Development**	
2.1	Principles of Translational Research-From Bench to Bedside: The Translational Research Process	2
2.2	Phases of Clinical Trials- Regulatory Bodies and Ethical –Considerations-Biomarkers and Diagnostics	2
2.3	Discovery and Validation of Biomarkers-Development of Diagnostic Tools and Techniques	1
2.4	Case Studies in Diagnostic Innovations-	1
2.5	Drug Discovery and Development-High-Throughput Screening Techniques	1
2.6	Lead Optimization and Preclinical Studies-Clinical Development and Regulatory Approval	2
3.0	**Advanced Technologies in Translational Biotechnology**	
3.1	Therapeutics and Biologics-Monoclonal Antibodies	1
3.2	Gene Therapy and Cell Therapy-RNA-based Therapeutics	1
3.3	Medical Devices and Diagnostics-Development and Innovation in Medical Devices	1
3.4	Advanced Diagnostic Technologies-Point-of-Care Testing and Devices	2
3.5	Bioinformatics and Computational Biology-Bioinformatics Tools and Resources	2
3.6	Computational Modeling and Simulations in Biotechnology	1
3.7	Data Analysis and Interpretation	1
4.0	**Industrial and Commercial Aspects**	
4.1	Biotechnology Industry and Market Trends-Overview of the Biotechnology Industry in India	1
4.2	Market Analysis and Current Trends-Intellectual Property Rights and Patent Laws	1
4.3	Biotechnology Entrepreneurship-Business Models and Strategies in Biotechnology	1
4.4	Funding and Venture Capital	1
4.5	Case Studies of Successful -Biotechnology Startups	1
4.6	Manufacturing and Quality Control-Biomanufacturing Processes	1
4.7	Quality Control and Assurance	1
4.8	Good Manufacturing Practices (GMP)	1
4.9	Regulatory Standards	1
5.0	**Emerging Trends and Future Directions**	
5.1	Emerging Technologies in Biotechnology-CRISPR and Gene Editing Technologies	1
5.2	Synthetic Biology and its Applications-Nanobiotechnology	1
5.3	Personalized Medicine-Principles of Personalized Medicine	1
5.4	Pharmacogenomics and Tailored Therapies	2
5.5	Precision Medicine and its Applications	1
5.6	Ethics, Society, and Policy-Ethical Issues in Biotechnology	1
5.7	Societal Impact and Public Perception	1
5.8	Policy and Regulatory Challenges in Biotechnology	1

Course Designer(s)

1. Dr.M.Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E32	Environmental Hazards and Management	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the concepts of environmental hazards and the causative agents
- To differentiate the potential hazards and disaster
- To identify the suitable framework followed by a national and international agency to mitigate the hazards and disasters
- To comprehend the different aspects of technology for reducing and managing the risk
- To create awareness about hazards management

Pre-requisites

- Environment Science

Course Outcomes

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

CO1	Recite the concepts of environmental hazards and its impact	Understand
CO2	Distinguish the potential role of elements causing health risk	Apply
CO3	Categorize the types of environmental hazards and disasters	Apply
CO4	Express the management and framework of hazards and disaster management	Apply
CO5	Choose the technologies that can be employed in the risk reduction and management	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E32- Environmental Hazards and Management								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Environmental Hazards Concepts of Environmental Hazards, Environmental Disasters and Environmental Stress – Hazard Approaches in Relation With Human Ecology – Taxonomy of Environmental Hazards – Metals, Organics and Nuclear – Health and Hazard Risk.	**[9]**
Types of Environmental Hazards and Disasters * Natural Hazards and Disasters: Planetary and Extra Planetary Hazards — Exogenous Hazards and Endogenous Hazards. Man Induced Hazards: Nuclear Accidents, Industrial Accidents, Environmental Impacts of Hazards and Disasters.	**[9]**
Frame Work and Management (Hazards and Disaster) Environmental Framework: Regulatory System- Laws and Regulation – Role of State and Central Bodies. Hazard Management — Hazard Risk Identification, Probability, Consequences, Characterization. Disaster Management: Effect to Migrate Natural Disaster — International Strategy for Disaster Reduction — Concept of Disaster Management — National Disaster Management Framework – Financial Arrangements – Role of Government And Media – Disaster Response.	**[9]**
Technology in Risk Reduction Application of Various Technologies — Data Bases, Rdbms, Management Information Systems and Decision Support System – Geographic Information Systems, Intranets and Extranets — Video Teleconferencing and Remote Sensing Technology — Contribution of Remote Sensing and Gis in Management. Low Cost Sensor Adoption For Rt Air, Water and Particulate Deposition Due to Emissions From Industries, Agricultural and Municipal Wastes.	**[9]**
Awareness Towards Risk Management Risk Reduction By Education – Network – Risk Management Through Public Awareness – Implication of Development Planning – Emergency Response – Case Study on Tsunami, Cyclone Thane, Sikkim Earthquake, Nuclear Plant Accident and Nano Powder Industry Outbreak, Ghaziabad air Pollution and Bhopal Gas Accident.	**[9]**
Total Hours:	**45**

Text Book(s):	
1.	Theodore, L. & Dupont, R. R., Environmental Health and Hazard Risk Assessment. Environmental Health and Hazard Risk Assessment, 2017.
2.	Vaidyanathan, S., "An Introduction to Diseaster Management: Natural Disasters & Man Made Hazards", IKON Publisher, 2011
Reference(s):	
1.	Shroder, J. F., Hazards and Disasters Series Biological and Environmental Hazards , Risks , and Disasters, 2016
2.	Ragazzi, M., "Air Quality Monitoring, Measuring, and Modeling Environmental Hazards", 2004
3.	Bimal Kanti Paul., "Environmental Hazards and Disasters: Contexts, Perspectives and Management", A John Wiley & Sons, Ltd., Publication, 2011
4.	Nicolas R. Dalezios., "Environmental Hazards Methodologies for Risk Assessment and Management", IWA Publishing, London, UK. 2014

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**Environmental Hazards**	
1.1	Concepts of Environmental Hazards	2
1.2	Environmental Disasters and Environmental Stress	2
1.3	Hazard Approaches in Relation With Human Ecology	2
1.4	Taxonomy of Environmental Hazards	1

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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1.5	Metals, Organics and Nuclear	1
1.6	Health and Hazard Risk	1
2	**Types of Environmental Hazards and Disasters**	
2.1	Natural Hazards and Disasters	1
2.2	Planetary and Extra Planetary Hazards	1
2.3	Exogenous Hazards and Endogenous Hazards	2
2.4	Man Induced Hazards: Nuclear Accidents	1
2.5	Industrial Accidents	2
2.6	Environmental Impacts of Hazards and Disasters.	2
3	**Frame Work and Management (Hazards and Disaster)**	
3.1	Environmental Framework: Regulatory System	1
3.2	Laws and Regulation – Role of State and Central Bodies	1
3.3	Hazard Management – Hazard Risk Identification	1
3.4	Probability, Consequences	1
3.5	Characterization. Disaster Management: Effect to Migrate Natural Disaster	1
3.6	International Strategy for Disaster Reduction	1
3.7	Concept of Disaster Management – National Disaster Management Framework	1
3.8	Financial Arrangements – Role Of Government And Media – Disaster Response	2
4	**Technology in Risk Reduction** .	
4.1	Application of Various Technologies – Data Bases, Rdbms	1
4.2	Management Information Systems and Decision Support System	1
4.3	Geographic Information Systems, Intranets and Extranets	1
4.4	Video Teleconferencing and Remote Sensing Technology	1
4.5	Contribution of Remote Sensing and Gis in Management	1
4.6	Low Cost Sensor Adoption For Rt Air,	1
4.7	Water and Particulate Deposition Due to Emissions From Industries	1
4.8	Agricultural and Municipal Wastes	2
5	**Awareness Towards Risk Management**	
5.1	Risk Reduction By Education – Network	1
5.2	Risk Management Through Public Awareness	1
5.3	Implication of Development Planning	2
5.4	Emergency Response – Case Study on Tsunami	1
5.5	Cyclone Thane, Sikkim Earthquake	2
5.6	Nuclear Plant Accident and Nano Powder Industry Outbreak	1
5.7	Ghaziabad air Pollution and Bhopal Gas Accident.	1

Course Designer(s)

1. Dr.K. Syed Zameer Ahmed – syedzameer@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E33	Molecular Medicine	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To provide foundational knowledge of the human genome, chromosomes, genes, and genetic engineering techniques.
- To introduce the process of transmission, diagnosis, and genetic counseling of human genetic diseases.
- To educate on molecular mechanisms underlying human diseases, including oncology and infectious agents.
- To explain the molecular signaling pathways and their roles in disease progression.
- To explore advanced diagnostic and therapeutic approaches in the treatment of human diseases, emphasizing personalized medicine.

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Demonstrate understanding of the organization of the human genome and genetic engineering techniques.	Understand
CO2	Apply knowledge of molecular diagnostics and genetic counseling in clinical settings.	Apply
CO3	Enlighten the molecular mechanisms of human diseases and their implications for treatment.	Apply
CO4	Analyze molecular signaling pathways and their roles in disease progression.	Apply
CO5	Utilize advanced diagnostic and therapeutic approaches in the treatment of human diseases, emphasizing personalized medicine.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	-	-	34
Understand	20	20	46
Apply	40	40	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E33- Molecular Medicine								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Basic Concepts in Molecular Medicine An Overview of the Orgnaisation of the Human Genome, Chromosome and Genes; R-DNA and Genetic Engineering Techniques used in Molecular Medicine; Transcriptional Control of Gene Expression; Transmission of Human Genetic Disease; The Human Genome Project; Oncogenes and Tumor Suppressor Genes; Molecular Diagnostic Testing; Genetic Counseling; Transgenic Mice as Modelso Human Diseases.	[9]
Development of Molecular Medicine * Molecular Mechanisms of Human Disease. Infectious Agents- Biological Aspects and Clinical Implications. Molecular Hematology and Oncology. Selection and Evolution: Implications for Molecular Medicine. Molecular Basis of Development of Medicine-Diagnostic and Therapeutic Potential. Human Embryonic Stem Cells: Biology and Clinical Implications.	[9]
Molecular Signaling Mechanism in Human Diseases Molecular Signaling Mechanism in Human Diseases. P27kip1-Connecting Oncogenes to Cell Cycle Control" "Roles of Micro RNAs in Animal Development and Human Cancer" "Epigenic Programming of the Genome in Embryos and Germ Cells" Ubiquitin Mediated Proteolysis in Senescence and Immune Signalling" "Nucleocytoplasmic Shuttling and Transcriptional Regulation: An Analysis of the STAT Signaling System" "Nuclear Organisation of Transcription" "Ubiquitination and Disposal of Cell Surface Receptors-Lessons from Viruse".	[9]
Molecular Diagnostic and Therapeutic Approaches for Human Diseases Role of DNA Micro Array and Protein Chips; Biotherapy; Probiotic; Phage Therapy; Virotherapy with (Replicationelective or Conditionally Replicating) Lytic Viruse; si RNA the Rapeutics; Concept of Personalised Medicine and Pharmacogenomics, Photodynamic Therapy.	[9]
Emerging Trends: Industrial Applications of Molecular Medicine Emerging Trends in Molecular Medicine- Expert Reviews on Molecular Medicine Related to Vaccine Design and Systemic Diseases-Developments as Updated From Time to Time.	[9]
Total Hours:	**45**

Text Book(s):	
1.	John Bradle, David Johnson and David Rubenstein. Lecture notes in molecular biology, Blackwell Publishing, 2001.
Reference(s):	
1.	Jameson Larry J. Principles of Molecular Medicine, Humana Press 1998. John-Wiley & Sons, Inc. (eds.), 2002.

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basic Concepts in Molecular Medicine**	
1.1	An Overview of the Orgnaisation of the Human Genome,	2
1.2	Chromosome and Genes; R-DNA and Genetic Engineering Techniques used in Molecular Medicine	1
1.3	Transcriptional Control of Gene Expression	1
1.4	Transmission of Human Genetic Disease	1
1.5	The Human Genome Project; Oncogenes and Tumor Suppressor Genes	2
1.6	Molecular Diagnostic Testing	1
1.7	Genetic Counseling; Transgenic Mice as Modelso Human Diseases	1
2.0	**Development of Molecular Medicine ***	
2.1	Molecular Mechanisms of Human Disease.	2

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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2.2	Infectious Agents- Biological Aspects and Clinical Implications	2
2.3	Molecular Hematology and Oncology. Selection and Evolution	1
2.4	Implications for Molecular Medicine	1
2.5	Molecular Basis of Development of Medicine	1
2.6	Diagnostic and Therapeutic Potential. Human Embryonic Stem Cells: Biology and Clinical Implications	2
3.0	**Molecular Signaling Mechanism in Human Diseases**	
3.1	Molecular Signaling Mechanism in Human Diseases. P27kip1-Connecting Oncogenes to Cell Cycle Control"	1
3.2	"Roles of Micro RNAs in Animal Development and Human Cancer" "Epigenic Programming of the Genome in Embryos and Germ Cells"	1
3.3	Ubiquitin Mediated Proteolysis in Senescence and Immune Signalling"	1
3.4	"Nucleocytoplasmic Shuttling and Transcriptional Regulation	2
3.5	An Analysis of the STAT Signaling System"	2
3.6	"Nuclear Organisation of Transcription"	1
3.7	"Ubiquitination and Disposal of Cell Surface Receptors- Lessons from Viruse	1
4.0	**Molecular Diagnostic and Therapeutic Approaches for Human Diseases**	
4.1	Role of DNA Micro Array and Protein Chips	2
4.2	Biotherapy; Probiotic; Phage Therapy	2
4.3	Virotherapy with (Replicationelective or Conditionally Replicating)	1
4.4	Lytic Viruse; si RNA the Rapeutics	1
4.5	Concept of Personalised Medicine and Pharmacogenomics	2
4.6	Photodynamic Therapy	1
5.0	**Emerging Trends: Industrial Applications of Molecular Medicine**	
5.1	Emerging Trends in Molecular Medicine	2
5.2	Expert Reviews on Molecular Medicine Related to Vaccine Design	3
5.3	Systemic Diseases	2
5.4	Developments as Updated From Time to Time	2

Course Designer(s)

1. Dr.M.Nithya – nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E34	Pharmacology and Toxicology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To describe basic toxicological phenomena in the light of normal cellular and biochemical conditions
- To explain the central principles regarding scientific communication, philosophy of science and bioethics
- To identify and discuss strengths and limitations of different methods to study toxicological effects, and their areas of application
- To analyse and critically review scientific articles in the field of toxicology
- To use the structure and language style appropriate for a scientific article

Pre-requisites

- Biochemistry

Course Outcomes

CO1	Designate basic toxicological principles and describe how different chemicals are taken up by processed in and eliminated from the body	Understand
CO2	Differentiate the importance of different organs for detoxification/ toxification of chemicals, and describe mechanisms for chemically induced neurotoxicity and endocrine toxicity	Apply
CO3	Entitle the different behaviour tests and their importance to discover of different neurological and endocrinological disturbances	Understand
CO4	Describe when different chemicals are most toxic, and mechanisms behind the effects.	Apply
CO5	Apply different toxicological frameworks within the professional disciplines.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	30	20	40
Apply	10	20	26
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech – Biotechnology								
60 BT E34 – Pharmacology and Toxicology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

General Toxicological Principles and Overview of Toxic Substances * The Part Includes Basic Description How Substances are Absorbed by, Distributed and Eliminated from the Body. The Part Contains Awareness about Toxicokinetic Models and the Processes of Biotransformation.	[9]
Toxicity in Specific Target Organs, Effects and Mechanisms* Basic Toxicological Knowledge of the Effect of Chemicals on Central Organs that are of Significance for the Uptakes/Elimination and Detoxification/Toxification, Process and Difference between Detoxification and Toxification. Basic Knowledge about how the Communication Systems of the Body, the Nervous System and the Endocrine System is Influenced of Chemicals.	[9]
Behaviour Toxicology, Molecular and Organ Toxicology Basic Behaviour Toxicological Knowledge, how Behavioural Techniques Can Reveal Chemicals that Give Functional Disturbances. Cell Signalling and Receptor Mediated Toxicity, Calcium. Mediated Toxicity, Cytokines Toxicity, Toxicogenomics. Haemotoxicity, Hepatotoxicity, Nephrotoxicity, Neurotoxicity, Cardiotoxicity and Local Toxicity.	[9]
Development Toxicology Basic Knowledge of Different Developmental Phases; Embryonic and Embryonic Development, Development During the Neonatal Period. Critical Developmental Phases Then Teratogenic Injuries and Functional Disturbances are Induced.	[9]
Toxicology and its application Preparation of Drugs from Plants, Bacteria, Fungus – Drug Concentration Optimization through *in Vitro* and *in Vivo* Studies and Animal Experiments, Application of Toxicology in Research Field.	[9]
Total Hours:	**45**
Text Book(s):	

1.	Vij Krishan, "Text book of Forensic Medicine and Toxicology- Principles and Practice", 4 th Edition, Elsevier, India.
2.	Curtis Klaassen., and John B. Watkins III.,"Casarett and Doull's Toxicology: The Basic Science of Poisons",9th Edition, McGraw-Hill Education, 2019.
Reference(s):	
1.	Michael J. Derelanko., and Mannfred A. Hollinger., "Handbook of Toxicology" 4th Edition, CRC Press, a subsidiary of Taylor & Francis Group, 2021.
2.	Hayes, A. Wallace; Kruger, Claire L. Hayes' "Principles and methods of toxicology", 6th Edition, 2015
3.	Wallace Hayes, A., Tao Wang, Darlene Dixon. "Essentials of Toxicology", 5th Edition, Academic Press, 2020
4.	Wallace Hayes A.., and Claire L. Kruger., "Textbook of Toxicology: Principles and Applications", 3rd Edition, John Wiley & Sons, Inc,2020.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**General Toxicological Principles and Overview of Toxic Substances**	
1.1	The Part Includes Basic Description how Substances are Absorbed by	2
1.2	Distributed and Eliminated from the Body	2
1.3	The Part Contains Awareness about Toxicokinetic Models	2
1.4	Processes of Biotransformation	3
2.0	**Toxicity in Specific Target Organs, Effects and Mechanisms:**	
2.1	Basic Toxicological Knowledge of the Effect of Chemicals on Central Organs	2
2.2	Significance for the Uptakes/Elimination	1
2.3	Detoxification/Toxification	1

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2.4	Process and Difference between Detoxification and Toxification.	2
2.5	Basic Knowledge about how the Communication Systems of the Body	1
2.6	The Nervous System and the Endocrine System is Influenced of Chemicals	2
3.0	**Behaviour toxicology, Molecular and Organ Toxicology**:	
3.1	Basic Behaviour Toxicological Knowledge	1
3.2	How Behavioural Techniques can Reveal Chemicals that Give Functional Disturbances	1
3.3	Cell Signalling and Receptor Mediated Toxicity	1
3.4	Calcium Mediated Toxicity	1
3.5	Cytokines Toxicity	1
3.6	Toxicogenomics.	1
3.7	Haemotoxicity, Hepatotoxicity	1
3.8	Nephrotoxicity, Neurotoxicity	1
3.9	Cardiotoxicity and Local Toxicity	1
4.0	**Development Toxicology**:	
4.1	Basic Knowledge of Different Developmental Phases	2
4.2	Embryonic and Embryonic Development	1
4.3	Development During the Neonatal Period	2
4.4	Critical Developmental Phases then Teratogenic Injuries	2
4.5	Functional Disturbances are Induced	2
5.0	**Toxicology and its application**	
5.1	Preparation of Drugs from Plants	2
5.2	Bacteria, Fungus	2
5.3	Drug Concentration Optimization through In Vitro and In Vivo Studies and Animal Experiments	3
5.4	Application of Toxicology in Research Field.	2

Course Designer(s)

1. Ms. Kalaiarasi M S - kalaiarasims@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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60 BT E35	Metabolomics and Metabolic Engineering	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To analyse metabolomics' role in systems biology for understanding biological networks
- To understand cellular metabolism fundamentals, including transport and biosynthetic reactions
- To apply material balances and data standards for accurate metabolic analysis
- To evaluate metabolic regulation mechanisms for optimizing cellular processes
- To utilize computational tools for modeling metabolic pathways and flux analysis

Pre-requisites

- Biochemistry, Stoichiometry, Bioprocess / Fermentation Technology

Course Outcomes

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

CO1	Utilize metabolomics techniques to examine dynamic metabolic networks.	Apply
CO2	Describe cellular metabolism and its regulatory mechanisms.	Understand
CO3	Demonstrate competency in material balances and data analysis.	Apply
CO4	Execute metabolic engineering strategies to enhance bioproduction.	Apply
CO5	Analyse metabolic fluxes using computational methods.	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT E35 - Metabolomics and Metabolic 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

Introduction to Metabolomics Role of Metabolomics in Systems Biology - Application of Metabolomics - Analytical Methods in Metabolomics - Data Standards - Databases for Chemical, Spectral and Biological Data - Reconstruction of Dynamic Metabolic Network Model - Examples - Study of Metabolome of a Simple Organism like *E. coli*.	[9]
Fundamentals of Metabolic Engineering Review of Cellular Metabolism: Transport Processes, Fueling Reactions, Biosynthetic Reactions - Polymerization and Growth Energetics - Comprehensive Models for Cellular Reactions: Stoichiometry, Reaction Rates, Dynamic Mass Balances.	[9]
Material Balances and Data Consistency Black Box Model and Elemental Balances, Heat Balance and Analysis of Overdetermined Systems, Identification of Gross Measurement Errors.	[9]
Metabolic Regulation and Application Metabolic Regulation Network at Enzyme and Whole Cell Levels - Successful Applications of Metabolic Engineering: Strain Improvement, Product - Overproduction, By-product Minimization - Extension of Substrate Utilization Range and Product Spectrum, Xenobiotic Degradation.	[9]
Systems Metabolic Modeling Metabolic Pathway Synthesis Algorithm - Metabolic Flux Analysis (MFA) and its Application Flux Balance Analysis (FBA), Regulatory On-Off Minimization (ROOM), Minimization of Metabolic Adjustments (MOMA) - Elementary Mode Analysis, Extreme Pathways Determination of Metabolic Fluxes by Isotope Labelling - Metabolic Control Analysis (MCA).	[9]
Total Hours:	**45**

Text Book(s):

1. Sang Yup Lee, Jens Nielsen and Gregory Stephanopoulos, "Metabolic Engineering: Concepts and Applications", 1st Edition, Wiley-VCH, 2021.
2. Christina Smolke, "Metabolic Pathway Engineering Handbook", 1st Edition, CRC Press, 2009.

Reference(s):

1. Tomita, M. and Nishioka, T., "Metabolomics: The Frontier of Systems Biology", Springer Verlag, Japan, 2005.
2. Wolfram Weckwerth, "Metabolomics: Methods and Protocols", 1st Edition, Humana Press Inc., 2007.
3. Cortassa, S., "An Introduction to Metabolic and Cellular Engineering", 2nd Edition, World Scientific Publishing Company, 2011.
4. Hal S. Alper, "Systems Metabolic Engineering: Methods and Protocols", 1st Edition, Humana Press Inc., 2013.

*** SDG 3 – Good Health and Well Being**

**** SDG 9: Industry, Innovation, and Infrastructure**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Metabolomics**	
1.1	Role of Metabolomics in Systems Biology:	2
1.2	Application of Metabolomics:	1
1.3	Analytical Methods in Metabolomics:	1
1.4	Data Standards and Databases in Metabolomics:	1
1.5	Reconstruction of Dynamic Metabolic Network Model	2
1.6	Study of Metabolome of a Simple Organism like *E. coli*:	2
2.0	**Fundamentals of Metabolic Engineering**	
2.1	Introduction to Cellular Metabolism:	1
2.2	Energy in Cellular Metabolism:	1

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2.3	Polymerization in Cellular Metabolism:	1
2.4	Comprehensive Models for Cellular Reactions (Part 1):	1
2.5	Comprehensive Models for Cellular Reactions (Part 2):	1
2.6	Comprehensive Models for Cellular Reactions (Part 3):	1
2.7	Application of Models in Metabolic Engineering (Part 1):	1
2.8	Application of Models in Metabolic Engineering (Part 2):	1
2.9	Interactive Session and Recap:	1
3.0	**Material Balances and Data Consistency**	
3.1	Introduction to Material Balances:	2
3.2	Heat Balance and Energy Conservation:	2
3.3	Overdetermined Systems and Data Analysis:	2
3.4	Application of Material Balances:	2
3.5	Review and Assessment:	1
4.0	**Material Balances and Data Consistency**	
4.1	Introduction to Metabolic Regulation:	1
4.2	Enzyme-Level Metabolic Regulation:	1
4.3	Whole-Cell-Level Metabolic Regulation:	1
4.4	Applications of Metabolic Engineering:	1
4.5	Extension of Substrate Utilization Range:	1
4.6	Expansion of Product Spectrum:	1
4.7	Xenobiotic Degradation:	1
4.8	Case Studies and Applications:	2
4.9	Review and Discussion:	1
5.0	**Systems Metabolic Modeling**	
5.1	Metabolic Pathway Synthesis Algorithm and Metabolic Flux Analysis (MFA):	2
5.2	Flux Balance Analysis (FBA) and Regulatory On-Off Minimization (ROOM):	2
5.3	Minimization of Metabolic Adjustments (MOMA), Elementary Mode Analysis, Extreme Pathways:	2
5.4	Determination of Metabolic Fluxes by Isotope Labelling and Metabolic Control Analysis (MCA):	2
5.5	Recap and Applications:	1

Course Designer(s)

1. Dr. Rengesh Balakrishnan - rengeshbalakrishnan@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
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60 BT E36	Biotechniques in Crop Improvement	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To develop crops with enhanced resistance to biotic stresses such as pests, diseases, and weeds
- To utilize molecular markers to assess genetic diversity within crop germplasm collections
- To develop biotechnological approaches to increase crop yields through improved genetics
- To widen the knowledge about biotechnological interventions to enhance the productivity of major crops
- To Generate transgenic plants as genetic resources for molecular breeding programs

Pre-requisites

- Biochemistry, Microbiology, Molecular Biology and Biology

Course Outcomes

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

CO1	Gain a comprehensive understanding of the molecular mechanisms underlying plant resistance to pests and diseases.	Understand
CO2	Summarize the understanding of molecular markers to select appropriate marker systems for specific crop improvement objectives.	Understand
CO3	Demonstrate the ability to construct genetic linkage maps using molecular markers and various mapping populations.	Apply
CO4	Apply interdisciplinary approaches, integrating knowledge from fields such as genetics, agronomy.	Apply
CO5	Utilize their comprehension of genetic engineering principles to devise and assemble transgenes	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	16	34
Apply	-	24	32
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E36 - Biotechniques in Crop Improvement								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	40	60	100

Biotechnological Approach for Crop Improvement * Biotechnological Approaches for Disease Resistance, Protection Against Fungal Pathogens and Drought Tolerance. Modification of Crop-Plant Nutritional Content (Vitamins, Amino Acids and Lipids). Modification of Crop-Plant Taste and Appearance (Sweetness, Starch and Preventing Discoloration). Polyploidy: Induction of Polyploidy by Artificial Methods; Role of Polyploidy in Crop Improvement.	[9]
Molecular Markers and Crop Improvement Types of Molecular Markers used in Analyzing Genetic Diversity for Crop Improvement; Molecular Mapping and Tagging of Agronomically Important Traits. Molecular Cytogenetic Markers: FISH and GISH, Their Application in Crop Improvement. Transposable Elements: Mechanism of Action and Their Role in Crop Improvement. Quantitative Trait Loci (QTL) Mapping: Introduction, Types of Mapping Populations .	[9]
Application of Molecular Markers Construction of Molecular Maps (Using F2, DH, Rils); Gene Tagging Using Bulked Segregant Analysis (BSA) and Near Isogenic Lines (Nils); QTL Analysis; Map-Based Cloning of Genes; Elementary Idea of Marker-Assisted Selection (MAS) in Plant Breeding.	[9]
Molecular Mapping and Tagging of Agronomically Important Traits Statistical Tools in Marker Analysis, Robotics; Marker-Assisted Selection for Qualitative and Quantitative Traits; Qtls Analysis in Crop Plants, Gene Pyramiding. Marker Assisted Selection and Molecular Breeding; Genomics and Genoinformatics for Crop Improvement; Integrating Functional Genomics Information on Agronomically / Economically Important Traits in Plant Breeding.	[9]
Production of Transgenic Plants in Various Field Crops Cotton, Wheat, Maize, Rice, Soybean, Oilseeds, Sugarcane etc. Commercial Releases. Biotechnology Applications in Male Sterility/Hybrid Breeding, Molecular farming. Mos and Related Issues (Risk and Regulations); GMO; International Regulations, Biosafety Issues of GMOs; Regulatory Procedures in Major Countries Including India, Ethical, Legal and Social Issues; Intellectual Property Rights. Bioinformatics & Bioinformatics Tools. Nanotechnology and Its Applications in Crop Improvement Programmes.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Abelson, P. H., "Biotechnology And Biological Frontiers",1st Edition , American Association for the Advancement of Science, Washington, U.S.A., 2019.
2.	Sambrook, J. and Russell, D.W., "Molecular Cloning: A Laboratory Manual". 3rd Edition, Vol. 1, Cold Spring Harbor Laboratory Press, New York., 2001.
Reference(s):	
1.	Grierson D (Edition.)., "Plant Genetic Engineering: Plant Biotechnology Series", Softcover reprint of the original 1st Edition. 1991., Volume I. Blockie, Glasgow, London., 2012
2.	Gupta PK., "Elements of Biotechnology".4th Edison, Rastogi Publ., 2010.
3.	Dodds, J. H. and Roberts, L. W., "Experiments in Plant Tissue Culture", 3rd Edition, Cambridge University Press, Cambridge, 1995.
4.	Ammirato, P. V., Evans, P. V., Evans, D. A., Sharp, W. R. and Yamada, Y., Handbook of Plant Cell Culture. Vols. 1, 2 & 3. MacMillan Publishing Co, New York, (1984).

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Biotechnological Approach for Crop Improvement**	
1.1	Biotechnological Approaches for Disease Resistance, Protection Against Fungal Pathogens and Drought Tolerance	2
1.2	Modification of Crop-Plant Nutritional Content (Vitamins, Amino Acids and Lipids	2
1.3	Modification of Crop-Plant Taste and Appearance (Sweetness, Starch and Preventing Discoloration	2

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Approved in Academic Council Meeting held on 25/05/2024

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1.4	Polyploidy: Induction of Polyploidy by Artificial Methods	2
1.5	Role of Polyploidy in Crop Improvement	1
2.0	**Molecular Markers and Crop Improvement**	
2.1	Types of Molecular Markers used in Analyzing Genetic Diversity for Crop Improvement	2
2.2	Molecular Mapping and Tagging of Agronomically Important Traits	2
2.3	Molecular Cytogenetic Markers: FISH and GISH, Their Application in Crop Improvement	1
2.4	Transposable Elements: Mechanism of Action and Their Role in Crop Improvement	1
2.5	Quantitative Trait Loci (QTL) Mapping: Introduction	1
2.6	Types of Mapping Populations	2
3.0	**Application of Molecular Markers**	
3.1	Construction of Molecular Maps (Using F2, DH, Rils)	2
3.2	Gene Tagging Using Bulked Segregant Analysis (BSA) and Near Isogenic Lines (Nils);	2
3.3	QTL Analysis; Map-Based Cloning of Genes	2
3.4	Elementary Idea of Marker	2
3.5	Assisted Selection (MAS) in Plant Breeding	1
4.0	**Molecular Mapping and Tagging of Agronomically Important Traits**	
4.1	Statistical Tools in Marker Analysis, Robotics	2
4.2	Marker-Assisted Selection for Qualitative and Quantitative Traits	1
4.3	Qtls Analysis in Crop Plants	1
4.4	Gene Pyramiding	1
4.5	Marker Assisted Selection and Molecular Breeding	1
4.6	Genomics and Genoinformatics for Crop Improvement	1
4.7	Integrating Functional Genomics Information on Agronomically / Economically Important Traits in Plant Breeding.	2
5.0	**Production of Transgenic Plants in Various Field Crops**	
5.1	Cotton, Wheat, Maize, Rice, Soybean, Oilseeds, Sugarcane etc. Commercial Releases	1
5.2	Biotechnology Applications in Male Sterility/Hybrid Breeding	1
5.3	Molecular farming. Mos and Related Issues (Risk and Regulations)	1
5.4	GMO; International Regulations	2
5.5	Biosafety Issues of GMOs; Regulatory Procedures in Major Countries Including India	1
5.6	Ethical, Legal and Social Issues	1
5.7	Intellectual Property Rights. Bioinformatics & Bioinformatics Tools	1
5.8	Nanotechnology and Its Applications in Crop Improvement Programmes	1

Course Designer(s)

1. Dr.M. Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Elective IV

60 BT E41	Fermentation Technology	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To define fermentation methods and their application in industry
- To identify techniques for primary metabolite recovery from fermentation
- To explain the mechanism and optimization of secondary metabolite production
- To analyse growth kinetics and microbial transformations in fermentation
- To evaluate modern fermentation technologies and their applications

Pre-requisites

- Microbiology, Stoichiometry

Course Outcomes

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

CO1	Comprehend the fundamental principles and methods of industrial fermentation.	Understand
CO2	Apply product recovery techniques such as centrifugation, filtration, and chromatography to isolate primary metabolites.	Apply
CO3	Evaluate the production mechanisms of secondary metabolites, including antibiotics and vitamins.	Evaluate
CO4	Analyse growth kinetics in different fermentation processes (batch, fed-batch, continuous) .	Analyse
CO5	Analyse the role of fermentation technology in producing chemicals, pharmaceuticals.	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	-	-	-	10	-
Understand	20	-	20	-	-	10	-
Apply	20	50	20	30	25	30	25
Analyse	-	50	10	40	50	30	50
Evaluate	-	-	10	30	25	20	25
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech- Biotechnology								
60 BT E41 - Fermentation Technology								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Introduction to Fermentation Technology* Introduction to Industrial Fermentation - Substrates in Fermentation - Fermentation Methods: Batch, Fed Batch, Continuous - Stages of Fermentation - Fermentation Medium - Microorganism Isolation and Screening: Primary and Secondary**.**	[6]
Production and Recovery of Primary Metabolites** Product Recovery Techniques: Centrifugation, Filtration, Chromatography, Sedimentation — Fermentation-Derived Primary Metabolites: Ethanol, Acetone, Organic Acids, Amino Acids - Yield Calculations.	[6]
Production of Secondary Metabolites and Process Optimization*** Mechanism of Secondary Metabolite Production - Antibiotics: Chloramphenicol or any other Macrolide - Vitamins: Vitamin B12, Riboflavin - Role of Metabolic Engineering in Process Improvement.	[6]
Growth Kinetics and Microbial Transformation** Growth Kinetics - Batch, Fed-Batch and Continuous Fermentation - Microbial Transformation: Types, Applications, Procedures - Single Cell Protein (SCP): Spirulina, Yeast Production.	[6]
Modern Fermentation Technology* Chemicals and Pharmaceuticals from Fermentation - Fermented Food Products - Genetically Modified Organisms (GMOs) — Precision Fermentation - Future of Fermentation Technology.	
Practical: 1. Measurement of cell biomass concentration by cell dry weight method 2. Determination of specific growth rate and specific substrate utilization rate 3. Determination of growth kinetics at various substrate concentration 4. Batch operation in a bioreactor to study bacterial growth kinetics 5. Bioprocess media optimization techniques – Plackett Burman design 6. Bioprocess media optimization techniques – Response surface methodology 7. Designing, modelling and simulation of batch reactor data 8. Demonstration of SuperPro Designer software **Tools used: MATLAB / SuperPro Designer / Minitab / Design Expert softwares**	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**
Text Book(s):	

1.	Peter F. Stanbury, Allan Whitaker and Stephen J. Hall. “Principles of Fermentation Technology”, 3rd Ed., Butterworth-Heinemann Publishers, 2017.
2.	Pauline M. Doran, Ross Carlson, and Kate Morrissey. “Bioprocess Engineering Principles”, 3rd Ed., Academic Press Inc., 2024.
Reference(s):	
1.	Crueger and Aneja. “Crueger's Biotechnology : A Textbook of Industrial Microbiology”, 3rd Ed., Medtech Scientific International, 2017.
2.	Alexander N. Glazer, Hiroshi Nikaido. “Microbial Biotechnology: Fundamentals of Applied Microbiology”, 2nd Ed., Cambridge University Press, 2008.
3.	Michael L. Shuler and Fikret Kargi. “Bioprocess Engineering: Basic Concepts”, 2nd Ed., Pearson Education India, 2015.
4.	Kulandaivel, S and Janarthanan, S. “Practical Manual on Fermentation Technology”, TechSar Pvt. Ltd., 2012.

***SDG 9: Industry, Innovation, and Infrastructure; SDG 12: Responsible Consumption and Production**
****SDG 7: Affordable and Clean Energy**
*****SDG 3: Good Health and Well-being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1.0	**Introduction to Fermentation Technology**	
1.1	Introduction to Industrial Fermentation	1

Passed in BoS Meeting held on 21/05/2024
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1.2	Substrates in Fermentation	1

1.3	Fermentation Methods	1
1.4	Stages of Fermentation and Fermentation Medium	1
1.5	Microorganism Isolation and Screening	1
1.6	Recap and Case Studies	1
2.0	**Production of Primary Metabolites**	
2.1	Product Recovery Introduction Basic principles of separation techniques	1
2.2	Centrifugation and Filtration	1
2.3	Chromatography	1
2.4	Sedimentation	1
2.5	Production of Primary Metabolites	1
2.6	Yield Calculations	1
3.0	**Production of Secondary Metabolites and Process Optimization**	
3.1	Secondary Metabolites	1
3.2	Biosynthesis of Secondary Metabolites	1
3.3	Antibiotics Production	1
3.4	Vitamins Production	1
3.5	Role of Metabolic Engineering in Process Improvement	1
3.6	Recap and Case Studies	1
4.0	**Growth Kinetics and Microbial Transformation**	
4.1	Growth Kinetics	1
4.2	Batch Fermentation Kinetics	1
4.3	Fed-Batch and Continuous Fermentation	1
4.4	Microbial Transformation	1
4.5	Single Cell Protein (SCP) Production	1
4.6	Recap and Case Studies	1
5.0	**Modern Fermentation Technology**	
5.1	Chemicals and Pharmaceuticals from Fermentation	1
5.2	Fermented Food Products	2
5.3	Genetically Modified Organisms (GMOs)	1
5.4	Precision Fermentation	1
5.5	Recap and Case Studies	1
Practical:		
1.	Measurement of cell biomass concentration by Cell Dry Weight Method	4
2.	Determination of Specific Growth Rate and Specific Substrate Utilization Rate	4
3.	Growth Kinetics at Various Substrate Concentration	4
4.	Batch Operation in a Bioreactor to Study Bacterial Growth Kinetics Data collection during batch operation Analysis of bacterial growth kinetics data	4
5.	Bioprocess Media Optimization Techniques – Plackett Burman Design	4
6.	Bioprocess Media Optimization Techniques — Response Surface Methodology	4
7.	Designing, Modelling and Simulation of Batch Reactor Data	4
8.	Demonstration of SuperPro Designer Software	2

Course Designer(s)

1. Dr. Rengesh Balakrishnan – rengeshbalakrishnan@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E42	Clinical Trials and Health Care Policies in Biotechnology	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To understand the basic requirements in clinical research
- To highlight the epidemiologic methods, study design, protocol preparation and gain knowledge in the basic bio-statistical techniques involved in clinical research
- To describe the principles involved in ethical, legal and regulatory issues in clinical trial
- To gain knowledge in the basic of the health care system
- To describe health care policies and planning

Pre-requisites

- Molecular biology

Course Outcomes

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

CO1	Demonstrate proficiency in handling and managing documentation related to clinical trials, including protocols, informed consent forms, and regulatory submissions.	Understand
CO2	Implement safety monitoring strategies in clinical trials to ensure the welfare and safety of participants, including adverse event reporting and risk management protocols.	Apply
CO3	Comply with regulatory requirements and guidelines for the preparation, maintenance, and documentation of clinical trial-related documents to ensure adherence to Good Clinical Practice (GCP) standards	Apply
CO4	Analyze the production of medical services within the healthcare system, including factors influencing the supply and distribution of healthcare providers, technologies, and facilities.	Analyze
CO5	Apply knowledge of health care policies to critically assess current issues, trends, and debates in healthcare delivery and financing.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	
Remember	20	-	20	-	-	34	
Understand	30	-	20	-	-	46	-
Apply	10	50	10	50	50	20	50
Analyse	-	50	10	50	50	-	50
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech-Biotechnology								
60 BT E42 – Clinical Trials and Health Care Policies in Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Requirements in Clinical Research Good Clinical Practice (ICH GCP E6), Clinical Trial Materials (Documentation, Investigational drugs, logistical Materials).	[6]
Types and Designs in Clinical Research and Safety Monitoring in Clinical Trials* Types of Research Designs Based on Controlling Method (Experimental, Quasi Experimental, and Observational Methods) Randomization Techniques (Simple Randomization, Restricted Randomization, Blocking Method and Stratification),Time Sequences (Prospective and Retrospective), Sampling Methods (Cohort Study, Case Control Study and Cross Sectional Study), Health Outcome Measures (Clinical & Physiological, Humanistic and Economic).	[6]
Clinical Trial Study and Governing Regulations Roles and Responsibilities of: Investigator, Study Coordinator, Sponsor, Monitor, Contract Research Organization, Site Management Organizations Guidelines to the Preparation of Following Documents: Protocols, Investigator's Brochure, Informed Consent Form, Case Report Forms, Contracts and Agreements, Trial Master File Preparation and Maintenance, Investigator Site File, Pharmacy File, Dairy Cards.	[6]
Overview to Understanding the Healthcare System* Health Care System Components, Elements of a Health Care System, The Role and Financing Methods of Third-Party Payers, The Production of Medical Services, An Overview of the U.S. Health Care System, Production of Health Services and Provider Choice in the United States.	[6]
Health Care Policies Health Care Policy- Overview- Private Health Care Sectors, Health Policy and Planning. Government Health Insurance Programs: Medicaid, CHIP, Medicare, Health care Quality and the Law	[6]
Practical: 1. Investigation of Drug Storage Conditions 2. Prospective Study on Drug Efficacy Using Simple Randomization 3. Cross-Sectional Study on Economic and Humanistic Health Outcomes 4. Role of the Investigator and Preparation of Informed Consent Forms 5. Monitor's Role in Ensuring Protocol Compliance 6. Cost-effectiveness Analysis of Healthcare Interventions 7. Healthcare Service Simulation: Provider Choice 8. Policy Proposal Development	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):	
1.	Loraine M., Gelsthorpe., and Brian J. Leon., "Clinical Research for Health Professionals: A User-Friendly Guide",:2nd Edition, Springer, 2017
2.	John I. Gallin., and Frederick P. Ognibene,, "Principles and Practice of Clinical Research",4th Edition, Academic Press Edition, 2017.
Reference(s):	
1.	Joel B. Teitelbaum., and Sara E. Wilensky., "Essentials of Health Policy and Law", 4th Edition, Jones & Bartlett Learning, 2019.
2.	Harry A. Sultz., and Kristina M., "Health Care USA: Understanding Its Organization and Delivery",9th Edition, Jones & Bartlett Learning, 2018.
3.	Nancy Burns., and Susan K. Grove., "Clinical Research in Practice: A Guide for the Bedside Scientist",3rd Edition, Jones & Bartlett Learning,2017
4.	Steven Piantadosi, "Clinical Trials: A Methodologic Perspective", 3rd Edition, Wiley, 2017.

*SDG 3 - Good Health and Well-being

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1.0	**Requirements in Clinical Research**	
1.1	Good Clinical Practice (ICH GCP E6)	1

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Approved in Academic Council Meeting held on 25/05/2024

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1.2	Clinical Trial Materials- Documentation	1

1.3	Clinical Trial Materials- Investigational drugs	2
1.4	Clinical Trial Materials- logistical Materials	2
2.0	**Types and Designs in Clinical Research and Safety Monitoring in Clinical Trials**	
2.1	Types of Research Designs Based on Controlling Method (Experimental and Quasi Experimental, Observational Methods))	1
2.2	Randomization Techniques (Simple Randomization, Restricted Randomization, Blocking Method and Stratification)	1
2.3	Time Sequences (Prospective and Retrospective),	1
2.4	Sampling Methods (Cohort Study and Case Control Study, Cross Sectional Study)	1
2.5	Health Outcome Measures (Clinical & Physiological).	1
2.6	Health Outcome Measures (Humanistic and Economic).	
3.0	**Clinical Trial Study and Governing Regulations**	
3.1	Roles and Responsibilities of: Investigator, Study Coordinator	1
3.2	Sponsor, Monitor	1
3.3	Contract Research Organization	1
3.4	Site Management Organizations Guidelines to the Preparation of Following Documents: Protocol	1
3.5	Investigator's Brochure,Informed Consent Form, Case Report Forms, Contracts and Agreements	1
3.6	Trial Master File Preparation and Maintenance, Investigator Site File, Pharmacy File, Dairy	1
4.0	**Overview to Understanding the Healthcare System**	
4.1	Health Care System Components	1
4.2	Elements of a Health Care System	1
4.3	The Role and Financing Methods of Third-Party Payers	1
4.4	The Production of Medical Services	1
4.5	An Overview of the U.S. Health Care System	1
4.6	Production of Health Services, Provider Choice in the United States	1
5.0	**Health Care Policies**	
5.1	Health Care Policy- Overview	1
5.2	Private Health Care Sectors	1
5.3	Health Policy and Planning	1
5.4	Government Health Insurance Programs: Medicaid, CHIP, Medicare	2
5.5	Health care Quality and the Law	1
Practical:		
1.	Investigation of Drug Storage Conditions	4
2.	Prospective Study on Drug Efficacy Using Simple Randomization	4
3.	Cross-Sectional Study on Economic and Humanistic Health Outcomes	4
4.	Role of the Investigator and Preparation of Informed Consent Forms	4
5.	Monitor's Role in Ensuring Protocol Compliance	4
6.	Cost-effectiveness Analysis of Healthcare Interventions	4
7.	Healthcare Service Simulation: Provider Choice	4
8.	Policy Proposal Development	2

Course Designer(s)

1. Ms. Kalaiarasi M S – kalaiarasims@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E43	Human Epigenetics	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To learn inheritance patterns of genes
- To get clear idea about sex determination
- To have knowledge about extra chromosomal inheritance
- To understand the genetic mapping
- To learn chromosomal abnormalities

Pre-requisites

- Molecular Biology, Cell Biology

Course Outcomes

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

CO1	Comprehend inheritance patterns, can predict the likelihood of certain traits or disorders appearing in offspring and make informed decisions about genetic counselling or medical interventions.	Understand
CO2	Recognize sex determination helps explain the biological basis of sexual dimorphism and can provide insights into reproductive biology and medical conditions related to sex development.	Understand
CO3	Awareness of extra chromosomal inheritance helps explain the inheritance patterns of certain traits, such as mitochondrial disorders, and provides insights into cellular biology and evolution.	Apply
CO4	Analyse the genes involved and their locations on chromosomes. This information can lead to the development of targeted therapies and diagnostic tests.	Analyse
CO5	Considerate the abnormalities helps diagnose genetic disorders, predict their outcomes, and guide medical management and genetic counselling.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	10	-	-	34	-
Understand	40	-	10	-	-	26	-
Apply	-	50	20	50	50	20	50
Analyse	-	50	20	50	50	20	50
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech – Biotechnology

60 BT E43 – Human Epigenetics

Semester	Hours / Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Mendelian Genetics and Extensions* Physical basis of Heredity — Structure and Function of Cell, Nucleus and Chromosome Mendelian Principles of Inheritance — Law of Segregation, Law of Dominance, Law of Independent Assortment — Animal Examples; Mendelian Inheritance of Human Traits; Chromosome Theory of Inheritance. Incomplete Dominance and Co dominance; Multiple Alleles, Lethal Alleles - Human examples- Hardy-weinberg equilibrium.	[6]
Sex Linked inheritance and Sex Determination Sex Linked Inheritance - Sex Linked Inheritance in Drosophila and Human; Sex Limited and Sex Influenced Inheritance with examples. Sex Determination - Sex Determination in Drosophila – Genic Balance Theory. Sex Determination in Eukaryotes – Heterogametic, Homogametic, Haplo-diploidy, Role of Environmental Factors, Mosaics. Sex determination in mammals- and role of human Y chromosome, Dosage compensation.	[6]
Extra-Chromosomal Inheritance Mitochondrial inheritance (petite mutations); Mitochondrial Inheritance in Man; Maternal Inheritance - Shell Coiling in Snail, Ephestia Pigmentation - Infective Heredity- Symbionts in Drosophila, Kappa Particles in Paramecium - Epigenetics and Genome Imprinting in Humans**.**	[6]
Linkage, crossing over and chromosome mapping* Linkage, Crossing Over and Recombination - CRISPR technique. Linkage and Chromosome Mapping in Eukaryotes — Cytological Basis of Crossing Over; Recombination Frequency, Two Factor and Three Factor Crosses; Interference and Coincidence; Mitotic Recombination - Linkage and Chromosome Mapping in Prokaryotes — Bacteria and Bacteriophages — Transformation, Transduction, Conjugation; Gene Mapping in Bacteria.Techniques for characterization of phenotypes associated with human genetic diseases.	[6]
Variation in Chromosome number and structure Specialized chromosomes - Lamp brush chromosomes. Polygene Chromosomes: Supernumerary Chromosomes. Variation in Chromosome Structure - Deletion, Duplication, Inversion, Translocation; Position effect - Variation in Chromosome Number - Euploidy and Aneuploidy in Man.	[6]
Practical: 1. Mitosis & Meiosis through temporary squash preparation 2. Mendel's laws through seed ratios & amp; Drosophila mutants 3. Study of linkage, recombination, chromosome mapping using test cross data 4. Study of human genetic traits: Sickle cell anaemia, Xeroderma Pigmentosum Albinism. Tests for red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe 5. Incomplete dominance and gene interaction through seed ratios 6. Blood Typing: ABO groups & Rh factor 7. Case Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes 8. Smear technique to demonstrate sex chromatin in buccal epithelial cells	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):	
1.	Griffiths et al (2015). An Introduction to Genetic Analysis. Freeman. 11th Edition.
2.	Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th Edition.
Reference(s):	
1.	Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th Edition.
2.	Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th Edition
3.	Watson et al. (2014). Molecular Biology of the Gene. 7th Edition
4.	Nussbaum et al (2015). Genetics in Medicine. Saunders. 8th Edition.

***SDG 3 – Good Health and Well Being**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of Hours**
1.0	Mendelian Genetics and Extensions	
1.1	Physical basis of Heredity – Structure and Function of Cell, Nucleus and Chromosome	1
1.2	Mendelian Principles of Inheritance – Law of Segregation, Law of Independent Assortment	1
1.3	Animal Examples; Mendelian Inheritance of Human Traits	1
1.4	Chromosome Theory of Inheritance. Incomplete Dominance and Codominance	1
1.5	Multiple Alleles, Lethal Alleles, Pleiotropic,	1
1.6	Penetrance and Expressivity – Human examples	1
2.0	**Sex Linked inheritance and Sex Determination**	
2.1	Sex Linked Inheritance - Sex Linked Inheritance in Drosophila and Human	1
2.2	Sex Limited and Sex Influenced inheritance with examples. Sex Determination - Sex Determination in Drosophila	1
2.3	Genic Balance Theory. Sex Determination in Eukaryotes	1
2.4	Heterogametic, Homogametic, Haplo-diploidy, Role of Environmental Factors, Mosaics	1
2.5	Sex determination in mammals	1
2.6	Role of human Y chromosome, Dosage compensation	1
3.0	**Extra-Chromosomal Inheritance**	
3.1	Mitochondrial inheritance (petite mutations); Mitochondrial Inheritance in Man	1
3.2	Maternal Inheritance - Shell Coiling in Snail, Ephestia Pigmentation	1
3.3	Infective Heredity- Symbionts in Drosophila	1
3.4	Infective Heredity- Kappa Particles in Paramecium	1
3.5	Epigenetics in Humans	1
3.6	Genome Imprinting in Humans	1
4.0	**Linkage, crossing over and chromosome mapping**	
4.1	Linkage, Crossing Over and Recombination. Linkage and Chromosome Mapping in Eukaryotes	1
4.2	Cytological Basis of Crossing Over; Recombination Frequency, Two Factor and Three Factor Crosses	1
4.3	Interference and Coincidence; Mitotic Recombination	1
4.4	Linkage and Chromosome Mapping in Prokaryotes	1
4.5	Bacteria and Bacteriophages – Transformation, Transduction, Conjugation	1
4.6	Gene Mapping in Bacteria	1
5.0	**Variation in Chromosome number and structure**	
5.1	Specialized chromosomes - Lamp brush chromosomes	1
5.2	Polygene Chromosomes: Supernumerary Chromosomes	1
5.3	Variation in Chromosome Structure - Deletion, Duplication	1
5.4	Variation in Chromosome Structure - Inversion, Translocation	1
5.5	Position effect - Variation in Chromosome Number	1
5.6	Euploidy and Aneuploidy in Man	1
Practical:		
1	Mitosis & Meiosis Through Temporary Squash Preparation	2
2	Mendel's Laws Through Seed Ratios & Amp; Drosophila Mutants	4
3	Study of Linkage, Recombination, Chromosome Mapping using Test Cross Data	4
4	Study of Human Genetic Traits: Sickle Cell Anaemia, Xeroderma Pigmentosum Albinism. Tests for Red-Green Colour Blindness, Widow's Peak, Rolling of Tongue, Hitchhiker's Thumb and Attached Ear Lobe.	2
5	Incomplete dominance and gene interaction through seed ratios	2

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Approved in Academic Council Meeting held on 25/05/2024

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6	Blood Typing: ABO groups & Rh factor	4
7	Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes	4
8	Smear technique to demonstrate sex chromatin in buccal epithelial cells	2

Course Designer(s)

1. Ms. R. Krishnaveni- rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E44	Nanobiotechnology	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To develop the fundamental understanding about nano molecules in biological systems.
- To learn a b o ut the various n a no particles and methods to prepare it.
- To a n a l ys e s the different techniques to characterize the nano materials.
- To widen the knowledge about the applications of nano particles in environment and pollution control system.
- To identify the application of nano materials in medical field.
-

Pre-requisites

- Chemistry,Bioinformatics

Course Outcomes

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

CO1	Recall the basic concepts, systems and synthesize of different types of nano particles	Understand
CO2	Classify the methods for the preparation of nano scale materials and its characterization	Understand
CO3	Identify the mechanism and role of biomolecules as nano materials.	Apply
CO4	Analyze the application of transducing elements in bionanotechnology and understand the mechanism of nanomaterials as drug delivery systems.	Analyze
CO5	Analyze the importance of nanotechnology for human health, environmental remediation, waste water treatment and food industry.	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	20	-	-	34	-
Understand	40	-	40	-	-	26	-
Apply	-	50	-	50	50	20	50
Analyze	-	50	-	50	50	20	50
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT E44- Nanobiotechnology

Semester	Hours / Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Nanomolecules in Biosystems* Lipids as Nanobricks and Mortar -Lipid Structure: Self Organizing Supramolecular Structures, Proteins-S Layer Proteins: Nanoscale Motors - Based on Bacteriorhodopsin: Ion Channels as Sensors: DNA - DNA Based Artificial Nanostructures - DNA as Nanowires - DNA as Molecular Tweezers; Nanobodies for Vaccine and Cancer Cell Detection.	[6]
Introduction to Nanobiotechnology and Synthesis** Nanoparticles -Types and Properties: Carbon Nanotubes: Quantum Dots, Fullerenes: Nanopores: Nanoshells: Nanocomposites: Synthesis of Nanoscale Materials - Top Down and Bottom up Approaches: Physical Method- Ball Milling -Plasma Arcing - Laser Ablation Method: Chemical Method- Sol Gels — Chemical Vapour Deposition: Green Synthesis of Nanoparticles: Nanoparticle Synthesis by Fungi, Bacteria and Actinomycetes.	[6]
Nano biotechnological applications in drug delivery detection systems* Types of Transducing Element and Its Applications in Bio-Nanotechnology: Electrochemical Transducer- Optical Transducer: Nano Biosensor -DNA Detection: Small Scale Systems of Drug Delivery - Gels, Scaffolds: Nanofibers: Stents: Composites and Magnetic Particles.	[6]
Characterization of Nanomaterials** Types of Characterization- Optical Probe - CLSM, SNOM, 2PFM, DLS: Electron Probe - SEM, TEM, HRTEM, AES, STEM: Scanning Probe - AFM, CFM, MFM, STM, APM, Spectroscopy Probe - UPS, UVVS, AAS, LSPR: Ion-Particle Probe - XRD, EDX, NMR: Thermodynamic - TGA, DSC, BET.	[6]
Biomimetic synthesis, Characterization and application of nano particles Green Synthesis of Nanoparticles: Nanoparticle Synthesis by Fungi, Bacteria and Actinomycetes: Characterization of Nanoparticles: Application of Nanoparticles: Soft Nanotechnology for Drug Delivery Systems.	[6]
Practical: 1. Chemical Synthesize Silver Nanoparticles using Co- Precipitation Method 2. Green Synthesis of TiO2 Nanoparticle Using Plant Extract 3. Green Synthesis of Zn Oxide Nanoparticle Using Microorganism 4. Synthesis of Aqueous Ferrofluid Nanoparticles 5. Absorption Spectroscopy Analysis of Metal Oxide Nanoparticles 6. Particle Size Analyzer of Metal Oxide Nanoparticles 7. Determination of Biological Activity of Nanoparticles using Bacteria 8. Surface Morphology Analysis of Synthesized Nanoparticle using AFM	[30]
Total Hours: (Lecture - 30; Practical - 30)	**60**

Text Book(s):

1.	Kulkarni, K. Sulabha.,"Nanotechnology: principles and practices". Capital publishing company, 2015.
2.	Natelson, Douglas.,"Nanostructures and nanotechnology". Cambridge University Press, 2015.

Reference(s):

1.	Jafarizadeh-Malmiri, H., Sayyar, Z., Anarjan, N., & Berenjian, A.," Nanobiotechnology in food: Concepts, applications and perspectives ". Berlin, Germany: Springer, 2019.
2.	Vinod Labhasetwar and Diandra L. Leslie-Pelecky. "Biomedical Applications of Nanotechnology",Wiley-Interscience,2020
3.	Arunava Goswami and Samrat Roy Choudhury, "Nanobiotechnology basic and applied aspects", Union Bridge Books,2017.
4.	Niemeyer C.M. and Mirkin C.A..,"Nanobiotechnology II: More Concepts and Applications",Wiley-VCH,2020

***SDG 3 – Good Health and Well Being**

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

1.0	**Nanomolecules in Biosystems***	
1.1	Lipids as Nanobricks and Mortar -Lipid Structure	1
1.2	Self-Organizing Supramolecular Structures	1
1.3	Proteins-S Layer Proteins; Nanoscale Motors- Based on Bacteriorhodopsin	1
1.4	Ion Channels as Sensors	1
1.5	DNA - DNA Based Artificial Nanostructures - DNA as Nanowires - DNA as Molecular Tweezers	1
1.6	Nanobodies for Vaccine and Cancer Cell Detection	1
2.0	**Introduction to Nanobiotechnology and Synthesis****	
2.1	Nanoparticles - Types and Properties	1
2.2	Carbon Nanotubes: Quantum Dots: Fullerenes: Nanopores	1
2.3	Nanoshells: Nanocomposites: Synthesis Of Nanoscale Materials - Top Down and Bottom Up Approaches	1
2.4	Physical Method- Ball Milling -Plasma Arcing - Laser Ablation Method	1
2.5	Chemical Method- Sol Gels - Chemical Vapour Deposition	1
2.6	Green Synthesis of Nanoparticles: Nanoparticle Synthesis by Fungi, Bacteria and Actinomycetes.	1
3.0	**Nano biotechnological applications in drug delivery detection systems***	
3.1	Types of Transducing Element and Its Applications in Bio-Nanotechnology	1
3.2	Electrochemical Transducer- Optical Transducer	1
3.3	Nano Biosensor -DNA Detection	1
3.4	Small Scale Systems of Drug Delivery - Gels, Scaffolds	1
3.5	Nanofibers: Stents	1
3.6	Composites and Magnetic Particles	1
4.0	**Characterization of Nanomaterials****	
4.1	Types of Characterization- Optical Probe - CLSM, SNOM, 2PFM, DLS	1
4.2	Electron Probe - SEM, TEM, HRTEM, AES, STEM	1
4.3	Scanning Probe - AFM, CFM, MFM, STM, APM	1
4.4	Spectroscopy Probe - UPS, UVVS, AAS, LSPR	1
4.5	Ion-Particle Probe - XRD, EDX, NMR	1
4.6	Thermodynamic - TGA, DSC, BET	1
5.0	**Biomimetic synthesis, Characterization and application of nano particles**	
5.1	Green Synthesis of Nanoparticles	1
5.2	Nanoparticle Synthesis by Fungi, Bacteria and Actinomycetes	2
5.3	Characterization of Nanoparticles	1
5.4	Application of Nanoparticles	1
5.5	Soft Nanotechnology for Drug Delivery System	1
Practical:		
1.	Chemical Synthesize Silver Nanoparticles Using Co- Precipitation Method	4
2.	Green Synthesis of TiO2 Nanoparticle Using Plant Extract	4
3.	Green Synthesis of Zn Oxide Nanoparticle Using Microorganism	4
4.	Synthesis of Aqueous Ferrofluid Nanoparticles	2
5.	Absorption Spectroscopy Analysis of Metal Oxide Nanoparticles	4
6.	Particle size analyzer of metal oxide nanoparticles	4
7.	Determination of Biological Activity of Nanoparticles Using Bacteria	4
8.	Surface Morphology Analysis of Synthesized Nanoparticle Using AFM	4

Course Designer(s)

1. Dr. Swathy J S - swathy@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E45	Next Generation Sequencing and Data Analysis	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To identify the different NGS technologies in the market
- To evaluate the main variables that influence the design of a sequencing project
- To differentiate between a good and a bad data set
- To describe the different workflows in the analysis of NGS data
- To interpret the results from the different NGS applications

Pre-requisites

- Biochemistry, Molecular Biology and Bioinformatics concepts

Course Outcomes

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

CO1	Describe the step-by-step process to analyze the data generated by NGS platforms along with relevant hands-on experience.	Apply
CO2	Analysis single nucleotide polymorphisms (snps) and indels.	Apply
CO3	Describe the complexities involved in the analysis of transcriptomic data in details.	Apply
CO4	An overview of other applications of the NGS technologies - genome assembly and epigenomics.	Apply
CO5	Comprehend the concepts of Big Data And High Performance Computing In Omics	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)				Model Examination (Marks)	End Sem Examination (Marks)	
	Test 1		Test 2				
	Theory	Lab	Theory	Lab	Lab	Theory	Lab
Remember	20	-	20	-	-	34	-
Understand	20	-	20	-	-	26	-
Apply	20	50	20	50	50	20	50
Analyse	-	50	-	50	50	20	50
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-
Total	60	100	60	100	100	100	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.RangasamyCollege ofTechnology–AutonomousR2022

B.Tech- Biotechnology

60 BT E45– Next Generation Sequencing and Data Analysis

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

NGS Platforms, Sequencing and Alignment NGS Platforms: Roche/454 FLX, Illumina/Solexa Genome Analyzer, Applied Biosystems solid System, Helicosheliscope, Pacific Biosciences / Single Molecule Real Time (SMRT) Sequencing, Genome Assembly Algorithms: Alignment of Short-Reads to Reference Genome Using Spaced Seed (ELAND, SOAP), Index-Filtering Algorithm (Seqmap), Quality-Score (RMAP), Q-Filter Algorithm (Shrimp), FM-Index (Bowtie, BWA,SOAP2), Sequence Alignment Formats: Sequence Alignment / Map (SAM) Format, Binary Alignment/Map (BAM) Format, Tools for Conversion (Sam tools), Alignment Viewers (IGV, MGAVIEWER)	[6]
Assembly and Contig Generation *De novo* Assembly: Overlap-Layout-Consensus (OLC) Approach (Arachne, Phusion), De Bruijn and Euler Path Approach (Euler, Soapdenovo), String Graph Assembler (SGA).Scaffolding: Supercontig, Contig Orientation, Contig Ordering, Contig Distancing and Gap Closing Using SOAPdenovo, ABySS, OPERA and RACA	[6]
R Package in NGS Analysis Application of R in NGS analysis: Introduction to Bioconductor, Reading of RNA-seq Data (ShortRead, Rsamtools, GenomicRanges), Annotation (biomaRt, genomeIntervals), Reads Coverage and Assign Counts (IRanges, GenomicFeatures), Differential Expression (DESeq)	[6]
Applications of NGS Biological Applications of NGS: Whole-Genome Sequencing, Exome Sequencing, Transcriptome Sequencing, Epigenome Sequencing, Interactome Sequencing, Methylome Sequencing	[6]
BIG Data and High Performance Computing in OMICS* BIG DATA in OMICS:Big Data Industry Standards, Data Acquisition, Cleaning, Distribution, Best Practices, Visualization and Design Principles of Big Data Infrastructures, Biological databases for Big Data Management, High Performance Computing, Grid, Cloud Computing for Omics Sciences.	[6]
Practical:	
1. Apply Bioinformatics Tools and Platforms for Integrating and Accessing Multiple Biological Databases 2. Bioinformatics Tools and Platforms used for Integrating and Accessing Multiple Biological Databases 3. Perform Quality Control on Raw NGS Data and Describe the Key Metrics You Would Evaluate. 4. Perform GATK Tool for Variant Calling, and Analyze the Results. 5. Execute RNA-Seq Analysis from Raw Data to Analyze Differential Expression Analysis 6. Using Bioconductor / R Package Perform Genomic Features for the Raw Sequence 7. Perform Pre-Processing for the *de novo* Genome Assembly Sequence 8. Analyse Error Correction for the *de novo* Genome Assembly Sequence 9. Perform Scaffolding in Genome Assembly for the Raw Sequence	
Total Hours: 30+30(Practicals)	**60**

Text Book(s):	
1.	Stuart M. BrownNext-generation DNA sequencing Informatics Cold Spring Harbor Laboratory 2013 ISBN 1936113872
2.	EijaKorpelainen, JarnoTuimala, Panu Somervuo, Mikael Huss, Garry Wong. RNA-seq Data Analysis: A Practical Approach. Chapman & Hall/CRC, 2014.ISBN-13: 978-1466595002
Reference(s):	
1.	Hillman Chris, Ahmad Yasmeen, Whitehorn Mark, and CobleyAndy Near real-time processing of proteomics data using HADOOP Mary annLiebert, Inc- Big Data. 2014 2 (1): BD44- BD49.
2.	SoweSulayman K. and Zettsu Koji Curating Big Data Made Simple: Perspectives from Scientific Communities Big Data. 2014 2 (1): 23-33

Passed in BoS Meeting held on 21/05/2024
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3.	Melanie Swan The quantified self: Fundamental Disruption in Big Data Science and Biological Discovery Mary ann Liebert, Inc. Big data ,2013, 1(2): BD85-99
4.	Wong Lee-Jun C. (ed.) Next generation sequencing: Translation to Clinical Diagnostics Springer 2013ISBN 978-1-4614-7001-4

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**NGS Platforms, Sequencing and Alignment**	
1.1	Roche/454 FLX, Illumina/Solexa Genome Analyzer	1
1.2	Applied Biosystems solid System, Helicosheliscope, Pacific Biosciences / Single Molecule Real Time (SMRT) Sequencing	1
1.3	Assembly Algorithms: Alignment of Short-Reads to Reference Genome Using Spaced Seed (ELAND, SOAP)	1
1.4	Index-Filtering Algorithm (Seqmap), Quality-Score (RMAP), Q-Filter Algorithm (Shrimp),	1
1.5	FM-Index (Bowtie, BWA,SOAP2), Suffix Tree (Mummer).	1
1.6	Alignment Formats: Sequence Alignment/Map (SAM) Format, Binary Alignment/Map (BAM) Format, IGV, MGAVIEWER	1
2.0	**Assembly and Contig Generation**	
2.1	*de novo* Assembly: Overlap-Layout-Consensus (OLC) Approach (Arachne, Phusion)	1
2.2	De Bruijn And Euler Path Approach (Euler, Soapdenovo)	1
2.3	String Graph Assembler (SGA)	1
2.4	Scaffolding: Supercontig	1
2.5	Contig Orientation, Contig Ordering, Contig Distancing	1
2.6	Gap Closing Using SOAPdenovo, ABySS, OPERA and RACA	1
3.0	**R Package in NGS Analysis**	
3.1	Application of R in NGS analysis	1
3.2	Introduction to Bioconductor, Reading of RNA-seq Data (ShortRead)	1
3.3	Rsamtools, GenomicRanges	1
3.4	Annotation (biomaRt, genomeIntervals)	1
3.5	Reads Coverage and Assign Counts (IRanges, GenomicFeatures)	1
3.6	Differential Expression (DESeq)	1
4.0	**Applications of NGS**	
4.1	Biological Applications of NGS	1
4.2	Whole-Genome Sequencing	1
4.3	Exome Sequencing	1
4.4	Transcriptome Sequencing	1
4.5	Epigenome, Interactome Sequencing	1
4.6	Methylome Sequencing	1
5.0	**BIG Data and High Performance Computing in OMICS**	
5.1	BIG DATA in OMICS:Big Data Industry Standards	1
5.2	Data Acquisition, Cleaning, Distribution	1
5.3	Best Practices, Visualization and Design Principles of Big Data	1
5.4	Infrastructures, Biological databases for Big Data Management	1
5.5	High Performance Computing, Grid, Cloud Computing for Omics Sciences.	2
Practical:		
1.	Apply Bioinformatics Tools and Platforms for Integrating and Accessing Multiple Biological Databases	4
2.	Bioinformatics Tools and Platforms used for Integrating and Accessing Multiple Biological Databases	4
3.	Perform Quality Control on Raw NGS Data and Describe the Key Metrics you Would Evaluate.	4

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4.	Perform GATK Tool For Variant Calling, and Analyze the Results.	4
5.	Execute RNA-Seq Analysis from Raw Data to Analyze Differential Expression Analysis	4
6.	Using Bioconductor / R Package Perform Genomic Features for the Raw Sequence	4
7.	Perform Pre-Processing for the *de novo* Genome Assembly Sequence	2
8.	Analyse Error Correction for the *de novo* Genome Assembly Sequence	2
9.	Perform Scaffolding in Genome Assembly for the Raw Sequence	2

Course Designer(s)

1. Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E46	Agricultural Biotechnology	Category	L	T	P	Credit
		PE	2	0	2	3

Objectives

- To learn the basic concepts in the current practices of Agronomy
- To discuss the importance of agricultural structures and irrigation methods
- To understand the plant tissue culture techniques
- To facilitate the knowledge and mechanism involved in transgenic plants
- To elaborate the applications of agricultural biotechnology

Pre-requisites

- Agricultural engineering and Plant Biotechnology

Course Outcomes

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

CO1	Determine the principles of agronomy for managing the environmental impact of agriculture and tilth practices.	Understand
CO2	Outline the design and construction of farm shed, fences and canals, pipeline systems to moderate depression created to channel water.	Remember
CO3	Elaborate the techniques involved in plant tissue cultures.	Apply
CO4	Examine the different methods of creating transgenic plants and its ethical implications.	Analyse
CO5	Critically evaluate the applications of agricultural biotechnology in greenhouse construction, biofertilizer production, and biocontrol agent development.	Evaluate

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech-Biotechnology								
60 BT E46 – Agricultural Biotechnology								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VII	2	0	2	60	3	50	50	100

Principles of Agronomy Definition of Agriculture and Agronomy – Factors Affecting Crop Growth – Climate and Eather Parameters – Soil Fertility and Productivity–Tillage and Tilth, it's Different Kinds of Tillage, Agriculture and Climate Change.	[6]
Agricultural Infrastructure Site Selection, Design and Construction of Farmstead - Farm House, Cattle Shed, Dairy Bam, Poultry Shed, Hog Housing, Machinery and Implement Shed, Storage Structures for Food Grains, Feed and Forage, Sources of Water for Irrigation - Methods of Irrigation - Surface, Sprinkler and Drip, Fertigation - Irrigation Efficiencies and their Estimation.	[6]
Plant Tissue Culture Techniques* Preparation of Plant Tissue Culture Media, Plant Growth Regulators, Sterilization of Explants, Callus and Suspension Cultures, Micropropagation, Meristem Culture, Organogenesis, Regeneration of Shoots and Roots.	[6]
Transgenic Plants CRIPSR – Cas9 Technology – Agrobacterium Mediated Transformation – Protoplast Fusion — Direct Gene Delivery Methods — Plant Viruse as Vectors and Chloroplast Transformation – Ethical Issues in Transgenic Plants.	[6]
Applications of Agricultural Biotechnology Hardening, Green House Construction, Field Plantation, Irrigation, Production of Biofertilizer & Biocontrol Agents, Azolla Cultivation, Spirulina Cultivation and Mushroom Cultivation.	[6]
Practical: 1. Determination of pH of soil samples 2. Determination of pH of water samples 3. Determination of water holding capacity of the soil 4. Study of different types of soil through water flow and absorption test 5. Preparation of biofertilizer using symbiotic Rhizobium bacteria 6. Cultivation of Azolla as biofertilizer 7. Cultivation of Spirulina – blue green algae 8. Surface sterilization of Explant 9. Preparation of Murashige and Skoog medium for plant tissue culture	[30]
Total Hours: (Lecture – 30; Practical – 30)	**60**

Text Book(s):	
1.	Sharma R.K.and Co., "Basics of Agriculture", Daya publishers, New Delhi, 2014.
2.	Singh, B.D., "Biotechnology", First Edition, Kalyani Publishers, New Delhi, India, 2015.
3.	Jagdishwar Sahay. "Elements of Agricultural Engineering", Standard Publishers Distributors, Delhi, 2006.
Reference(s):	
1.	George Acquaah, "Horticulture-principles and practices" Prentice-Half of India Pvt. Ltd., New Delhi, 2002.
2.	Michael and Ojha. "Principles of Agricultural Engineering" Jain brothers, New Delhi, 2005.
3.	Harry L. Field, John M. Long, "Introduction to Agricultural Engineering Technology: A Problem Solving Approach", 4th Edition, Springer International Publishing AG, Switzerland, 2018

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1.0	**Principles of agronomy**	
1.1	Definition of agriculture and agronomy	1
1.2	Factors affecting crop growth	1

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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1.3	Climate and weather parameters	1

1.4	Soil fertility and productivity–tillage	1
1.5	Tilth, it's different kinds of tillage	1
1.6	Agriculture and climate change	1
2.0	**Agricultural Infrastructure**	
2.1	Site selection, design and construction of farmstead	1
2.2	Farm house, cattle shed, dairy bam, poultry shed, hog housing	1
2.3	Machinery and implement shed, storage structures for food grains, feed and forage	1
2.4	Sources of water for irrigation	1
2.5	Methods of irrigation – surface, sprinkler and drip, fertigation	1
2.6	Irrigation efficiencies and their estimation	1
3.0	**Plant Tissue Culture techniques**	
3.1	Preparation of Plant tissue culture media	1
3.2	Plant growth regulators	1
3.3	Sterilization of explants	1
3.4	Callus and suspension cultures	1
3.5	Micropropagation, meristem culture	1
3.6	Organogenesis, regeneration of shoots and roots	1
4.0	**Transgenic Plants**	
4.1	CRIPSR – Cas9 Technology	1
4.2	Agrobacterium mediated transformation	1
4.3	Protoplast fusion	1
4.4	Direct gene delivery methods	1
4.5	Plant viruse as vectors and chloroplast transformation	1
4.6	Ethical issues in transgenic plants	1
5.0	**Applications of agricultural biotechnology**	
5.1	Hardening, Green house construction	1
5.2	Field plantation, Irrigation	1
5.3	Production of Biofertilizer& Biocontrol agents	2
5.4	Azolla cultivation, Spirulina cultivation and Mushroom cultivation	2
Practical:		
1.	Determination of pH of soil samples	2
2.	Determination of pH of water sample	2
3.	Determination of water holding capacity of the soil	4
4.	Study of different types of soil through water flow and absorption test	4
5.	Preparation of biofertilizer using symbiotic Rhizobium bacteria	2
6.	Cultivation of Azolla as biofertilizer	4
7.	Cultivation of Spirulina – blue green algae	4
8.	Surface sterilization of Explant	4
9.	Preparation of Murashige and Skoog medium for plant tissue culture	4

Course Designer(s)

1. Ms. K. Abinayaa - abinayaa@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

ELECTIVE V

60 BT E51	Bioprocess Modelling and Simulation	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Understand Process Design Principles.
- Comprehend physical and mathematical modelling concepts.
- Apply Kinetics and Reactor Modelling.
- Develop Mathematical Models for Fermentation.
- Identify models from experimental data and apply numerical techniques for model solution.

Pre-requisites

- Stoichiometry, Bioprocess Technology

Course Outcomes

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

CO1	Recognize process synthesis and design strategies using optimization techniques.	Understand
CO2	Formulate mathematical models incorporating physical and cybernetic principles.	Apply
CO3	Evaluate kinetics and reactor behaviour applying Michaelis-Menten and Monod models.	Apply
CO4	Interpret fermentation processes, considering kinetics, stoichiometry, and physiological aspects.	Analyse
CO5	Apply numerical techniques to identify, formulate, and solve bioprocess models accurately.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech. - Biotechnology								
60 BT E51 - Bioprocess Modelling and Simulation								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Introduction to Bioprocess Modelling* Process Design Fundamentals: Introduction to process synthesis and analysis - Optimization Strategies - Principles of Process Plant Simulation	[9]
Modelling Aspects in Bioprocess Engineering* Physical and Mathematical Modelling - Model Formulation Principles - Fundamental Laws of Modelling - Cybernetics in Bioprocess Systems	[9]
Kinetics and Reactor Modelling Michaelis-Menten Kinetics - Kinetics of substrate utilization, product formation, and biomass production in cell cultures - Ideal Batch Reactor Analysis - Continuous-Flow Stirred-Tank Reactor (CSTR) modelling - Monod Growth Kinetics and Chemostat Model	[9]
Mathematical Modelling of Fermentation Processes Kinetics of Simple Processes - Stoichiometry in Microbial Processes - Physiological Aspects in Fermentation Models - Modelling Oxygen Transfer	[9]
Model Formulation and Solution Techniques* Model Identification from Experimental Data - Formulation Principles and Limitations - Building lumped and distributed parameter models - Numerical Techniques for Solution: Gauss-Jacobi and special methods, Bisection, regular-false, and Wegstein methods - Application of Numerical Methods in Bioprocess Models	[9]
Total Hours:	**45**

Text Book(s):	
1.	Luyben, W., "Process Modeling,Simulation and Control for Chemical Engineers", 2nd Edition, McGraw Hill Education, 2013.
2.	Michael Shuler and Fikret Kargi, "Bioprocess Engineering: Basic Concepts", 2nd Edition, Prentice Hall, Englewood Cliffs, NJ, 2002.
3.	Peter F Stanbury, Allan Whitaker and Stephen J Hall, "Principles of Fermentation Technology", 3rd Edition, Butterworth-Heinemann, 2016.
Reference(s):	
1.	Shijie Liu, "Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design", Elsevier Science Ltd., 2012.
2.	Bequette, B., "Process Dynamics: Modeling, Analysis and Simulation", 1st Edition, Pearson, 1998.
3.	Kim Gail Clarke, "Bioprocess Engineering: An Introductory Engineering and Life Science Approach", 1st Edition, Woodhead Publishing Ltd., 2013.

*SDG 9: Industry, Innovation, and Infrastructure

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Bioprocess Modelling**	
1.1	Introduction to Bioprocess Modelling:	1
1.2	Process Synthesis:	1
1.3	Process Analysis:	1
1.4	Optimization Strategies:	1
1.5	Optimization Strategies (continued):	1
1.6	Principles of Process Plant Simulation	1
1.7	Process Plant Simulation Tools	1
1.8	Application of Simulation Tools	1
1.9	Summary and Review:	1
2.0	**Modelling Aspects in Bioprocess Engineering**	
2.1	Physical and Mathematical Modelling:	1
2.2	Model Formulation Principles:	1
2.3	Fundamental Laws of Modelling:	1

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2.4	Fundamental Laws (continued):	1

2.5	Cybernetics in Bioprocess Systems:	1
2.6	Cybernetic Principles (continued):	1
2.7	Practical Modelling Examples:	1
2.8	Challenges in Modelling:	1
2.9	Summary and Review:	1
3.0	**Kinetics and Reactor Modelling**	
3.1	Michaelis-Menten Kinetics:	1
3.2	Kinetics of Substrate Utilization:	1
3.3	Product Formation and Biomass Production:	1
3.4	Ideal Batch Reactor Analysis:	1
3.5	Continuous-Flow Stirred-Tank Reactor (CSTR) Modelling:	1
3.6	Monod Growth Kinetics:	1
3.7	Chemostat Model:	1
3.8	Practical Reactor Modelling:	1
3.9	Summary and Review:	1
4.0	**Mathematical Modelling of Fermentation Processes**	
4.1	Kinetics of Simple Processes:	1
4.2	Stoichiometry in Microbial Processes:	1
4.3	Physiological Aspects in Fermentation Models:	1
4.4	Physiological Aspects in Fermentation Models:	1
4.5	Oxygen Transfer (continued):	1
4.6	Advanced Fermentation Modelling:	1
4.7	Challenges in Fermentation Modelling:	1
4.8	Practical Modelling Exercises:	1
4.9	Summary and Review:	1
5.0	**Model Formulation and Solution Techniques**	
5.1	Model Identification from Experimental Data:	1
5.2	Formulation Principles and Limitations:	1
5.3	Building Lumped Parameter Models:	1
5.4	Building Distributed Parameter Models:	1
5.5	Numerical Techniques for Solution:	1
5.6	Numerical Techniques (continued):	1
5.7	Numerical Techniques (continued):	1
5.8	Application of Numerical Methods in Bioprocess Models:	1
5.9	Summary and Review:	1

Course Designer(s)

1. Dr.S.Poornima - spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E52	Regulatory Affairs in Biotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To introduce QA and QC, stressing CGMP and environmental controls' significance in biological products manufacturing
- To explain IND, NDA, and ANDA submission processes, with an overview of DPCO and its implications
- To provide insights into Drugs and Cosmetics Act, 1940, and Rules, 1945, and pertinent safety and clinical efficacy guidelines
- To introduce validation concepts and types in biological products manufacturing, detailing its importance and procedural steps
- To explain industrial safety principles, risk management, and diverse accreditation processes in the biotechnology sector

Pre-requisites

- Biopharmaceutical Technology

Course Outcomes

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

CO1	Recall the basic principles of QA, QC, and cGMP, and describe the environmental controls necessary for biological products manufacturing.	Remember
CO2	Explore the procedures for IND, NDA, and ANDA submissions and explain the impact of the DPCO on pharmaceutical pricing.	Understand
CO3	Outline the Drugs and Cosmetics Act and Rules and apply quality guidelines to ensure compliance with safety and efficacy standards.	Apply
CO4	Comprehend the various types of validation processes and apply the steps of validation to ensure the quality and consistency of biological products.	Apply
CO5	Apply principles of industrial safety management, conduct hazard assessments, and manage risk to ensure safe and compliant manufacturing environment	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E52 - Regulatory Affairs in Biotechnology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	40	60	100

Quality Assurance and Quality Control in Biological Products Manufacturing* Introduction to Quality Assurance (QA) and Quality Control (QC) - Principles and Practices of Current Good Manufacturing Practices (CGMP) - Personnel Roles and Responsibilities - Facility Requirements and Environmental Controls - Manufacturing Processes and Factors Affecting Quality - Overview of Schedule M - Emphasis on Environmental Controls Specific to Biological Products Manufacturing	[9]
Regulatory Submissions and Approval Processes* Investigational New Drug (IND) Application - New Drug Application (NDA) - Abbreviated New Drug Application (ANDA) - Review and Approval Processes - Overview of the Drug Price Control Order (DPCO) - Detailed Exploration of the DPCO and its Implications for Pharmaceutical Pricing	[9]
Legal and Quality Guidelines* Drugs and Cosmetics Act, 1940 and Drugs and Cosmetics Rules, 1945 - Comprehensive Overview of the Drugs and Cosmetics Act and Rules - Quality Guidelines: Safety (Nonclinical Safety Studies) Guidelines, Clinical efficacy guidelines, Multidisciplinary Guidelines	[9]
Validation in Biological Products Manufacturing* Introduction to Validation and its Importance - Process Validation and its Scope - Types of Validation: Prospective, Retrospective, Concurrent, and Revalidation - Steps Involved in Validation - Standard Operating Procedures (SOPs) and Documentation - Detailed Steps Involved in Different Types of Validation Processes	[9]
Industrial Safety and Accreditations Industrial Risk and Safety Management - Hazard Assessments - Risk Management - Industrial Safety Management - Environmental Management - HACCP Principles and Application Guidelines - Fire Systems Management - Pollution Control Management - Industrial Accreditations: Manufacturing Accreditations, Product Accreditations, R&D Lab Accreditations	[9]
Total Hours:	**45**

Text Book(s):	
1.	Weinberg, S., "Guidebook for Drug Regulatory Submissions", 1st Edition, John Wiley & Sons Inc., 2009.
2.	Shayne Cox Gad, "Pharmaceutical Manufacturing Handbook: Regulations and Quality", 1st Edition, Wiley-Interscience, 2008.
3.	Anasuya Patil, Valarmathi, S., Mr Vinay Kumar Yanmandru, Abhishek Suman, Narla Sunitha and Varsha Deva, "Textbook on Pharmaceutical Regulatory Affairs - Regulatory Affairs of Pharmaceuticals", Shashwat Publication, 2023.
Reference(s):	
1.	Donald C. Singer, Raluca-Ioana Stefan and Jacobus F. van Staden, "Laboratory Auditing for Quality and Regulatory Compliance", 1st Edition, CRC Press, 2019.
2.	Harrison, C.F., "Pharmaceutical Regulatory Affairs: An Introduction for Life Scientists", Createspace Independent Pub, 2016.
3.	John I. Disouza, Maharukh Rustomjee, Vandana B. Patravale, "Pharmaceutical Product Development: Insights Into Pharmaceutical Processes, Management and Regulatory Affairs", 1st Edition, Taylor & Francis Ltd., 2021.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Quality Assurance and Quality Control in Biological Products Manufacturing**	
1.1	Introduction to Quality Assurance (QA) and Quality Control (QC)	1
1.2	Principles and Practices of Current Good Manufacturing Practices (CGMP)	2
1.3	Personnel Roles and Responsibilities	1
1.4	Facility Requirements and Environmental Controls	1

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1.5	Manufacturing Processes and Factors Affecting Quality	1
1.6	Overview of Schedule M	1
1.7	Emphasis on Environmental Controls Specific to Biological Products Manufacturing	2
2.0	**Regulatory Submissions and Approval Processes**	
2.1	Investigational New Drug (IND) Application	1
2.2	New Drug Application (NDA)	2
2.3	Abbreviated New Drug Application (ANDA)	1
2.4	Review and approval processes	2
2.5	Overview of the Drug Price Control Order (DPCO)	1
2.6	Detailed Exploration of the DPCO and its Implications for Pharmaceutical Pricing	2
3.0	**Legal and Quality Guidelines**	
3.1	Drugs and Cosmetics Act	1
3.2	1940 and Drugs and Cosmetics Rules	2
3.3	1945 - Comprehensive Overview of the Drugs and Cosmetics Act and Rules	1
3.4	Quality Guidelines: Safety (Nonclinical Safety Studies) Guidelines	1
3.5	Clinical efficacy guidelines	2
3.6	Multidisciplinary guidelines	2
4.0	**Validation in Biological Products Manufacturing**	
4.1	Introduction to Validation and its Importance	2
4.2	Process Validation and its Scope	1
4.3	Types of Validation: Prospective	2
4.4	Retrospective, Concurrent, and Revalidation	1
4.5	Steps Involved in Validation	1
4.6	Standard Operating Procedures (SOPs) and Documentation	1
4.7	Detailed Steps Involved in Different Types of Validation Processes	1
5.0	**Industrial Safety and Accreditations**	
5.1	Industrial risk and safety Management	1
5.2	Hazard assessments - Risk Management	1
5.3	Industrial safety Management- Environmental Management	1
5.4	HACCP Principles and Application Guidelines	1
5.5	Fire Systems Management	1
5.6	Pollution control Management	1
5.7	Industrial accreditations: Manufacturing Accreditations	1
5.8	Product Accreditations	1
5.9	R&D Lab Accreditations	1

Course Designer(s)

1. Dr.B. Kalpana - kalpana@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E53	Biomedical Instrumentation	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn about the instrumental analysis of human physiology and anatomy.
- To familiarize about the various electrical and non-electrical measurements aids
- To identify the applications of chemicals in the synthesis of implant materials.
- To understand the concepts of imaging in diagnosis and monitoring effectiveness of the treatments.
- To acquire knowledge on the existing life assisting and robotic devices.

Pre-requisites

- Basic Physics, Anatomy and Physiology

Course Outcomes

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

CO1	Recognize the basic bio-potential and biomechanical rhythm of human physiology with its characteristics	Understand
CO2	Quantify the electrical parameters measurement in correlation to the instruments and the role of physiological signals and transducers	Understand
CO3	Identify the role of non-electrical parameters measurement in correlation to the human physiology	Apply
CO4	Study various biomaterials for various biomedical applications	Apply
CO5	Examine and interpret the imaging equipment principles and output signals	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	20	26
Apply	-	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT E53- Biomedical Instrumentation

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

Basic Electro-Physiology and Biomechanics of Human System* Electrical Potentials in the Human Body and the Origin of Bio-mechanics: Neuromuscular System: Neurons-Synapses and Muscles-Electrical Properties of Nerves and Muscles: Basic components of a Biomedical System- Cardiovascular systems- Respiratory systems -Kidney and Blood Flow - Biomechanics of Bone - Biomechanics of Soft Tissues - Basic Mechanics of Spinal Column and Limbs.	[9]
Electrical Parameter Measurements Basic Mechanisms and Principles of Biomedical/ Biosensors and Biopotential Amplifiers: Bio-potential Electrodes- Biological Amplifiers- ECG, EEG, EMG, ERG, Lead Systems and Recording Methods- Typical Waveforms and Signal Characteristics: Physiological Signals and Transducers - Transducers – Selection Criteria – Piezo electric: Ultrasonic Transducers - Temperature Measurements - Fibre Optic Temperature Sensors.	[9]
Non-electrical Parameter Measurements ** Measurement of Blood Pressure: Cardiac Output- Heart Rate and Heart Sound: Pulmonary Function Measurement: Spirometer- Photo Plethysmography and Body Plethysmography — Blood Gas Analysers: pH of Blood: Measurement of Blood pCO2, pO2, Finger-Tip oxymeter - ESR, GSR Measurements.	[9]
Biomaterials** Definition and Classification of Bio-Materials: Wound Healing Process- Body Response to Implants- Blood Compatibility: Implant Materials: Metallic Implant Materials: Polymeric Implant Materials: Polymerization- Polyamides- Acrylic Polymers- Rubbers: Bio polymers: Collagen and Elastin: Medical Textiles: Silica- Chitosan- PLA Composites- Sutures and Wound Dressings: Biocompatibility Testing of Medical Devices (ISO Standard 10993)	[9]
Diagnostic Imaging and Therapeutic Devices* Ionizing Radiation- Diagnostic x-ray Equipment- Use of Radio Isotope in Diagnosis- Medical Image Modalities: MRI, PET, SPECT and CT: Endoscopy- Bronchoscope- Gastro Scope- Colonoscope — Ultrasonography –Thermography : Different Types of Biotelemetry Systems and Patient Monitoring System: Therapeutic Devices**:** Pacemakers- Defibrillators- Hearing Aids- Heart lung Machine ECMO- Ventilators- Diathermy- Dialysers- Lithotripsy:Nano Robots: Surgery- 3D Surgical Techniques and Orthopedic Prostheses Fixation.	[9]
Total Hours:	**45**

Text Book(s):

1.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2014.
2.	John G. Webster, Amit J. Nimunkar., ““Medical Instrumentation: Application and Design””, Wiley,Hoboken, NJ, 2020.

Reference(s):

1.	Barbara Christe, "Introduction to Biomedical Instrumentation: The Technology of Patient Care," 2nd Edition, Cambridge University Press, Cambridge, UK, 2017.
2.	Khandpur R.S.., “Handbook of Biomedical Instrumentation”., McGraw-Hill Education, New York, NY,2015.
3.	Andrew G. Webb, “Principles of Biomedical Instrumentation”, 1st Edition, Cambridge University Press, Cambridge, UK, 2018.
4.	John G. Webster and Amit J. Nimunkar, "Medical Instrumentation: Application and Design," 5th Edition, Wiley, Hoboken, NJ, 2020.

*** SDG 3 – Good Health and Well Being**

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Basic Electro-Physiology and Biomechanics of Human System**	
1.1	Electrical Potentials in the Human Body and the Origin of Bio-mechanics	1
1.2	Neuromuscular System	1
1.3	Neurons-Synapses and Muscles	1

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1.4	Electrical Properties of Nerves and Muscles	1

1.5	Basic components of a Biomedical System	1
1.6	Cardiovascular systems	1
1.7	Respiratory systems -Kidney and Blood Flow	1
1.8	Biomechanics of Bone - Biomechanics of Soft Tissues	1
1.9	Basic Mechanics of Spinal Column and Limbs.	1
2.0	**Electrical Parameter Measurements**	
2.1	Basic Mechanisms and Principles of Biomedical/ Biosensors and Biopotential Amplifiers	1
2.2	Bio-potential Electrodes- Biological Amplifiers- ECG, EEG, EMG, ERG	2
2.3	Lead Systems and Recording Methods	1
2.4	Typical Waveforms and Signal Characteristics	1
2.5	Physiological Signals and Transducers	1
2.6	Transducers – Selection Criteria – Piezo electric	1
2.7	UltrasonicTransducers - Temperature Measurements	1
2.8	Fibre Optic Temperature Sensors.	1
3.0	**Non-electrical Parameter Measurements**	
3.1	Measurement of Blood Pressure	1
3.2	Cardiac Output- Heart Rate and Heart Sound	1
3.3	Pulmonary Function Measurement	1
3.4	Spirometer- Photo Plethysmography and Body Plethysmography	2
3.5	Blood Gas Analysers	1
3.6	pH of Blood: Measurement of Blood pCO2, pO2,	1
3.7	Finger- Tip oxymeter - ESR, GSR Measurements.	2
4.0	**Biomaterials**	
4.1	Definition and Classification of Bio-Materials	1
4.2	Wound Healing Process- Body Response to Implants- Blood Compatibility	1
4.3	Implant Materials: Metallic Implant Materials	1
4.4	Polymeric Implant Materials	1
4.5	Polymerization- Polyamides- Acrylic Polymers- Rubbers	1
4.6	Bio polymers: Collagen and Elastin	1
4.7	Medical Textiles	1
4.8	Silica- Chitosan- PLA Composites	1
4.9	Sutures and Wound Dressings	1
4.10	Biocompatibility Testing of Medical Devices (ISO Standard 10993)	1
5.0	**Diagnostic Imaging and Therapeutic Devices**	
5.1	Ionizing Radiation- Diagnostic x-ray Equipment	1
5.2	Use of Radio Isotope in Diagnosis- Medical Image Modalities	1
5.3	MRI, PET, SPECT and CT	1
5.4	Endoscopy- Bronchoscope- Gastro Scope- Colonoscope – Ultrasonography –Thermography	2
5.5	Different Types of Biotelemetry Systems and Patient Monitoring System	1
5.6	Therapeutic Devices**:** Pacemakers	1
5.7	Defibrillators- Hearing Aids- Heart lung Machine ECMO- Ventilators- Diathermy- Dialysers- Lithotripsy	1
5.8	Nano Robots: Surgery- 3D Surgical Techniques and Orthopedic Prostheses Fixation	1

Course Designer(s)

1. Dr. Swathy J S - swathy@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E54	Biomaterials	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Recognize the fundamental principles of biomaterials science and the concept of biocompatibility.
- Identify and describe the physical, chemical, and biological properties of metals, polymers, ceramics, and composites.
- Explain the mechanical, tribological, and physical properties of biomaterials and their clinical significance.
- Describe the interactions between biomaterials and blood components, cells, and tissues, including relevant assays.
- Summarize the degradation processes and toxicological aspects of biomaterials in biological environments and their medical applications.

Pre-requisites

- Basics of Biology, Microbiology and Biochemistry

Course Outcomes

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

CO1	Sketch the key concepts of biomaterials science and explain the importance of biocompatibility in medical use.	Understand
CO2	Classify different biomaterials and describe their physical, chemical, and biological properties.	Understand
CO3	Enlighten mechanical and tribological properties like elasticity, toughness, and wear resistance of biomaterials.	Understand
CO4	Designate interactions between biomaterials and biological systems and explain relevant assay methods.	Apply
CO5	Deliberate degradation mechanisms, toxicity, and various medical applications like cardiovascular devices and drug delivery systems.	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E54 – Biomaterials								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Fundamentals of Biomaterials Science* Introduction to Biomaterials Science - Concept of Biocompatibility - Classes of Biomaterials Used in Medicine: Metals, Polymers, Ceramics, Composites - Basic Properties of Biomaterials: Physical, Chemical, Biological - Medical Requirements and Clinical Significance - Disinfection and Sterilization of Biomaterials.	[9]
Physico-chemical Properties of Biomaterials Mechanical Properties: Elasticity, Yield Stress, Ductility, Toughness, Strength, Fatigue, Hardness, Wear Resistance - Tribological Properties: Friction, Wear, Lubricity - Morphology and Texture - Physical Properties: Electrical, Optical, Magnetic, Thermal- Chemical and Biological Properties.	[9]
Biomaterial Interactions with Biological Elements* Elements in Contact with Biomaterials: Blood Composition, Plasma Proteins, Cells, Tissues - Assays to Determine Cell-Material Interactions: Cytotoxicity Assays, DNA and RNA Assays, Protein Production Assays, Immunostaining - Inflammation and Wound Healing - Foreign Body Response.	[9]
Degradation and Toxicity of Biomaterials* Degradation of Materials in Biological Environment: Polymers, Metals, Ceramics - Systemic Toxicity and Hypersensitivity - Blood Coagulation and Blood-Material Interactions - Tumorigenesis	[9]
Applications of Biomaterials** Cardiovascular Applications - Dental Implants - Adhesives and Sealants - Ophthalmologic Applications - Orthopedic Applications - Drug Delivery Systems - Sutures - Bioelectrodes - Biomedical Sensors and Biosensors	[9]
Total Hours:	**45**

Text Book(s):	
1.	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", 2nd Edition, Academic Press Inc., 2004.
2.	Johnna S. Temenoff and Antonios G. Mikos, "Biomaterials: The Intersection of Biology and Materials Science", 2nd Edition, Pearson College Div., 2022.
3.	Mauli Agrawal, C., Gopinath Mani, Joo L. Ong and Mark R. Appleford, "Introduction to Biomaterials: Basic Theory with Engineering Applications", 1st Edition, Cambridge University Press, 2013.
Reference(s):	
1.	Robert Lanza, Robert Langer and Joseph P. Vacanti, "Principles of Tissue Engineering", 4th Edition, Academic Press Inc., 2013.
2.	Deb, S., "Biomaterials for Oral and Craniomaxillofacial Applications", 1st Edition, Karger, 2015.
3.	Binghe Wang, Longqin Hu and Teruna J. Siahaan, "Drug Delivery: Principles and Applications", 2nd Edition, Wiley, 2016 .

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Fundamentals of Biomaterials Science**	
1.1	Introduction to Biomaterials Science	1
1.2	Concept of Biocompatibility	2
1.3	Classes of Biomaterials used in Medicine: Metals, Polymers, Ceramics	2
1.4	Composites - Basic Properties of Biomaterials: Physical, Chemical, Biological	2
1.5	Medical Requirements and Clinical Significance	1
1.6	Disinfection and Sterilization of Biomaterials	1
2.0	**Physico-chemical Properties of Biomaterials**	
2.1	Mechanical Properties: Elasticity, Yield Stress, Ductility	2
2.2	Toughness, Strength, Fatigue, Hardness, Wear Resistance	1

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2.3	Tribological Properties: Friction, Wear, Lubricity	1
2.4	Morphology and Texture	2
2.5	Physical Properties: Electrical, Optical, Magnetic, Thermal	2
2.6	Chemical and Biological Properties	1
3.0	**Biomaterial Interactions with Biological Elements**	
3.1	Elements in Contact with Biomaterials: Blood Composition, Plasma Proteins	2
3.2	Cells, Tissues - Assays to Determine Cell	3
3.3	Material Interactions: Cytotoxicity Assays, DNA and RNA Assays	2
3.4	Protein Production Assays, Immunostaining	1
3.5	Inflammation and Wound Healing - Foreign Body Response	1
4.0	**Degradation and Toxicity of Biomaterials**	
4.1	Degradation of Materials in Biological Environment: Polymers, Metals, Ceramics	3
4.2	Systemic Toxicity and Hypersensitivity	2
4.3	Blood Coagulation and Blood-Material Interactions	2
4.4	Tumorigenesis	2
5.0	**Applications of Biomaterials**	
5.1	Cardiovascular Applications	1
5.2	Dental Implants	1
5.3	Adhesives and Sealants	1
5.4	Ophthalmologic Applications	1
5.5	Orthopedic Applications	1
5.6	Drug Delivery Systems	1
5.7	Sutures	1
5.8	Bioelectrodes	1
5.9	Biomedical Sensors and Biosensors	1

Course Designer(s)

1. Dr.S.Poornima - spoornima@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E55	Systems Biology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To provide foundational knowledge in phylogenetic analysis, including methods and models.
- To teach methods and techniques for performing parsimony analysis and optimization alignment.
- To introduce traditional and advanced techniques for analyzing large phylogenetic data sets.
- To educate on partitioning and evaluating multiple datasets in phylogenetic analysis.
- To explore comparative phylogenomics, including genome databases and evolutionary analysis techniques.

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Demonstrate proficiency in phylogenetic analysis methods and tree construction.	Understand
CO2	Apply parsimony analysis techniques effectively in phylogenetic studies.	Understand
CO3	Explain large phylogenetic data sets using various traditional and advanced techniques.	Understand
CO4	Evaluate and partition multiple datasets in phylogenetic analysis.	Apply
CO5	Perform comparative phylogenomic analysis using complex genome databases and bioinformatics tools.	Analyse

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E55– Systems Biology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Phylogenetic Analysis and Parsimony Analysis * Phylogenetics Analysis - Introduction, Methods- the Matrix, Homology, Character Coding, Choosing Outgroups, Weighting, the Tree, Multiple Trees, Tree Statistics; Models of Causation-Parsimony Analysis -Introduction, the Legacy of Willi Hennig, Methods, Searching, Parsimony Analysis using Nona	[9]
Optimization Alignment Introduction, Going Down to Get the Tree Length, Going up to Get Ancestral States, Short Cuts and Errors, Improvements; Techniquesf Analyzing Large Data Sets - Traditional Techniques, Composite Optima, Ratchet,Sectorial Searches, Tree-Fusing, Tree-Drifting, Combined Methods, Minimum Length, TNT	[9]
Partitioning of Multiple Datasets in Phylogenetic Analysis Measures of Support -The Bootstrap, Jackknife, Noise, Direct Measures of Support-Partitioning of Multiple Datasets in Phylogenetic Analysis - Statistical Tests of Data Incongruence, Measures of Character Interaction Incombined Analysis, Congruence, Incongruence and Phylogenetic Inference	[9]
Comparative Phylogenomics Complex Model Organism Genome Databases - Database Foundations, Genome Databases, Homology and Genome Databases; Comparative Phylogenomics - Genomics and Systematics, Genomics Techniques – Cloning and Library Construction, Megabase DNA Isolation, Physical Mapping, Shortgun Sequencing; Subgenomics – Comparative Maps and Syntheny, Primer Batteries and Multiplexing.	[9]
Comparative Methods and Analysis Correlated Evolution and Independent Contrasts, Importance of Topology, Examining The Tempo and Mode of Evolutionary Change. Analyzing Data at the Population Level - Sequence and Allele Frequency Data.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Techniques in molecular systematics and evolution, Rob Desalle, Gonzalo Giribet, Ward Wheeler, Springer.
Reference(s):	
1.	Gusfield ,Dan. “Algorithms on strings Trees and Sequences”,1st ed., Cambridge University Press,2005.
2.	Baldi, P., Brunak,S Bioinformatics: The Learning Approach,2nd ed., MIT Press 2001.

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Phylogenetic Analysis and Parsimony Analysis**	
1.1	Phylogenetics Analysis	1
1.2	Introduction, Methods- the Matrix, Homology	2
1.3	Character Coding, Choosing Outgroups,	2
1.4	Weighting, the Tree, Multiple Trees, Tree Statistics	1
1.5	Models of Causation-Parsimony Analysis	1
1.6	Introduction, the Legacy of Willi Hennig, Methods	1
1.7	Searching, Parsimony Analysis using Nona	1
2.0	**Optimization Alignment**	
2.1	Introduction, Going Down to Get the Tree Length	2
2.2	Going up to Get Ancestral States, Short Cuts and Errors	1
2.3	Improvements; Techniquesf Analyzing Large Data Sets	1
2.4	Traditional Techniques	2

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2.5	Composite Optima, Ratchet,Sectorial Searches, Tree-Fusing, Tree-Drifting, Combined Methods, Minimum Length, TNT	3
3.0	**Partitioning of Multiple Datasets in Phylogenetic Analysis**	
3.1	Measures of Support -the Bootstrap	2
3.2	Jackknife, Noise, Direct Measures of Support	1
3.3	Partitioning of Multiple Datasets in Phylogenetic Analysis	2
3.4	Statistical Tests of Data Incongruence, Measures of Character Interaction Incombined Analysis, Congruence, Incongruence and Phylogenetic Inference	4
4.0	**Comparative Phylogenomics**	
4.1	Complex Model Organism Genome Databases - Database Foundations	1
4.2	Genome Databases, Homology and Genome Databases	2
4.3	Comparative Phylogenomics - Genomics and Systematics,.	2
4.4	Genomics Techniques – Cloning and Library Construction,	2
4.5	Megabase DNA Isolation, Physical Mapping, Shortgun Sequencing; Subgenomics —	1
4.6	Comparative Maps and Syntheny, Primer Batteries and Multiplexing	1
5.0	**Comparative Methods and Analysis**	
5.1	Correlated Evolution and Independent Contrasts	1
5.2	Importance of Topology	1
5.3	Examining the Tempo	2
5.4	Mode of Evolutionary Change	2
5.5	Analyzing Data at the Population Level	2
5.6	Sequence and Allele Frequency Data	1

Course Designer(s)

1. Dr.M.Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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60 BT E56	Biodiversity and its Conservation	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To develop the knowledgeof students in Biodiversity and its management
- To widen the knowledge about the sustainable utilization of natural resources
- To understand the regulatory authorities and their role about Biodiversity and its conservation
- To recognize the threats to the Biodiversity.
- To distinguish the roles and responsibilities of the regulatory authorities in Biodiversity and its conservation

Pre-requisites

- Environmental Science, Plant and Animal Biotechnology

Course Outcomes

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

CO1	Summarize the concepts and types of Biodiversity and its management.	Understand
CO2	Annotate the losses and methods of estimating biodiversity loss.	Apply
CO3	Analyze the significance of bioresourses and aesthetic use biodiversity.	Apply
CO4	Examine the various methods used conservation of biodiversity	Apply
CO5	Categorize the sustainable management and conservation of Biodiversity.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E56- Biodiversity and its Conservation								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Introduction to Biodiversity* Biodiversity – Definition, Types -Genetic, Species and Ecosystems Diversity; Goals and Constraints of Biodiversity Science. Genetic Diversity - Nature and Origin of Genetic Variation, Measuring Genetic Variation by Allozyme, Species Diversity – Measurement, Concepts of Species Richness, Abundance, and Turnover, Species/Area Relationships, Global Distribution of Species Richness; A General Account on Ecosystem Diversity.	[9]
Loss of Biodiversity and Human Influence on Biodiversity* Species Extinction- Fundamentals Cause, Deterministic and Stochastic Processes, Current and Future Extinction Rates; Methods of Estimating Loss of Biodiversity- Threatened Species - The Iucn Threat Categories (Extinct, Endangered, Vulnerable, Rare, Intermediate and Insufficiently Known).	[9]
Biodiversity and Human Welfare A Very General Account on use of Bioresources- Plant use: Food - Timber - Medicinal Ornamental and Other use- Animal use: Food Animals (Terrestrial and Aquatic), Nonfood use of Animals, Domestic Livestock- use of Microbes. Valuing Biodiversity- Consumptive use Values, Productive use Values, Social Values, Ethical And Moral Values - an Outline Account on Methods of Valuing Biodiversity.	[9]
Threats to Biodiversity and Its Conservation Habitat Loss - Poaching of Wild Life, Man-Wildlife Conflict, Endangered and Endemic Species of India - Biogeographical Classification of India, Value of Biodiversity- Conservation of Biodiversity-*in situ* - Need for an Integrated Protected Area System (Ipas), *ex situ*- Conservation of Cultivators and Livestock Breeds	[9]
Sustainable Management and Conservation of Biodiversity and Bioresources Sustainable Management - National Polices and Instruments Relating the Protection of the Wild/ Domesticated Flora and Fauna asWell as Habitats; International Policies and Instruments - A General Account On Multilateral Treaties- The Role of NBAI, CBD, IUCN, GEF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES.	[9]
Total Hours	**45**

Text Book(s):	
1.	David L., Hawksworth, "Biodiversity and conservation", Springer, 2018
2.	Krishnamurthy., K. V. "Textbook of Biodiversity" CRC Press. 2014.
Reference(s):	
1.	Antoine Guisan , "Habitat sustainability and Distribution Models", Cambridge University Press , 2017
2.	Primack, R., "Essentials of Conservation Biology". Sinauer Associates, Inc., USA2006.
3.	Friis, Robert H.,."Essentials of Environmental Health". Jones and Bartlett, Inc., Sudbury, MA 2014
4.	Theodore, L., & Dupont, R. R. "Environmental Health and Hazard Risk Assessment. " "Environmental Health andHazard Risk Assessment" (2017).

***SDG: 13 – Climate Action**

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Introduction to Biodiversity**	
1.1	Biodiversity – Definition, Types -Genetic, Species and Ecosystems Diversity	1
1.2	Goals and Constraints of Biodiversity Science	1
1.3	Genetic Diversity - Nature and Origin of Genetic Variation - Measuring Genetic Variation by Allozyme	2
1.4	Species Diversity – Measurement, Concepts of Species Richness, Abundance, and Turnover, Species / Area Relationships	2
1.5	Global Distribution of Species Richness	2
1.6	A General account on Ecosystem Diversity	1
2.0	**Loss of Biodiversity and Human Influence on Biodiversity**	
2.1	Species Extinction	1

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2.2	Fundamentals Cause, Deterministic and Stochastic Processes	2
2.3	Current and Future Extinction Rates	2
2.4	Methodsof Estimating Loss of Biodiversity	3
2.5	Threatened Species, the IUCN Threat Categories (Extinct, Endangered, Vulnerable, Rare, Intermediate and Insufficiently Known)	1
3.0	**Biodiversity and Human Welfare**	
3.1	A Very General Account on use of Bioresources	1
3.2	Plant use: Food, Timber, Medicinal Ornamental and Other use	2
3.3	Animal use: Food Animals (Terrestrial And Aquatic), Nonfood use of Animals	2
3.4	Domestic Livestock- use of Microbes	1
3.5	Valuing Biodiversity	1
3.6	Consumptive use Values, Productive use Values, Social Values, Ethical and Moral Values	1
3.7	An Outline Account on Methods of Valuing Biodiversity	1
4.0	**Threats to Biodiversity and its Conservation**	
4.1	Habitat Loss, Poaching of Wild Life	1
4.2	Man-Wildlife Conflict, Endangered and Endemic Species of India	2
4.3	Biogeographical Classification of India	1
4.4	Value of Biodiversity- Conservation of Biodiversity	1
4.5	*in situ* - Need for an Integrated Protected Area System (IPAS	2
4.6	*ex situ*- Conservation of Cultivators and Livestock Breeds	2
5.0	**Sustainable Management and Conservation of Biodiversity and Bioresources**	
5.1	Sustainable Management - National Polices and Instruments Relating the Protection of the Wild/ Domesticated Flora and Fauna asWell as Habitats	1
5.2	International Policies	2
5.3	Instruments - a General Account on Multilateral Treaties	2
5.4	The Role of NBAI, CBD, IUCN,	1
5.5	GEF, IBPGR, NBPGR, WWF	2
5.6	FAO, UNESCO and CITES	2

Course Designer(s)

1. Dr.S.Sidhra - sidhra@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT E57	Crop Production Technology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To introduce the students to principles of agricultural and horticultural crop production
- To understand the crop selection and establishment procedures
- To learn about the different management practices during crop establishment and growth
- To introduce the production practices of agricultural and horticultural crops
- To delineate the role of agricultural engineers in relation to various crop production practices

Pre-requisites

- Basic Biology

Course Outcomes

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

CO1	Extend the knowledge on basic principles of crop production.	Understand
CO2	Identify suitable crops and decide upon its establishment procedures.	Apply
CO3	Express the knowledge on the different crop management practices.	Apply
CO4	Discuss about the area of production of agricultural and horticultural crops.	Apply
CO5	Discriminate their role in relation to various crop production practices.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT E57- Crop Production Technology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	40	60	100

Principles of Crop Production and Crop Classification* Concepts in Crop Production; Geographical Distribution of Crops and Cropping Systems; Economic Importance - Cereals, Pulses, Oilseeds, Fiber Crops, Forage Crops, Medicinal , Aromatic Crops and Horticultural Crops.	[9]
Crop Selection and Establishment Regional and Seasonal Selection of Crops; Systems of Crop Production; Competition among Crop Plants; Spacing and Arrangement of Crop Plants; Field Preparation for Crops Including Systems of Tillage; Establishment of an Adequate Crop Stand and Ground Cover, Including Selection and Treatment of Seed and Nursery Growing.	[9]
Crop Management Crop Water Management; Crop Nutrition Management - Need for Supplementation to Soil Supplied Nutrients, Sources, Generalized Recommendations, Methods and Timing of Application of Supplemental Nutrients Including Fertigation Scheduling; Crop Protection Including Management of Weeds, Pests and Pathogens; Integrated Methods of Managing Water, Nutrients and Plant Protection; Types and Methods of Harvest.	[9]
Production Practices of Agricultural Crops Generalized Management and Cultivation Practices for Important Groups of Field Crops in Tamilnadu: Cereal Crops, Grain Legumes, Oil Seed Crops, Sugarcane, and Fiber Crops and Special Purpose Crops such as those Grown for Green Manure and Fodder	[9]
Production Practices of Horticultural Crops Important Groups of Horticultural Crops in Tamil Nadu Such as Vegetable Crops, Fruit Crops, Flower Crops; Cultivation Practices of Representatives of Each Group; Special Features of Production of Horticultural Crops - Green House Cultivation.	[9]
Total Hours	**45**

Text Book(s):	
1.	Gupta, M. Organic agriculture development in India. ABD publishers, Jaipur, India (2004).
2.	Kristensen, P., Taji, A. and Reganold, J., “Organic Agriculture: A Global Perspective”, CSIRO Press, Victoria,Australia, 2006.
Reference(s):	
1.	APEDA Guidelines for Production of Organic Rice in India, Agricultural and Processed Food ProductsExportDevelopment Authority, New Delhi (2001).
2.	Yadav, A.K. Organic Agriculture (Concept, Scenario, Principals and Practices), National Centre of Organic Farming Department of Agriculture and Cooperation, Ministry of Agriculture, Govt of India,CGO-II,Kamla Nehru Nagar Ghaziabad, 201 001, Uttar Pradesh (2015).
3.	Shiva, V., Pande, P. and J. Singh Principles of Organic Farming: Renewing the Earth's Harvest.Navdanya,New Delhi (2004).

*** SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Principles of Crop Production and Crop Classification**	
1.1	Concepts in Crop Production	1
1.2	Geographical Distribution of Crops and Cropping Systems	1
1.3	Economic Importance- Cereals, Pulses	2
1.4	Oilseeds, Fiber Crops	2
1.5	Forage Crops, Medicinal	2
1.6	Aromatic Crops and Horticultural Crops	1
2.0	**Crop Selection and Establishment**	
2.1	Regional and Seasonal Selection of Crops	1
2.2	Systems of Crop Production; Competition among Crop Plants	2
2.3	Field Preparation for Crops Including Systems of Tillage	2

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2.4	Establishment of an Adequate Crop Stand and Ground Cover	3
2.5	Including Selection and Treatment of Seed and Nursery Growing	1
3.0	**Crop Management**	
3.1	Crop Water Management; Crop Nutrition Management	1
3.2	Need for Supplementation to Soil Supplied Nutrients, Sources	2
3.3	Generalized Recommendations, Methods and Timing of Application of Supplemental Nutrients Including Fertigation Scheduling	2
3.4	Crop Protection Including Management of Weeds, Pests and Pathogens	1
3.5	Integrated Methods of Managing Water	1
3.6	Nutrients and Plant Protection	1
3.7	Types and Methods of Harvest	1
4.0	**Production Practices of Agricultural Crops**	
4.1	Generalized Management and Cultivation Practices for Important Groups of Field Crops in Tamilnadu	1
4.2	Cereal Crops, Grain Legumes	3
4.3	Oil Seed Crops, Sugarcane	3
4.4	Fiber Crops and Special Purpose Crops such as those Grown for Green Manure and Fodder	2
5.0	**Production Practices of Horticultural Crops**	
5.1	Important Groups of Horticultural Crops in Tamil Nadu Such as Vegetable Crops	1
5.2	Flower Crops	2
5.3	Cultivation Practices of Representatives of Each Group	2
5.4	Special Features of Production of Horticultural Crops	2
5.5	Green House Cultivation	2

Course Designer(s)

1. Dr.M.Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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OPEN ELECTIVE

60 BT L01	Agricultural Engineering	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To lean the basic concepts in the current practices of Agronomy.
- To discuss the importance of agricultural structures and irrigation methods.
- To understand the post-harvest procedures for the improvement of marketing strategy.
- To facilitate the knowledge for Post-harvest technology development
- To empower the students to became agro pruners.

Pre-requisites

- Physics, Chemistry, and Biology

Course Outcomes

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

CO1	Determine the principles of agronomy for managing the environmental impact of agriculture and tilth practices.	Understand
CO2	Comprehend the design and construction of farm shed, fences and structures for plant environment	Apply
CO3	Elaborate the design and construction of canals, pipeline systems to moderate depression created to channelwater.	Apply
CO4	Clarify the concept of designing, operation and testing of various machines used in post harvesting and storagepractices..	Apply
CO5	Design the industrial oriented agro products production plant and project report preparation	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	20	20	30
Apply	20	20	36
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT L01 - Agricultural Engineering

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

Principles of Agronomy* Definition of Agriculture and Agronomy- Branches and Scope of Agriculture - Factors Affecting Crop Growth -Soil Fertility and Productivity Tillage and Tilth - Different Kinds of Tillage: Earth Moving Equipment - Their Construction and Working Principles Viz Bulldozer, Trencher,Excavators Etc.	[9]
Agricultural Structures Site Selection, Design and Construction of Farmstead - Farm House, Cattle Shed, Poultry Shed, Hog Housing, Machinery and Implement Shed - Design and Construction of Fences and Farm Roads - Structures for Plant Environment - Green House, Poly House and Shade House, Storage Structures of Food Grains and Feeds.	[9]
Irrigation and Drainage Sources of Water for Irrigation - Methods of Irrigation - Surface, Sprinkler and Drip, Fertigation - Irrigation Efficiencies and Their Estimation Design and Construction of Canals, Field Channels, Underground Pipelines System, Agriculture Drainage, Darcy's Law, Design of Surface andSubsurface Drainage, Recycling of Drainage Water for Irrigation.	[9]
Post Harvest and Storage Engineering Harvest - Post Harvest Threshing Machines - Design, Principles, Operations, Maintenance and Testing -Winnovers, Cleaners and Graders &Separators, Design Principles, Operation, Maintenance and Testing - Dehuller, Dehusker and Packing Unit - Storage Bins, Long Term Storage Container and Cold Storage Design.	[9]
Plant Installation and Report Preparation Industrial Layout Planning and Installation - Power and Power Transmission - Sanitation, Cost Analysis-Detailed Project Report Preparation-Design and Requirement of Industrial Production Plant - Case Studies for Design of Modern Rice Plant and Layout - Bank Statement and Audited Returns.	[9]
Total Hours:	**45**

Text Book(s):

1. Sharma R.K.and Co., "Basics of Agriculture", Daya Publishers, New Delhi, 2014.
2. Jagdishwar Sahay., "Elements of Agricultural Engineering", Standard Publishers Distributors, Delhi, 2006.

Reference(s):

1. George Acquaah., "Horticulture-Principles and Practices" Prentice-Half of India Pvt. Ltd., New Delhi, 2002.
2. Michael, A.M., "Irrigation -Theory and Practice" Vikas Publishing House, New Delhi, 1990.
3. Michael and Ojha., "Principles Of Agricultural Engineering" Jain Brothers, New Delhi, 2005.
4. Harry L. Field, John M. Long., " Introduction to Agricultural Engineering Technology: A Problem Solving Approach", 4th Edition, Springer International Publishing AG, Switzerland, 2018

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Principles of agronomy**	
1.1	Definition of Agriculture and Agronomy	1
1.2	Branches And Scope of Agriculture	1
1.3	Factors Affecting Crop Growth	1
1.4	Soil Fertility and Productivity tillage and Tilth	1
1.5	Different Kinds of Tillage	1
1.6	Earth Moving Equipment	2
1.7	Their Construction and Working Principles Viz Bulldozer	1
1.8	Storage Structures of Food Grains and Feeds	1

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2.0	**Agricultural Structures**	
2.1	Site Selection Design and Construction of Farmstead	2
2.2	Farm House Cattle Shed, Poultry Shed, Hog Housing	2
2.3	Machinery and Implement Shed	1
2.4	Design and Construction of Fences and Farm Roads	1
2.5	Structures For Plant Environment	1
2.6	Green House, Poly House and Shade House - Storage Structures of Food Grains and Feeds.	2
3.0	**Irrigation and Drainage**	
3.1	Sources of Water for Irrigation	1
3.2	Methods of Irrigation	1
3.3	Surface, Sprinkler and Drip, Fertigation	1
3.4	Irrigation Efficiencies and Their Estimation design and Construction of Canals, Field Channels	2
3.5	Underground Pipelines System	1
3.6	Agriculture Drainage	1
3.7	Darcy's Law, Design of Surface andSubsurface Drainage	1
3.8	Recycling of Drainage Water For Irrigation	1
4.0	**Post Harvest and Storage Engineering**	
4.1	Harvest - Post Harvest Threshing Machines	1
4.2	Design, Principles, Operations, Maintenance and Testing	1
4.3	Winnovers, Cleaners and Graders &Separators	1
4.4	Design Principles, Operation, Maintenance and Testing	1
4.5	Dehuller Dehusker and Packing Unit	2
4.6	Storage Bins	1
4.7	Long Term Storage Container and Cold Storage Design.	2
5.0	**Plant Installation and Report Preparation**	
5.1	Industrial Layout Planning and Installation	1
5.2	Power And Power Transmission	1
5.3	Sanitation, Cost Analysis	1
5.4	Detailed Project Report Preparation	2
5.5	Design and Requirement of Industrial Production Plant	1
5.6	Case Studies For Design of Modern Rice Plant and Layout	2
5.7	Bank Statement and Audited Returns.	1

Course Designer(s)

1. Dr.M. Nithya - nithyam@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

61 BT L02	Animal Studies in Research	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To understand the functional food concept as related to ingredient efficacy and its nutraceutical properties.
- To widen the knowledge on role of food in disease management.
- To provide basic concepts on clinical trials.
- To Familiarize the principles of pharmacological research.
- To extent scientific knowledge on the regulations for animal research

Pre-requisites

- Biology

Course Outcomes

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

CO1	Designate the components of functional foods and nutraceuticals	Understand
CO2	Assess the functions of food in preventing and managing diseases.	Understand
CO3	Interpret the understandings on toxicology and different animals used in preclinical testing	Apply
CO4	Analyze the pharmacological parameters and management of laboratory animals.	Apply
CO5	Provide understanding on regulations for the usage of animals in research	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	20	46
Apply	-	20	20
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
61 BT L02 - Animal Studies in Research								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV/ V/ VI	3	0	0	45	3	40	60	100

Functional Food and Nutraceutical Introduction - Classification and Executive Models for Nutraceuticals - Plant Sources- Plant Secondary Metabolites- Alkaloids, Phenols, Terpenoids. Animal Source- Milk and Products, Meat, Fish. Microbial Source- Prebiotics and Probiotics - Examples of Bacteria Used as Probiotics - Synbiotics for Maintaining Good Health. Algal Source- Omega - 3 PUFA.	[9]
Food in Management of Health and Diseases* Food as a Source of Drug- Nutraceuticals - Role of Nutraceuticals in Diabetes Mellitus, Circulatory Problems - Obesity and Stress - Nephrological Disorders, Liver Disorders, Cancer, Osteoporosis, Arthritis, Psoriasis and Ulcers - Examples of Nutraceuticals as Antioxidants in Preventing Diseases.	[9]
Preclinical Testing and Clinical Trials: Basic Toxicology - Acute Toxicity Studies- Multiple Exposure Studies, - Basic Pharmacology & Pharmaceutical Chemistry, Use of Animal Model and Pre-Clinical and Clinical Trials- New Drugs- Investigation (IND) Application, NDA Requirements. Toxicology — Oral Toxicity, Sub-Acute - Acute Toxicity and Chronic Toxicity. Toxic Dose, LD50, Dose-Response Relationships	[9]
Pharmacological Research* Introduction, Laboratory Animals- Physiological Parameters and Response - Handling and Care of Different Animals -Routes of Administration Oral- Intraperitonial, Intramuscular and Intravenous; Advantages and Disadvantages of Animal Experimentation, Anaesthesia and Chemica Euthanasia Used in Laboratory.	[9]
Regulations for Animal Research Animal Ethics - Regulations for Conducting Animal Experimentation -3 R's Concept, Alternatives to Animal Experimentations -Regulatory Agencies, Pharmacovigilance, GCP - Guidelines and GLP Guidelines, Research Ethics and Publication Ethics.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Shayne C. Gad., Shayne C. Gad., "Animal Models in Toxicology", 3rd Edition, CRC Press. Taylor & Francis Group,2016
2.	Robert , H., Weichbrod, Gail A., (Heidbrink) Thompson., John N. Norton," Management of Animal Care and Useprograms Inresearch, Education, and Testing" 2nd Ed, CRC Press. Taylor & Francis Group, 2017.
Reference(s):	
1.	Israel Goldberg (Ed.) Functional Foods, Designer Foods, Pharma Foods, Nutraceuticals, Aspen Publishers Inc., USA,1999
2.	Gupta., S.K., "Drug Discovery and Clinical Research,"Jaypee Brothers Medical Publishers,2011
3.	Raj K. Keservani., Anil K. Sharma., Rajesh K. Kesharwani,"Nutraceuticals and Dietary Supplements Applications in Health Improvement and Disease Management", CRC Press. Taylor & Francis Group,2021.
4.	Young, J., (1996) Functional Foods: Strategies for Successful Product Development. FT Management Report PearsonProfessional Publishers, London.

***SDG 3 – Good Health and Well Being**

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Functional Food and Nutraceutical**	
1.1	Introduction	1
1.2	Classification and Executive Models for Nutraceuticals	1
1.3	Plant Sources- Plant Secondary Metabolites	1
1.4	Alkaloids, Phenols, Terpenoids. Animal Source	1

Passed in BoS Meeting held on 21/05/2024
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1.5	Milk and Products, Meat, Fish. Microbial Source	1

1.6	Prebiotics and Probiotics - Examples of Bacteria Used as Probiotics	2
1.7	Synbiotics for Maintaining Good Health. Algal Source	1
1.8	Omega - 3 PUFA..	1
2.0	**Food in Management of Health and Diseases**	
2.1	Food as a Source of Drug- Nutraceuticals	2
2.2	Role of Nutraceuticals in Diabetes Mellitus, Circulatory Problems	2
2.3	Obesity and Stress	1
2.4	Nephrological Disorders	1
2.5	Liver Disorders, Cancer, Osteoporosis, Arthritis, Psoriasis and Ulcers	1
2.6	Examples of Nutraceuticals as Antioxidants in Preventing Diseases.	2
3.0	**Preclinical Testing and Clinical Trials**	
3.1	Basic Toxicology	1
3.2	Acute Toxicity Studies	1
3.3	Multiple Exposure Studies	1
3.4	Basic Pharmacology & Pharmaceutical Chemistry	2
3.5	Use of Animal Model and Pre-Clinical and Clinical Trials	1
3.6	New Drugs- Investigation (IND) Application, NDA Requirements	1
3.7	Investigation (IND) Application, NDA Requirements. Toxicology — Oral Toxicity, Sub-Acute	1
3.8	Toxic Dose, LD50, Dose-Response Relationships	1
4.0	**Pharmacological Research**	
4.1	Introduction, Laboratory Animals	1
4.2	Physiological Parameters and Response	1
4.3	Handling and Care of Different Animals	2
4.4	Routes of Administration Oral	1
4.5	Intraperitonial, Intramuscular and Intravenous; Advantages and Disadvantages of Animal Experimentation	2
4.6	Anaesthesia and Chemica Euthanasia Used in Laboratory.	2
5.0	**Regulations for Animal Research**	
5.1	Animal Ethics	1
5.2	Regulations for Conducting Animal Experimentation	2
5.3	3 R's Concept, Alternatives to Animal Experimentations	2
5.4	Regulatory Agencies Pharmacovigilance, GCP	2
5.5	Guidelines and GLP Guidelines	1
5.6	Research Ethics and Publication Ethics.	1

Course Designer(s)

1. Dr.K.Syed Zameer Ahmed – syedzameer@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT L03	Production Technology of Agricultural and Food Processing Machinery	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To improve the level of understanding of agriculture and food processing machinery
- To help the agriculture farmers for selecting the appropriate machinery based on crops
- To know the various bakery products and its importance in machinery planning
- To enhance the knowledge of modern machinery in fruits and vegetable set up
- To apply the modern packing solution for various industry needs

Pre-requisites

- Biology

Course Outcomes

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

CO1	Employ the different production tools involved in the agriculture and food processing machinery	Understand
CO2	Analyse the different machinery involved in post harvest processing set up	Understand
CO3	Interpret the strategy of planning of different machinery for bakery products	Apply
CO4	Enhance the knowledge of machinery involved in fruits and vegetable processing	Apply
CO5	Recall the modern technology involved in food packing machinery	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	20	20	34
Understand	40	20	46
Apply	-	20	20
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT L03 - Production Technology of Agricultural and Food Processing Machinery								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV/ V/ VI	3	0	0	45	3	40	60	100

Production Technology of Farming Machinery* Welding and its Types - CNC Machine, Lathe Machine - Drilling Equipment - Laser Cutting Machinery and its Types - Simulation Software, Earth Moving Equipment — Their Construction & Working Principles Viz Buldozer -Trencher, Excavators Etc.,- Sowing, Planting and Transplanting Equipment.	[9]
Post Harvesting Machinery Agriculture Crop Processing Machinery – Winnowers, Graders, Aspirators - Destoner, Dehuller - Sheller, Separators, Elevators - Colour Sortex Machine, Rice Polisher Machine.	[9]
Food Bakery Machinery Bakery Machinery and Equipment - Mixing- Blenders - Horizontal and Vertical Planetary, Make up Equipment, Divider, Rounder Proofer,Moulder - Baking Equipment – Different Types of Oven-Slicer Cookies Making Machinery - Cakes, Buns and Bread.	[9]
Modern Fruits and Vegetable Processing Machinery* Fruits Sorter - Construction of Solar Based Cold Storage and Refrigerated Vans - Freezer Design and usage; Plate Contact Freezer - Air Blast Freezer, - Cryogenic Freezer, Irradiation Technology and Machinery- Design of Various Dryer; PHTC, RPEX, LSU and Drum Dryer. Solar Dryer.	[9]
Product Packaging Machinery Benefit of Vacuum - Gas and Shrink Packaging. Band Sealing Machine - Single Head and Multi Head Granules Packaging Machine, - Wrapping Machine, Thermal Sealing Machine - Liquid Filling and Pouch Packing Machinery - Powder Packing Machine and its Variants	[9]
Total Hours:	**45**

Text Book(s):	
1.	Zeki Berk., "Food Process Engineering and Technology", Academic Press, 2018
2.	Bosoi, E. S., "Theory, construction and calculation of Agriculture machines" (Vol 1 and 2), Oconion Press pvt.Ltd., NewDelhi, 1990
Reference(s):	
1.	Mukhopadhyay S.N., "Food Engineering: Process And Technology", CRC Press, 2017
2.	Tadeusz Kudra, Arun S. Mujumdar., "Advanced Drying Technologies", 2nd Edition, CRC Press, 2009
3.	Jagdishwar Sahay., "Elements of Agricultural Engineering", Standard Publishers Distributors, Delhi, 2006.
4.	Harry L. Field, John M. Long., " Introduction to Agricultural Engineering Technology: A Problem Solving Approach",4th Edition,Springer International Publishing AG, Switzerland, 2018

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Production Technology of Farming Machinery**	
1.1	Welding and its Types	1
1.2	CNC Machine, Lathe Machine	1
1.3	Drilling Equipment	1
1.4	Laser Cutting Machinery and its Types	1
1.5	Simulation Software	1
1.6	EarthMoving Equipment – Their Construction & Working Principles Viz Buldozer	2
1.7	Trencher, Excavators Etc., Sowing	1
1.8	Sowing, Planting and Transplanting Equipment.	1
2.0	**Post Harvesting Machinery**	

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2.1	Agriculture Crop Processing Machinery	2
2.2	Winnowers, Graders	2
2.3	Graders, Aspirators	1
2.4	Destoner, Dehuller	1
2.5	Sheller, Separators, Elevators	1
2.6	Colour Sortex Machine, Rice Polisher Machine	2
3.0	**Food Bakery Machinery**	
3.1	Bakery Machinery and Equipment	1
3.2	Mixing- Blenders	1
3.3	Horizontal and Vertical Planetary	1
3.4	Make up Equipment, Divider, Rounder, Proofer,Moulder	2
3.5	Baking Equipment – Different Types of Oven	1
3.6	Slicer. Cookies Making Machinery	2
3.7	Cakes, Buns and Bread	1
4.0	**Modern Fruits and Vegetable Processing Machinery**	
4.1	Fruits Sorter	1
4.2	Construction of Solar Based Cold Storage and Refrigerated Vans	2
4.3	Freezer Design and usage ; Plate Contact Freezer	1
4.4	Air BlastFreezer, Cryogenic Freezer	1
4.5	Cryogenic Freezer, Irradiation Technology and Machinery,	2
4.6	Design of Various Dryer; PHTC, RPEX,LSU and Drum Dryer. Solar Dryer.	2
5.0	**Product Packaging Machinery**	
5.1	Benefit of Vacuum	1
5.2	Gas and Shrink Packaging. Band Sealing Machine	2
5.3	Single Head and Multi Head Granules Packaging Machine	2
5.4	Wrapping Machine, Thermal Sealing Machine	2
5.5	Liquid Filling and Pouch Packing Machinery	1
5.6	Powder Packing Machine and its Variants	1

Course Designer(s)

1. Ms.R.Krishnaveni– rkrishnaveni@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT L04	Pollution and Its Management	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To learn the fundamental concepts in the field of pollution.
- To study the depth of different pollution and its control.
- To impart knowledge on hazardous waste management.
- To develop methods for removal of pollutants.
- To understand all the regulations and act proposed by the law.

Pre-requisites

- Biology

Course Outcomes

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

CO1	Outline the basics about causes of pollution and its impact on environment	Understand
CO2	Distinguish the different types of pollution, their sources and its reme measures	Apply
CO3	Inspect the hazardous waste management and its disposal methods	Apply
CO4	Examine the various methods used for the removal of pollutants and recovery methods	Apply
CO5	Survey the role of regulatory bodies in protecting the natural resources and prevention of pollution	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.Tech - Biotechnology

60 BT L04 - Pollution and Its Management

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

Introduction to Pollution Concept of Pollution, Causes of Environmental Pollution, Environmental Problems Due to Pollution, Concept of Development, Major Conflicts of Development and Environment, Mining and Environment.	[9]
Air, Water, Soil Pollution and its Control **Air Pollution:** Definition, Sources (Natural and Anthropogenic), Major Air Pollutants, Classification of Air Pollutants, Their Sources and Impacts, Global Problems Associated with Air Pollution - Green House Effect, Global Warming and Climatic Changes, Acid Rain, Photochemical Smog, Ozone Layer Depletion. Methods of Air Pollution Control, Air Quality Standards and Index. **Water Pollution:** Concept, Classification, Major Sources and Impacts, Oil Pollution, Thermal Pollution, Oceanic Pollution. Classification of Water Quality Parameters (Organic, Inorganic, Nutrient & Heavy Metals), Approaches to Prevent & Control of Water Pollution, Rain Water Harvesting Methods for Water Conservation. **Soil Pollution:** Soil Pollution, Causes of Soil Pollution, Soil Salinity, Sources of Soil Pollutants, Major Impacts and Remedial Measures, Bioremediation and Restoration of Contaminated Soil	[9]
Hazardous Waste and Biomedical Waste Management Hazardous Waste, Characterization and Site Assessment Waste Minimization and Resource Recovery, Collection, Storage, Transportation; Hazards of Improper Treatment and Disposal Method; Accidental Exposure of Dangerous Waste and Emergency Measures. Biomedical Waste Classification and its Management Methods	[9]
Removal of Pollutants Methods for Removal of Pollutants from Gaseous Effluents; Particulate Matter, Waste Water Treatment Activated Sludge Process. Removal of Nitrogenous Pollution, Removal of Nitrogen; Physico-Chemical Processes; Biological Method of Pollution Control. Analytical Methods of Small Amount of the Metal Pollutants; Removal and Recovery Techniques of Heavy Metals**.**	[9]
Regulatory Aspects and legislation Industrial Emissions Liquids and Gasses; Pollution Caused by Various Chemical Industries and its Overall Effect on Quality of Human Life and the Environment, Water Quality Management in In dia. MINAS for Sugar Industries, Distilleries, Pesticides Industry and Mercury from Caustic Soda Industry, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act.	[9]
Total Hours:	**45**

Text Book(s):

1. Gupta M., (2004). Organic agriculture development in India. ABD publishers, Jaipur, India.
2. Kristensen P., Taji, A. and Reganold, J., "Organic Agriculture: A Global Perspective", CSIRO Press, Victoria, Australia, 2006.

Reference(s):

1. Metcalf and Eddy., "Wastewater engineering, Treatment and Reuse", Tata Mc Graw Hill Publications, 2008.
2. Rao C. S. 2007. "Environmental Pollution Control Engineering" New Age International, New Delhi
3. Martina Zelenakova., "Water Management and the Environment: Case Studies", Springer International Publishing, Switzerland, 2018.
4. Rajagopalan R., 2015. "Environmental studies: from crisis to cure" (No. Ed. 3). Oxford University Press

*** SDG 15: Life on Land**

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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Course Content and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Introduction to Pollution**	
1.1	Concept of Pollution, Causes of Environmental Pollution	2
1.2	Environmental Problems Due to Pollution, Concept of Development	3
1.3	Major Conflicts of Development and Environment	2
1.4	Mining and Environment	2
2.0	**Air, Water, Soil Pollution and its Control**	
2.1	**Air Pollution:** Definition, Sources (Natural and Anthropogenic), Major Air Pollutants, Classification of Air Pollutants, Their Sources and Impacts, Global Problems Associated with Air Pollution - Green House Effect, Global Warming and Climatic Changes, Acid Rain, Photochemical Smog, Ozone Layer Depletion. Methods of Air Pollution Control, Air Quality Standards and Index.	4
2.2	**Water Pollution:** Concept, Classification, Major Sources and Impacts, Oil Pollution, Thermal Pollution, Oceanic Pollution. Classification of Water Quality Parameters (Organic, Inorganic, Nutrient & Heavy Metals), Approaches to Prevent & Control of Water Pollution, Rain Water Harvesting Methods for Water Conservation.	3
2.3	**Soil Pollution:** Soil Pollution, Causes of Soil Pollution, Soil Salinity, Sources of Soil Pollutants, Major Impacts and Remedial Measures, Bioremediation and Restoration of Contaminated Soil	2
3.0	**Hazardous waste and Biomedical waste management**	
3.1	Hazardous Waste, Characterization and Site Assessment Waste Minimization and Resource Recovery	2
3.2	Collection, Storage, Transportation	1
3.3	Chemical Physical and Biological Treatment	2
3.4	Hazards of Improper Treatment and Disposal Method; Accidental Exposure of Dangerous Waste and Emergency Measures.	2
3.5	Biomedical Waste Classification and its Management Methods	2
4.0	**Removal of Pollutants**	
4.1	Methods for Removal of Pollutants from Gaseous Effluents; Particulate Matter,	2
4.2	Waste Water Treatment Activated Sludge Process.	1
4.3	Removal of Nitrogenous Pollution, Removal of Nitrogen;	1
4.4	Physico-Chemical Processes; Biological Method of Pollution Control.	2
4.5	Analytical Methods of Small Amount of the Metal Pollutants;	2
4.6	Removal and Recovery Techniques of Heavy Metals**.**	1
5.0	**Regulatory Aspects and legislation**	
5.1	Industrial Emissions Liquids and Gasses; Pollution Caused by Various Chemical Industries and its overall Effect on Quality of Human Life and the Environment	3
5.2	Water Quality Management in India	2
5.3	MINAS for Sugar Industries, Distilleries, Pesticides Industry and Mercury from Caustic Soda Industry	2
5.4	Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act	2

Course Designer(s)

1. Dr.K.Syed Zameer Ahmed - syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT L05	Organic Farming for Sustainable Agriculture	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To impart the principles and importance of organic farming for sustainable agriculture
- To learn about the soil fertility and manures
- To learn the production technology of organic compost and to practice the its design criteria.
- To provide the better understanding about organic standard certificates
- To discuss about the future perspectives of organic farming

Pre-requisites

- Biology

Course Outcomes

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

CO1	Comprehend the principles, various types of farming and the challenges for organic agriculture.	Understand
CO2	Comprehend the various components of soil fertility and the technique manage the soil fertility	Understand
CO3	Exemplify the production of organic compost and the method of its spreading.	Apply
CO4	Recognize the history and development of organic standards and certification	Apply
CO5	Analyse the future perspective of organic farming for sustainable agriculture	Analyze

Mapping with Programme Outcomes

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

Assessment Pattern

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

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT L05 - Organic Farming for Sustainable Agriculture								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV/ V/ VI	3	0	0	45	3	40	60	100

Overview of Organic Farming Origin and Principles for Organic Farming - Indian Agriculture Before the Green Revolution - Green Revolution - Impact of Green Revolution on the Environment - Types of Farming: Pure Organic, Integrated and Mixed Farming System - Needs and Challenges for Organic Agriculture- Key Indicators of Sustainable Agriculture.	[9]
Soil Fertility and Production of Organic Compost* Components of Soil Fertility - Physical, Chemical and Biological - Managing Soil Fertility in Organic Farming Systems - Organic Manures: Farmyard, Compost Sheep and Goat, Poultry, Oil-Cakes, Sewage, Sludge and Sullage Manure. Composting - Importance of Composting - Method of Spreading Compost - Microbes Involved in Composting - Design Criteria - Rate and Time of Application - Kinetics of Composting - Type and Amount of Compost - Practical Method of Making Compost.	[9]
Sustainable Agriculture SWOT Analysis of Organic Farming- Sustainable Agriculture- Key Indicators of Sustainable Agriculture- Organic Farming and Climate Change	[9]
Organic Standards and Certification History and Development of Organic Standards and Certification - Organic Standards Setting Processes - Conformity Assessment Processes (International Verification Processes) - Key Challenges for the Future of Organic Regulation.	[9]
Perspectives of Organic Farming** Economic Management in Organic Agriculture - Understanding the Market for Organic Food-Supply Chain Management — Social Responsibility in Organic Agriculture: Learning, Collaboration and Regulation - Organic Fertilizer:Supplementary Nutrient Source for Rice, Sugarcane, Sorghum and Banana - Marketing of Organic Products- Pest Management	[9]
Total Hours:	**45**

Text Book(s):	
1.	Gupta, M., (2004). Organic agriculture development in India. ABD publishers, Jaipur, India.
2.	Kristensen, P., Taji, A. and Reganold, J., "Organic Agriculture: A Global Perspective", CSIRO Press, Victoria, Australia, 2006.
Reference(s):	
1.	APEDA (2001). Guidelines for Production of Organic Rice in India, Agricultural and Processed Food Products Export Development Authority, New Delhi.
2.	Yadav, A.K. (2015). Organic Agriculture (Concept, Scenario, Principals and Practices), National Centre of Organic Farming Department of Agriculture and Cooperation, Ministry of Agriculture, Govt of India, CGO-II, Kamla Nehru Nagar Ghaziabad, 201 001, Uttar Pradesh.
3.	Shiva, V., Pande, P. and J. Singh (2004). Principles of Organic Farming: Renewing the Earth's Harvest. Navdanya, New Delhi.

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

****SDG 3 – Good Health and Well Being**

Course Content and Lecture Schedule

S.No	Topic	No. of Hours
1	**Overview of Organic Farming**	
1.1	Origin and Principles of Organic Farming - Indian Agriculture before the Green Revolution	2
1.2	The Green Revolution - Impact of Green Revolution on the Environment	2
1.3	Types of Farming: Pure Organic, Integrated and Mixed Farming System	2
1.4	Needs and Challenges for Organic Agriculture	1
1.5	Key Indicators of Sustainable Agriculture.	1
2	**Soil Fertility and Production of Organic Compost**	

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

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2.1	Components of Soil Fertility - Physical, Chemical and Biological	1
2.2	Managing Soil Fertility in Organic Farming Systems	1
2.3	Organic Manures: Farmyard, Compost Sheep And Goat, Poultry, Oil-Cakes, Sewage, Sludge and Sullage Manure.	2
2.4	Composting - Importance of Composting - Method of Spreading Compost	1
2.5	Microbes Involved in Composting - Design Criteria - Rate and Time of Application	2
2.6	Kinetics Of Composting - Type and Amount of Compost	1
2.7	Practical Method of Making Compost.	2
3	**Sustainable Agriculture**	
3.1	SWOT Analysis of Organic Farming	2
3.2	Sustainable Agriculture	2
3.3	Key Indicators of Sustainable Agriculture	2
3.4	Organic Farming and Climate Change	3
4	**Organic Standards and Certification**	
4.1	History and Development of Organic Standards and Certification	2
4.2	Organic Standards Setting Processes	2
4.3	Conformity Assessment Processes (International Verification Processes)	2
4.4	Key Challenges for The Future of Organic Regulation	2
5	**Perspectives of Organic Farming**	
5.1	Economic Management in Organic Agriculture	1
5.2	Understanding the Market for Organic Food-Supply Chain Management	2
5.3	Social Responsibility in Organic Agriculture: Learning, Collaboration and Regulation	2
5.4	Organic Fertilizer	1
5.5	Supplementary Nutrient Source for Rice, Sugarcane, Sorghum and Banana	2
5.6	Marketing of Organic Products	2
5.7	Pest Management	2

Course Designer(s)

1. Dr.Swathy J S - swathy@ksrct.ac.in

Passed in BoS Meeting held on 21/05/2024
Approved in Academic Council Meeting held on 25/05/2024

BOS- Chairman

60 BT L06	Basics of Bioinformatics	Category	L	T	P	Credit
		OE	3	0	0	3

Objectives

- To develop inter disciplinary skills in the application of computers in biotechnology and learn aboutthebiological data
- To learn about the bioinformatics databases, databanks, data format of Biological databases
- To understand the concept of data processing and data retrieval from the online sources
- To analyze the optimal alignment using methods of sequence analysis
- To acquire the applications and scope of in-silico biology

Pre-requisites

- Biology/ Computer Science

Course Outcomes

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

CO1	Get acquainted with biological data acquisition methods and file formats	Understand
CO2	Recite various biological primary databases, secondary databases and different sequence file formats	Understand
CO3	Characterize the optimal alignment of sequences either by local or global algorithm	Apply
CO4	Designate the methods involved in pairwise and Multiple sequence alignment and analysis the conserved regions	Apply
CO5	Recognize the major applications of Bioinformatics and scope	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
B.Tech - Biotechnology								
60 BT L06 - Basics of Bioinformatics								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
IV/ V/ VI	3	0	0	45	3	40	60	100

Biological Data Acquisition* The Form of Biological Information- Retrieval Methods for DNA Sequence - Protein Sequence and Protein Structure Information- Scope of Bioinformatics- Data File Formats- Data Life Cycle and Database - Management System Models.	[9]
Databases* Biological Database and its Types Introduction - To Data Types and Source - General Introduction of Biological Databases - Nucleic Acid Databases (NCBI, DDBJ, and EMBL) - Protein Databases (Primary, Composite, and Secondary)- Specialized Genome Databases: (SGD,TIGR, and ACEDB). - Structure Databases (CATH, SCOP, and PDB	[9]
Data Processing Data – Access, Retrieval and Submission -Standard Search Engines - Data Retrieval Tools — ENTREZ, DBGET and SRS - Submission of (New and Revised) Data - Sequence Similarity Searches - Local Versus Global -Distance Metrics - Similarity and Homology - Scoring Matrices.	[9]
Methods of Analysis Dynamic Programming Algorithms - Needleman-Wunsch and Smith-Waterman- Heuristic Methods of Sequence Alignment - FASTA, and PSI BLAST - Multiple Sequence Alignment and Software tools for - Pairwise and Multiple Sequence Alignment	[9]
Applications Genome Annotation and Gene Prediction- ORF Finding; Phylogenetic Analysis- Comparative Genomics - Orthologs - Paralogs Genome Analysis – Genome Annotation.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Arthur K. Lesk., "Introduction to Bioinformatics" Oxford University Press. ,4thEdition 2014
2.	Durbin R., Eddy S.,Krogh A., Mitchison G.,"Biological Sequence Analysis Probabilistic Models of proteins andnucleic acids"Cambridge University Press. 2013
Reference(s):	
1.	David W. Mount., "Bioinformatics Sequence and Genome Analysis", 2nd Edition, Cold Spring Harbor LaboratoryPress, New York, US, 2004.
2.	Rastogi, S.C., "Bioinformatics — Concepts, skills and applications", CBS Publishers and Distributors, New Delhi, India, 2003.
3.	EijaKorpelainen, JarnoTuimala, PanuSomervuo, Mikael Huss and Garry Wong.,"RNA-Seq Data Analysis: A Practical Approach",CRC Press, 2014
4.	Xinkun Wang,"Next Generation Sequencing Data Analysis" CRC Press, 2016

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

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Biological Data Acquisition**	
1.1	The Form of Biological Information	1
1.2	Retrieval Methods for DNA Sequence	1
1.3	Protein Sequence and Protein Structure Information	2
1.4	Scope of Bioinformatics	1
1.5	Data File Formats	1
1.6	Data Life Cycle and Database	2
1.7	Management System Models	1
2.0	**Databases**	
2.1	Biological Database and its Types Introduction	2

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2.2	To Data Types and Source - General Introduction of Biological Databases	2
2.3	Nucleic Acid Databases (NCBI, DDBJ, and EMBL)	1
2.4	Protein Databases (Primary, Composite, and Secondary)	2
2.5	Specialized Genome Databases: (SGD,TIGR, and ACEDB)	1
2.6	Structure Databases (CATH, SCOP, and PDB SUM).	1
3.0	**Data Processing**	
3.1	Data – Access, Retrieval and Submission	1
3.2	Standard Search Engines	1
3.3	Data Retrieval Tools	1
3.4	ENTREZ, DBGET and SRS - Submission of (New and Revised) Data	2
3.5	Sequence Similarity Searches	1
3.6	Local Versus Global -Distance Metrics- Similarity and Homology	2
3.7	Scoring Matrices.	1
4.0	**Methods of Analysis**	
4.1	Dynamic Programming Algorithms	1
4.2	Needleman-Wunsch and Smith-Waterman	2
4.3	Heuristic Methods of Sequence Alignment	1
4.4	FASTA, and PSI BLAST	1
4.5	Multiple Sequence Alignment and Software tools	2
4.6	Pairwise and Multiple Sequence Alignment	2
5.0	**Applications**	
5.1	Genome Annotation and Gene Prediction	2
5.2	ORF Finding; Phylogenetic Analysis	2
5.3	Comparative Genomics Orthologs - Paralogs	2
5.4	Genome Analysis	2
5.5	Genome Annotation.	1

Course Designer(s)

1. Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

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