K.S. Rangasamy College of Technology

(Autonomous)

CURRICULUM & SYLLABI

of

M. Tech Biotechnology

(For the batch admitted in 2025 – 2026)

R 2025

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 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

Department of 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 professional 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 bio techniques through life-long learning.

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

ROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: Acquire in-depth knowledge of Biological science and Bioengineering for gaining ability to develop and evaluate new ideas

PO2: Demonstrate Scientific and technological skills to design and perform research through modern techniques for the development of high throughput process and products

PO3: Provide potential solutions for solving technological problems in various domains of Biotechnology considering the societal, public health, cultural environmental factors.

PO4: Create and apply modern engineering tools for the prediction and modeling of complex bioengineering activities

PO5: Analyze/ Biotechnological problems and formulate intellectual and innovative vistas for research and development with self-management and team work skills towards collaborative, multidisciplinary scientific endeavors in order to achieve common goals

PO6: Demonstrate adherence to accepted standards of professional bioethics and social responsibilities with entrepreneurial and managerial skills for the implementation of multidisciplinary projects

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

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

Programme Educational Objectives	Programme Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
PEO 1	3	3	2	3	2	3
PEO 2	2	2	3	2	3	1
PEO 3	3	2	3	2	2	2

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

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

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1	70 PDB 101	Mathematical Statistics	BS	5	3	1	0	4	Probability and Statistics

PROFESSIONAL CORE (PC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1	70 PDB 102	Advanced Microbiology	PC	3	3	0	0	3	Microbiology
2	70 PDB 103	Advanced Biochemistry	PC	3	3	0	0	3	Biochemistry
3	70 PDB 104	Cell and Molecular Biology	PC	3	3	0	0	3	Molecular Biology
4	70 PDB 105	Plant and Animal Cell Technology	PC	3	3	0	0	3	Plant and Animal Cell Biology
5	70 PDB 106	Introduction to Engineering Principles	PC	5	3	1	0	4	Principles of Chemical Engineering
6	70 PDB 201	Advanced Genetic Engineering	PC	3	3	0	0	3	Genetic Engineering
7	70 PDB 202	Immunology	PC	3	3	0	0	3	Basic of Immunology
8	70 PDB 203	Bioprocess Engineering and Technology	PC	5	3	1	0	4	Bioprocess Technology
9	70 PDB 204	Biopharmaceutical Technology	PC	3	3	0	0	3	Basic of Biopharmaceutical
10	70 PDB 205	Bioreactor Operations	PC	5	3	1	0	4	NIL
11	70 PDB 206	Computational Biology	PC	3	3	0	0	3	NIL
12	70 PDB 301	Stem Cell Research and Applications	PC	3	3	0	0	3	Cell Biology
13	70 PDB 302	Bioentrepreneurship	PC	3	3	0	0	3	Startups and Entrepreneurship
14	70 PDB 303	Downstream Processing in Biotechnology	PC	5	3	1	0	4	NIL
15	70 PDB 304	Research Methodology and Scientific Communication Skills	PC	3	3	0	0	3	NIL
16.	70 PDB 305	Intellectual property rights, Biosafety and Bioethics	PC	3	3	0	0	3	NIL
17.	70 PDB 1P1	Biochemistry and Analytical Techniques Laboratory	PC	4	0	0	4	2	Biochemistry Laboratory
18.	70 PDB 1P2	Advanced Microbiology Laboratory	PC	4	0	0	4	2	Microbiology Laboratory

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19	70 PDB 2P1	Molecular Biology and Genetic Engineering Laboratory	PC	4	0	0	4	2	NIL
20	70 PDB 2P2	Immunology Laboratory	PC	4	0	0	4	2	NIL
21	70 PDB 3P1	Downstream Processing in Biotechnology Laboratory	PC	4	0	0	4	2	NIL

PROFESSIONAL ELECTIVES (PE)SEMESTER II, ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1	70 PDB E11	Bioreaction Engineering	PE	3	3	0	0	3	NIL
2	70 PDB E12	Computational Programming	PE	3	3	0	0	3	NIL
3	70 PDB E13	Environmental Biotechnology	PE	3	3	0	0	3	NIL
4	70 PDB E14	Enzyme Engineering and Technology	PE	3	3	0	0	3	Protein and Enzyme Technology
5	70 PDB E15	Metabolic and Systems Biology	PE	3	3	0	0	3	NIL

SEMESTER III, ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1	70 PDB E21	Medical Devices	**PE**	**3**	**3**	**0**	**0**	**3**	NIL
2	70 PDB E22	Molecular Diagnostics	**PE**	**3**	**3**	**0**	**0**	**3**	Molecular Biology
3	70 PDB E23	Nanobiotechnology	**PE**	**3**	**3**	**0**	**0**	**3**	NIL
4	70 PDB E24	Production of Biotherapeutics	**PE**	**3**	**3**	**0**	**0**	**3**	NIL
5	70 PDB E25	OMICS Technologies	**PE**	**3**	**3**	**0**	**0**	**3**	NIL
6	70 PDB E26/ 70 PIS 001	Research Methodology and IPR	**PE**	**3**	**3**	**0**	**0**	**3**	NIL

AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	70 PAC 001	English for Research paper Writing	AC	30	2	0	0	0	NIL
2.	70 PAC 002	Disaster Management	AC	30	2	0	0	0	NIL
3.	70 PAC 003	Constitution of India	AC	30	2	0	0	0	NIL
4.	70 PAC 004	Value Education	AC	30	2	0	0	0	Professional English
5.	70 PAC 005	Pedagogy Studies	AC	30	2	0	0	0	NIL
6.	70 PAC 006	Stress Management by Yoga	AC	30	2	0	0	0	NIL
7.	70 PAC 007	Personality Development through Life Enlightenment Skills	AC	30	2	0	0	0	NIL
8.	70 PAC 008	Sanskrit for Technical Knowledge	AC	30	2	0	0	0	NIL
9.	70 PAC 009	Research Ethics	AC	30	2	0	0	0	NIL

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Prerequisite
1.	70 PDB 3P2	Project Work Phase – I	EEC	10	0	0	10	5	NIL
2.	70 PDB 3P3	Internship/ Industrial Training	EEC	0	0	0	0	2	NIL
3.	70 PDB 4P1	Project Work Phase - II	EEC	34	0	0	34	17	Project Work Phase - I

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K.S. RANGASAMY COLLEGE OF TECHNOLOGY,
TIRUCHENGODE-637215
(An Autonomous Institution affiliated to Anna University)
COURSES OF STUDY
(For the candidates admitted in 2025-2026)
SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	70 PDB 101	Mathematical Statistics	BS	5	3	1	0	4
2.	70 PDB 102	Advanced Microbiology	PC	3	3	0	0	3
3.	70 PDB 103	Advanced Biochemistry	PC	3	3	0	0	3
4.	70 PDB 104	Cell and Molecular Biology	PC	3	3	0	0	3
5.	70 PDB 105	Plant and Animal Cell Technology	PC	3	3	0	0	3
6.	70 PDB 106	Introduction to Engineering Principles	PC	5	3	1	0	4
7.	70 PAC 001	English for Research Paper Writing	AC	2	2	0	0	0
PRACTICALS								
8.	70 PDB 1P1	Biochemistry and Analytical Techniques Laboratory	PC	4	0	0	4	2
9.	70 PDB 1P2	Advanced Microbiology Laboratory	PC	4	0	0	4	2
			Total	**32**	**20**	**2**	**8**	**24**

SEMESTER II

S.No.	CourseCode	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	70 PDB 201	Advanced Genetic Engineering	PC	3	3	0	0	3
2.	70 PDB 202	Immunology	PC	3	3	0	0	3
3.	70 PDB 203	Bioprocess Engineering and Technology	PC	5	3	1	0	4
4.	70 PDB 204	Biopharmaceutical Technology	PC	3	3	0	0	3
5.	70 PDB 205	Bioreactor Operations	PC	5	3	1	0	4
6.	70 PDB 206	Computational Biology	PC	3	3	0	0	3
7.	70 PDB E1*	Professional Elective I	PE	3	3	0	0	3
8.	70 PAC 002	Disaster Management	AC	2	2	0	0	0
PRACTICALS								
9.	70 PDB 2P1	Molecular Biology and Genetic Engineering Laboratory	PC	4	0	0	4	2
10.	70 PDB 2P2	Immunology Laboratory	PC	4	0	0	4	2
			Total	**35**	**23**	**2**	**8**	**27**

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SEMESTER III

S.No.	CourseCode	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	70 PDB 301	Stem Cell Research and Applications	PC	3	3	0	0	3
2	70 PDB 302	Bioentrepreneurship	PC	3	3	0	0	3
3	70 PDB 303	Downstream Processing in Biotechnology	PC	5	3	1	0	4
4	70 PDB 304	Research Methodology and Scientific Communication Skills	PC	3	3	0	0	3
5	70 PDB 305	Intellectual property rights, Biosafety and Bioethics	PC	3	3	0	0	3
6	70 PDB E2*	Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7	70 PDB 3P1	Downstream Processing in Biotechnology Laboratory	PC	4	0	0	4	2
8	70 PDB 3P2	Project Work Phase – I	EEC	10	0	0	10	5
9.	70 PDB 3P3	Internship / Industrial Training	EEC	0	0	0	0	2
Total				**34**	**18**	**2**	**14**	**28**

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
PRACTICALS								
1.	70 PDB 4P1	Project Work Phase – II	EEC	34	0	0	34	17
Total				**34**	**0**	**0**	**34**	**17**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 96

Note: BS- Basic Science Courses, ES-Engineering Science Courses, PE-Professional Core Courses, PE- Professional Elective Courses, EEC-Employability Enhancement Courses, PAC- Audit Course& MC-Mandatory Courses

SUMMARY

S.No.	Category	Credits Per Semester				Total Credits	Percentage (%)
		I	II	III	IV		
2.	BS	4	-	-	-	**04**	**4.16**
4.	PC	20	24	18	-	**62**	**64.5**
5.	PE	-	3	3	-	**06**	**6.25**
6.	EEC	-	-	7	17	**24**	**25**
7.	AC	AC-I	AC-II	-	-	**-**	-
Total		**24**	**27**	**28**	**17**	**96**	**100**

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BoS Chairman Signature

K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637 215
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M.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2025-2026)

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	70 PDB 101	Mathematical Statistics	2	40	60	100	45	100
2	70 PDB 102	Advanced Microbiology	2	40	60	100	45	100
3	70 PDB 103	Advanced Biochemistry	2	40	60	100	45	100
4	70 PDB 104	Cell and Molecular Biology	2	40	60	100	45	100
5	70 PDB 105	Plant and Animal Cell Technology	2	40	60	100	45	100
6	70 PDB 106	Introduction to Engineering Principles	2	40	60	100	45	100
7	70 PAC 001	English for Research Paper Writing	2	100	-	100	-	100
PRACTICAL								
8	70 PDB 1P1	Biochemistry and Analytical Techniques Laboratory	3	60	40	100	45	100
9	70 PDB 1P2	Advanced Microbiology Laboratory	3	60	40	100	45	100

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

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

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70 PDB 101	Mathematical Statistics	Category	L	T	P	Credit
		BS	3	1	0	4

Objectives

- To acquire knowledge on basics of Mathematics.
- To get exposed to concepts involving random variable and functions of random variable.
- To understand the basics of descriptive statistics.
- To familiarize with various methods in testing of hypothesis.
- To design and analyze the statistical experiments.

Pre-requisites

- Probability and Statistics

Course Outcomes

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

CO1	Interpret the basics of Mathematics.	Apply
CO2	Compute correlation and regression.	Apply
CO3	Apply the basics of descriptive statistics.	Apply
CO4	Test the statistical hypothesis using parametric and non-parametric tests.	Apply
CO5	Analyze the design of experiments using different methods.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	3	3	2	3
CO2	3	3	3	3	2	3
CO3	3	3	3	3	2	3
CO4	3	3	3	3	2	3
CO5	3	3	3	3	2	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PDB 101 – Mathematical Statistics

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

Matrices and Complex Numbers Introduction to Matrices – Addition, Subtraction, Multiplication, Inverse, System of Equations-Complex Numbers - Addition, Subtraction, Multiplication, Division - Demoivre's theorem - Vectors –Scalar Product - Vector Product	[9]
Probability and Random Variable Probability – Axioms of Probability – Conditional Probability – Random Variables – Discrete Random Variable – Continuous Random Variable – Mathematical Expectation - Correlation –Rank Correlation –Regression	[9]
Descriptive Statistics Measures Of Central Tendency – Mean - Median - Mode – Measures of Dispersion – Quartile deviation - Mean Deviation - Standard Deviation – Coefficient of Variation – Skewness –Kurtosis	[9]
Testing Of Hypothesis Null Hypothesis - Alternative Hypothesis - Test of Significance of Small Samples - Student's 'T' Test – SingleMean - Difference of Means - F- Test - Chi-Square Test – Goodness of Fit - Independence of Attributes - Non-Parametric Tests – Sign Test for Paired Data - Mann-Whitneyu Test - Kruskal-Wallis Test (H-Test)	[9]
Design of experiments Analysis of variance – One-way classification – Completely randomized design – Two-way classification- Latin square – 22 Factorial design.	[9]
Total Hours(45)+Tutorial (15)	**60**

Text Book(s):

1.	Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", 11th Edition, Sultan Chand & Sons,New Delhi, 2007.
2.	Veerarajan T., "Probability, Statistics and Random Process", Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2nd Edition, 2008.

Reference(s):

1.	Richard A. Johnson, "Miller & Freund's Probability and Statistics for Engineers", PearsonEducation, Delhi, 7thEdition, 2005.
2.	Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye., "Probability andStatistics for Engineers and Scientists", Pearson Education, New Delhi, 9th Edition, 2011.
3.	Sheldon Ross, "A first Course in Probability", Pearson Education, Delhi, 8th Edition, 2010.
4.	Lipschutz, Seymour, Schiller, John.J, "Schaum's outlines - Introduction to Probability andStatistics", TataMcGrawHill, New Delhi, 1998.
5.	Probability and Statistics - Dr. Somesh Kumar, NPTEL online video courses.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Introduction to Mathematics**	
1.1	Introduction to Matrices	1
1.2	Matrices : Addition, Subtraction, Multiplication, Inverse, System ofequations	1
1.3	Complex numbers	1
1.4	Complex numbers : Addition, Subtraction, Multiplication, Division	1
1.5	Demoivre's theorem	1
1.6	Tutorial	2
1.7	Vectors	1

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1.8	Scalar Product	1
1.9	Vector Product	1
1.10	Tutorial	2
2	**Probability and Random Variable**	
2.1	Probability, Axioms of probability, Conditional Probability	1
2.2	Random Variables	1
2.3	Discrete random variable	1
2.4	Continuous random variable	1
2.5	Tutorial	2
2.6	Mathematical expectation	1
2.7	Correlation	1
2.8	Rank correlation	1
2.9	Regression	1
2.10	Tutorial	2
3	**Descriptive Statistics**	
3.1	Measures of Central tendency – Mean	1
3.2	Median – Mode	1
3.3	Measures of Dispersion – Quartile deviation	1
3.4	Mean deviation	1
3.5	Tutorial	2
3.6	Standard deviation	1
3.7	Coefficient of variation	1
3.8	Skewness	1
3.9	Kurtosis	1
3.10	Tutorial	2
4	**Testing of Hypothesis**	
4.1	Null hypothesis - Alternative hypothesis - Test of significance of small samples	1
4.2	Student's 't' test – Single mean - Difference of means	1
4.3	F- test	1
4.4	Chi-square test - Goodness of fit - Independence of attributes	1
4.5	Tutorial	2
4.6	Non-parametric Tests	1
4.7	Sign test for paired data	1
4.8	Mann-Whitney U test	1
4.9	Kruskal-Wallis test (H-test)	1
4.10	Tutorial	2
5	**Design of Experiments**	
5.1	Analysis of variance	1
5.2	One-way classification	1
5.3	Completely randomized design	2
5.4	Tutorial	2
5.5	Two-way classification	1
5.6	Latin square	2
5.7	2^2 Factorial design	1
5.8	Tutorial	2
	Total	60

Course Designer(s)

Mrs.K.Geetha - geethak@ksrct.ac.in

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70 PDB 102	Advanced Microbiology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To know the history development of microbiology and structural organization of bacteria
- To impart the knowledge about the microorganisms and its diversity
- To understand the methods of controlling microorganisms
- To study the structure, classification and cultivation methods of viruses
- To learn about host – Microbe interactions and microbial communication system

Pre-requisites

- **Microbiology**

Course Outcomes

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

CO1	Understand the history of microbiology and structural Organization of bacteriaand its multiplication	Understand
CO2	Outline knowledge about the microorganisms and its diversity	Apply
CO3	Demonstrate how to control microbial growth by using various sterilization method andantibiotics	Apply
CO4	Study the taxonomy, cultivation methods and its significant importance.	Understand
CO5	Evaluate the interactions between microbes, hosts and environment and microbialcommunication system	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	2	3	-	-
CO2	3	2	2	2	2	2
CO3	2	2	1	1	2	2
CO4	2	2	2	3	2	1
CO5	3	3	1	1	1	2
3 - Strong; 2 - Medium; 1 - Some						

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech – Biotechnology								
70 PDB 102 - Advanced Microbiology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I	**3**	**0**	**0**	**45**	**3**	**40**	**60**	**100**

Microbial Characteristics: Introduction to Microbiology and Microbes, History & Scope of Microbiology, Morphology, Structure, Growth and Nutrition of Bacteria, Bacterial Growth Curve, Bacterial Culture Methods; Bacterial Genetics: Mutation and Recombination in Bacteria, Plasmids, Transformation, Transduction and Conjugation; Antimicrobial Resistance.	[9]
Microbial Diversity: Microbial Taxonomy and Evolution of Diversity, Classification of Microorganisms, Criteria for Classification; Classification of Bacteria; Cyanobacteria, Acetic Acid Bacteria, Pseudomonads, Lactic and Propionic Acid Bacteria, Endospore Forming Bacteria, Mycobacteria and Mycoplasma; Achaea: Halophiles, Methanogens, Hyperthermophilic Achaea, Thermopiles; Eukaryotes: Algae, Fungi, Slime Molds and Protozoa; Extremophiles and Uncultivable Microbes, Introduction To Metagenomics.	[9]
Controlof Microorganisms: Sterilization, Disinfection and Antisepsis: Physical and Chemical Methods for Control of Microorganisms, Antibiotics, Antiviral and Antifungal Drugs, Biological Control of Microorganisms.	[9]
Virology: Virus and Bacteriophages, General Properties of Viruses, Viral Structure, Taxonomy of Virus, Viral Replication,Cultivation and Identification of Viruses; Sub-Viral Particles–Viroid's and prions.	[9]
Interaction of Microbes With Its Environment: Host-Pathogen Interaction, Ecological Impacts of Microbes; Symbiosis (Nitrogen Fixation and ruminant Symbiosis); Microbes and Nutrient Cycles; Microbial Communication System; Biofilms, Bacterial Quorum Sensing; Microbial Fuel Cells.	[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.	GerardJ. Tortora, Berdell R.Funke, ChristineL.Case. "Microbiology An Introduction",13t h Edition. Pearson Education, 2015
Reference(s):	
1.	Pelczar, M.J., Chan, E.C.S. and Krieg, M.R. "Microbiology: An application Based Approach". Tata McGraw Hill Publications, New Delhi, India, 2005.
2.	Ronald M. Atlas. Principles of Microbiology. WCB McGraw-Hill, 1997.
3.	Black, J.G. and Laura, J. B. 'Microbiology: Principles and Explorations',10th Edition, WileyPublishers, 2018.
4.	Cowan, M. K. 'Microbiology: A Systems Approach', McGraw Hill Publications, New Delhi, India, 2011.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Microbial Characteristics**	
1.1	Introduction to Microbiology and Microbes	1
1.2	History & Scope of Microbiology, Morphology, Structure	1
1.3	Growth and Nutrition of Bacteria, Bacterial Growth Curve, BacterialCulture Methods	2
1.4	Bacterial Genetics: Mutation and Recombination in Bacteria	1
1.5	Plasmids, Transformation, Transduction And Conjugation	1
1.6	Antimicrobial Resistance	1

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2	**Control Of Microorganisms**	
2.1	Microbial Taxonomy and Evolution of Diversity	2
2.2	Classification of Microorganisms, Criteria for Classification	1
2.3	Classification of Bacteria; Cyanobacteria, Acetic Acid Bacteria, Pseudomonads, Lactic And Propionic Acid Bacteria, Endospore Forming Bacteria,Mycobacteria And Mycoplasma.	2
2.4	Archaea: Halophiles, Methanogens, Hyperthermophilic Achaea, Thermopiles; Eukaryotes.	2
2.5	Eukaryotes: Algae, Fungi, Slime Molds and Protozoa	2
2.6	Extremophiles and Uncultivable Microbes	2
2.7	Introduction to Metagenomics	2
3	**Control of Microorganisms**	
3.1	Sterilization	2
3.2	Disinfection and Antisepsis: Physical and Chemical Methods For Control Of Microorganisms	2
3.3	Antibiotics	2
3.4	Antiviral and Antifungal Drugs	2
3.5	Biological Control of Microorganisms	1
4	**Virology**	
4.1	Virus and Bacteriophages	2
4.2	General Properties of Viruses	2
4.3	Viral Structure, Taxonomy of Virus	1
4.4	Viral Replication, Cultivation and Identification of Viruses	1
4.5	Sub-Viral Practices – Viroid's and Prion	2
5	**Interaction of Microbes With Its Environment**	
5.1	Host-Pathogen Interaction, Ecological Impacts of Microbes	1
5.2	Symbiosis (Nitrogen Fixation and ruminant Symbiosis); Microbes	2
5.3	Microbes And Nutrient Cycles	2
5.4	Microbial Communication System;	2
5.5	Biofilms, Bacterial Quorum Sensing	1
5.6	Microbial Fuel Cells.	1
	Total	**45**

Course Designer(s)

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Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB 103	Advanced Biochemistry	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To understand the chemical basis of life with respect to structural and functional relationships
- To provide the basic knowledge on the biological catalysis and metabolic regulation
- To impart the understanding of bio membrane organization with reference to biomolecules
- To widen the knowledge on principles of bioenergetics and signaling pathways
- To enhance the knowledge on elucidation and integration of metabolic pathways

Pre-requisites

- **Biochemistry**

Course Outcomes

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

CO1	Understand the chemistry of formation of proteins and computational models of protein folding	Understand
CO2	Describe the basic concepts of enzyme catalysis and its regulatory strategies.	Apply
CO3	Analysis the structural features of carbohydrates, lipids and nucleic acids.	Understand
CO4	Demonstrate the general principles of bioenergetics and interaction of signaling pathways in metabolic regulations.	Apply
CO5	Describe how common foodstuff are turned in to metabolic energy and integration of allbiomolecules in a central pathway.	Apply

Mapping with Programme Outcomes

COs	POs					
CO1	1	2	3	4	5	6
CO2	3	3	2	3	-	3
CO3	3	3	3	3	-	3
CO4	2	3	2	3	2	-
CO5	3	3	3	2	3	3
3 - Strong; 2 - Medium; 1 - Some						

Assessment Pattern

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB 103 - Advanced Biochemistry

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

Protein Structure Chemical Basis of Life: Miller-Urey Experiment, Water and Its Physicochemical Properties, Ionization of Water, Composition of Living Matter; Abiotic Formation of Amino Acid Oligomers, Structure-Function Relationships: Amino Acids- Structure and Functional Group Properties, Peptides And Covalent Structure of Proteins, Elucidation of Primary And Higher Order Structures, Structure-Function Relationships In Model Proteins Like Ribonuclease A, Hemoglobin, Chymotrypsin.	**[9]**
Enzyme Kinetics Enzyme Catalysis – General Principles of Catalysis; Quantitation of Enzyme Activity and Efficiency; Enzyme Characterization and Michaels- Menten Kinetics; Activation, Inhibition and Covalent Modification; Single Substrate Enzymes; Catalytic Strategies With Specific Examples of Proteases, Carbonic Anhydrases, Regulatory Strategies With Specific Example of Haemoglobin; Ribozymes.	**[9]**
Glycobiology, Liquids and Nucleic Acids Sugars-Mono, Di, and Polysaccharides With Specific Reference to Glycogen, Amylose and Cellulose, Glycosylation of Other Biomolecules- Glycoproteins and Glycolipids; Lipids- Structure and Properties of Important Members of Storage and Membrane Lipids; Lipoproteins. Nucleic Acids - Nucleosides, Nucleotides, Nucleic Acids - Structure, A Historical Perspective Leading Up to the Proposition of DNA Double Helical Structure; Difference In RNA and DNA Structure, Types of RNA.	**[9]**
Bio-Energetics Bioenergetics-basic principles; Introduction to GPCR, Inositol/DAG//PKC and Ca++ Signaling Pathways;Glycolysis and Gluconeogenesis; Citric Acid Cycle, Citric Acid Cycle as a Source of Biosynthetic Precursors; Oxidative Phosphorylation; Importance of Electron Transfer in Oxidative Phosphorylation; F_1-F_0 ATP Synthase; Shuttles Across Mitochondria.	**[9]**
Role of Vitamins & Cofactors in Metabolism Pentose Phosphate Pathway; Glycogen Metabolism, Reciprocal Control of Glycogen Synthesis and Breakdown, Roles of Epinephrine and Glucagon and Insulin in Glycogen Metabolism; Fatty Acid Metabolism; Nucleotide Biosynthesis; Biosynthesis of Membrane Lipids and Sterols With Specific Emphasis on Cholesterol Metabolism and Mevalonate Pathway; Logic and Integration of Central Metabolism; Entry/ Exit of Various Biomolecules From Central Pathways.	**[9]**
Total Hours:	**45**

Text Book(s):

1. David L. Nelson, Michael M. Cox. “Lehninger Principles of Biochemistry” 6th Ed., New York, NY: Worth, 2012.
2. Donald Voet, Judith G. Voet. “ Biochemistry” 5th Ed., Hoboken, NJ: J. Wiley & Sons,2016

Reference(s):

1. Stryer, L. “Biochemistry” 8th Ed., New York: Freeman, 2015.
2. Reginald H. Garrett, Charles M. Ghrisham. “Biochemistry” 6th Ed., Cengage learning, Boston USA, 2016. .
3. Alan Fresh, “Structure and mechanism in protein science – A guide to enzyme catalysis and protein folding” Cambridge, 2017.
4. Victor Rodwell, David Bender, Kathleen Botham, “Harper’s Illustrated Biochemistry” 31st Ed., McGraw-Hil, 2017.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1	**Protein Structure**	
1.1	Chemical Basis of Life: Miller-Urey Experiment	1
1.2	Water and its Physicochemical Properties, Ionization of Water,	1
1.3	Composition of Living Matter; Abiotic Formation of Amino Acid Oligomers.	1
1.4	Structure-Function Relationships.	1
1.5	Amino Acids – Structure and Functional Group Properties,	1
1.6	Peptides and Covalent Structure of Proteins	1
1.7	Elucidation of Primary and Higher order Structures	1
1.8	Structure-Function Relationships in Model Proteins Like Ribonuclease A, Hemoglobin, Chymotrypsin	1
1.9	Structure-Function Relationships in Model Proteins Like Chymotrypsin	1
2	**Enzyme Kinetics**	
2.1	Enzyme Catalysis – General Principles of Catalysis.	1
2.2	Quantitation of Enzyme Activity and Efficiency.	1
2.3	Enzyme Characterization.	1
2.4	Michaelis-Menten Kinetics.	1
2.5	Activation, Inhibition.	1
2.6	Covalent Modification.	1
2.7	Single Substrate Enzymes.	1
2.8	Catalytic Strategies With Specific Examples of Proteases, Carbonic Anhydrases.	1
2.9	Regulatory Strategies With Specific Example of Hemoglobin; Isozymes.	1
3	**Glycobiology, Liquids and Nucleic Acids**	
3.1	Sugars-Monosaccharide's and Disaccharides	1
3.2	Polysaccharides With Specific Reference to Glycogen, Amylose and Cellulose	1
3.3	Glycosylation of Other Biomolecules- Glycoproteins and Glycolipids	1
3.4	Lipids- Structure and Properties of Important Members of Storage Membrane Lipids.	2
3.5	Lipoproteins.	1
3.6	Nucleic Acids - Nucleosides, Nucleotides.	1
3.7	Nucleic Acids – Structure	1
3.8	A Historical Perspective Leading Up to the Proposition Of DNA Double Helical Structure;Difference in RNA and DNA Structure.	1
3.9	Types of RNA.	1
4	**Bio-Energetics**	
4.1	Bioenergetics-Basic Principles	1
4.2	Introduction to GPCR Signaling Pathways	1
4.3	Inositol/DAG//PKC and Ca++ Signaling Pathways;	1
4.4	Glycolysis and Gluconeogenesis;	
4.5	Citric Acid Cycle,	2
4.6	Citric Acid Cycle as a Source of Biosynthetic Precursors	1
4.7	Oxidative Phosphorylation;	1
4.8	Importance of Electron Transfer in Oxidative Phosphorylation;	1
4.9	F1-F0 ATP Synthase; Shuttles Across Mitochondria	1
5	**Role of Vitamins & Cofactors in Metabolism**	
5.1	Pentose Phosphate Pathway, Glycogen Metabolism, Reciprocal Control of	1

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	Glycogen Synthesis and and Breakdown,	
5.2	Roles of Epinephrine and Glucagon and Insulin in Glycogen Metabolism.	2
5.3	Fatty Acid Metabolism; Nucleotide Biosynthesis; of Various Biomolecules From Central Pathways.	1
5.4	Biosynthesis of Membrane Lipids and Sterols With Specific Emphasis on Cholesterol Metabolism and Mevalonate Pathway.	2
15.5	Logic and Integration of Central Metabolism; Entry/ Exit.	1
	Total	45

Course Designer(s)

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BoS Chairman Signature

70 PDB 104	Cell and Molecular Biology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- Tosensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules
- To provide an insight into the process of cellular Signaling, trafficking and transport.
- To impart the concept of cellular process of cell cycle, its regulation and cell death.
- To build on the knowledge of DNA, its replication mechanism and consequences of mutations.
- To learn themolecular events involved in the flow of information from genes to proteins and the molecular events of prokaryotic and eukaryotic gene transcription.

Pre-requisites

- **Molecular Biology**

Course Outcomes

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

CO1	Discuss the structure and function of cell and its organelles.	Understand
CO2	Explain the process of molecular mechanism of cellular signaling and transport.	Apply
CO3	Illustrate the mechanism of cell cycle, cell division, cell-cell interactions and cell death.	Understand
CO4	Describe the regulation of DNA replication, transcription and translation atmolecular level.	Apply
CO5	Justify the importance of mutation in gene expression and its regulation.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	-	3	2
CO2	3	3	2	3	3	-
CO3	3	3	2	-	3	-
CO4	3	3	2	3	2	3
CO5	3	3	2	3	2	-
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

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BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB 104 - Cell and Molecular Biology

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

Dynamic Organization of Cell Universal Features of Cells; Cell Chemistry and Biosynthesis: Chemical Organization of Cells; Internal Organization of The Cell - Cell Membranes: Structure of Cell Membranes and Concepts Related to Compartmentalization in Eukaryotic Cells; Intracellular Organelles: Endoplasmic Reticulum and Golgi Apparatus, Lysosomes and Peroxisomes, Ribosomes, Cellular Cytoskeleton, Mitochondria, Chloroplasts and Cell Energetics; Nuclear Compartment: Nucleus, Nucleolus and Chromosomes.	**[9]**
Cellular Signaling, Transport and Trafficking Molecular Mechanisms of Membrane Transport, Nuclear Transport, Transport Across Mitochondria and Chloroplasts; Intracellular Vesicular Trafficking From Endoplasmic Reticulum through Golgi Apparatus to Lysosomes/Cell Exterior.	**[9]**
Cellular Processes Cell Cycle and its regulation; Cell division: Mitosis, Meiosis and Cytokinesis; Cell Differentiation: Stem Cells, Their Differentiation into Different Cell Types and Organization into Specialized Tissues; Cell-ECM and Cell-Cell Interactions; Cell Receptors and Trans-Membrane Signaling; Cell Motility and Migration; Cell Death: Different Modes of Cell Death and Their Regulation.	**[9]**
Chromatin Structure and Dynamics Chromatin Organization - Histone and DNA Interactome: Structure and Assembly of Eukaryotic and Prokaryotic DNA polymerases, DNA-replication, Repair and Recombination; Chromatin Control: Gene Transcription and Silencing by Chromatin-Writers,-Readers and –Erasers; Transcriptional Control: Structure and Assembly of Eukaryotic and Prokaryotic RNA Polymerases, Promoters and Enhancers, Transcription factors as Activators and Repressors, Transcriptional Initiation, Elongation and Termination; Post-Transcriptional Control: Splicing and Addition of Cap and Tail, mRNA Flow Through Nuclear envelope into Cytoplasm, Breakdown of Selective and Specific mRNAs Through Interference by Small Non-coding RNAs (miRNAs and siRNAs), Protein Translation Machinery, Ribosomes- Composition and Assembly; Universal Genetic Codes, Degeneracy of Codons, Wobble Hypothesis; Iso-Accepting tRNA; mechanism of initiation, elongation and termination; co- and post- Translational Modifications, Mitochondrial Genetic Code.	**[9]**
Genome Instability and Cell Transformation Mutations, Proto-oncogenes, Oncogenes and Tumor Suppressor Genes, Physical, Chemical and Biological Mutagens; Types of Mutations; Intra-genic and Inter-Genic Suppression; Transpositions- Transposable Genetic elements in prokaryotes and eukaryotes, Role of Transposons in Genome; Viral and Cellular Oncogenes; Tumor Suppressor Genes; Structure, Function and Mechanism of Action; Activation and Suppression of Tumor Suppressor Genes;Oncogenes as Transcriptional Activators.	**[9]**
Total Hours:	**45**

Text Book(s):

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P.Molecular Biology of the Cell.New York:Garland Science, 2002
2. Lodish, H. F. Molecular Cell Biology. New York: W.H. Freeman, 2000.

Reference(s):

1. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's Genes XI. Burlington, MA:Jones & Bartlett Learning.

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2.	Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). Becker's World of the Cell. Boston: BenjaminCummings.
3.	Cooper, G. M., & Hausman, R. E, The Cell: a Molecular Approach. Washington: ASM; Sunderland 2009.
4.	Watson, J. D., Molecular Biology of the Gene (7th ed.). Menlo Park, CA Benjamin/Cummings 1987.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Dynamic Organization of Cell**	
1.1	Universal Features of Cells; Cell Chemistry and Biosynthesis	1
1.2	Chemical Organization of Cells; Internal Organization of the Cell	1
1.3	Cell Membranes: Structure of Cell Membranes	1
1.4	Concepts Related to Compartmentalization in Eukaryotic Cells	1
1.5	Intracellular Organelles: Endoplasmic Reticulum	1
1.6	Golgi Apparatus, Lysosomes and Peroxisomes	1
1.7	Ribosomes, Cellular Cytoskeleton	1
1.8	Mitochondria, Chloroplasts	1
1.9	Cell Energetics, Nuclear Compartment: Nucleus, Nucleolus and Chromosomes.	1
2	Cellular Signaling, Transport and Trafficking	1
2.1	Molecular mechanisms of Membrane Transport, Transport Across Mitochondria and Chloroplasts	1
2.2	Intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior. Nuclear transport	2
2.3	Transport Across Mitochondria	1
2.4	Transport Across Chloroplasts	1
2.5	Intracellular Vesicular Trafficking from Endoplasmic Reticulum through Golgi Apparatus to Lysosomes	2
2.6	Intracellular Vesicular Trafficking from Endoplasmic Reticulum through Golgi apparatus tocell exterior.	1
3	**Cellular processes**	
3.1	Cell cycle and its regulation	1
3.2	Cell division: Mitosis	1
3.3	Cell division: Meiosis and cytokinesis	1
3.4	Cell Differentiation: Stem Cells, Their Differentiation into Different Cell Types and Organization into Specialized Tissues	2
3.5	Cell-ECM and Cell-Cell Interactions	1
3.6	Cell Receptors and Trans- Membrane Signaling	1
3.7	Cell Motility and Migration	1
3.8	cell death: Different Modes of Cell Death and Their Regulation	1
4	**Chromatin Structure and Dynamics**	
4.1	Chromatin organization - Histone and DNA Interactome: Structure DNA-Replication, Repair and Recombination	1
4.2	Chromatin Control: Gene Transcription And Silencing By Chromatin-Writers,-Readers And –Erasers	1
4.3	Transcriptional Control: Structure And Assembly Of Eukaryotic And Prokaryotic RNA Polymerases, Promoters And Enhancers, Transcription Factors As Activators and Repressors, Transcriptional Initiation, Elongation and Termination	1
4.4	Post-Transcriptional Control: Splicing and Addition of Cap and Tail, mRNA Flow ThroughNuclear Envelope into Cytoplasm, Breakdown	2

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	Of Selective And Specific mRNAs Through Interference by Small Non- Coding rDNA (miRNA And siRNA)	
4.5	Protein Translation Machinery, Ribosomes- Composition and Assembly	1
4.6	Universal Genetic Codes, Degeneracy of Codons, Wobble Hypothesis	1
4.7	Wobble Hypothesis; Iso-Accepting tRNA; Mechanism of Initiation, Elongation andTermination	1
4.8	Co- And Post- Translational Modifications, Mitochondrial Genetic Code.	1
5	**Genome Instability And Cell Transformation**	
5.1	Mutations, Proto-Oncogenes, Oncogenes and Tumour Suppressor Genes	1
5.2	Physical, Chemical and Biological Mutagens	1
5.3	Types of Mutations; Intra-Genic and Inter-Genic Suppression	1
5.4	Transpositions- Transposable Genetic Elements in Prokaryotes and Eukaryotes	1
5.5	Role of Transposons in Genome	1
5.6	Viral And Cellular Oncogenes	1
5.7	Tumor Suppressor Genes; Structure Function and Mechanism of Action	1
5.8	Activation and Suppression of Tumor Suppressor Genes	1
5.9	Oncogenes as Transcriptional Activators	1
	Total	45

Course Designer(s)

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Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB 105	Plant and Animal Cell Technology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To educate students about the fundamental concepts of animal and plant cell system,
- Bioprocess technology usingeukaryotic system and their related applications.
- To meet challenges of new and emerging areas of biotechnology industry
- To gain strong understanding of plant and animal based cell cultures system.
- To develop the skills of the students in the area of Plant Biotechnology and its wide applications.
- To understand the important concepts involved in the bioprocess monitoring and downstream processing.

Pre-requisites

- Plant and Animal Cell Biology

Course Outcomes

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

CO1	Comprehend the concepts of plant tissue culture, transformation andapplications in industry.	Understand
CO2	Investigate the process of conservation of plants for future posterity and Productionof Hybrid plants.	Understand
CO3	Depict the crucial animal cell culture technique used in animal cell cultures	Understand
CO4	Learn the prospects and problems of transgenic animals along with the ethicalguidelines as well as safety regulations.	Apply
CO5	Narrate the strategies for secondary metabolite production and their advancemethodologies and take up animal/plant based biological research	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	3	3	-	-
CO2	3	2	3	3	3	-
CO3	3	2	3	3	2	2
CO4	3	2	2	3	2	3
CO5	3	2	3	3	2	-
3 - Strong; 2 - Medium; 1 - Some						

Assessment Pattern

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech - Biotechnology

70 PDB 105 – Plant and Animal Cell Technology

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

Plant Cell Culture Totipotency; Plant Growth Regulators; Regeneration and Micro propagation of Plants: Clonal Propagation, Organogenesis, Shoot-Tip and Meristem Culture, Haploid Culture, Triploid Culture, Protoplast Culture; Somaclonal Variation; Tissue Culture and Cell Suspension Culture System: Methodology, Growth Kinetics and Nutrient Optimization; Precursors and Elicitors; Plant Products of Industrial Importance, Production of Secondary Metabolites.	[9]
Transgenic Plants Organization and Expression of Chloroplast Genome and Mitochondrial Genome- 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]
Animal Cell Culture Animal Cell Culture; Media Composition and Growth Conditions; Animal Cell and Tissue Preservation; Anchorage and Non-Anchorage Dependent Cell Culture; Primary and Secondary Culture; Animal Cell Growth Characteristics and Kinetics; Micro &Macro carrier Culture;Hybridoma Technology; Stem Cell Technology; Mechanisms of Drug Resistance and Cell Death.	[9]
Transgenic Animals Cloning Techniques in Animals, Gene Transformation Techniques in Animals. Transgenic Animals: Transgenic Mice, Transgenic Rabbits, Transgenic Cattle, Transgenic Pig and Transgenic Fish, Ethical Issues Related to Transgenic Animals. Organ Culture Technology- Production of Complete Organ. Biotechnology in Animal Production, Manipulation of Growth Hormone, Somatotropic Hormone.	[9]
Secondary Metabolite Production Principles, Design and Operation of Bioreactors: Specific Design Criteria For Mammalian and Plant Systems; Strategies for FermentationWith Recombinant Organisms; Isolation, Characterization and Production of Secondary Metabolites From different Plant Cell Types; Bioprocess Monitoring and Control: Current Practices in the Bioprocess Industries, Advanced Methodologies; Overview of DownstreamProcessing: Centrifugation, Filtration and Chromatographic Techniques.	[9]
Total Hours:	**45**

Text Book(s):

1. Singh, B.D., “Biotechnology”, First Edition, Kalyani Publishers, New Delhi, India, 2015.
2. Ranga, M.M., “Animal Biotechnology”, Third Edition, Agrobios India limited, Jodhpur. India, 2013.

Reference(s):

1. Purohit, S. S., “Plant Tissue Culture”, Student Edition, Jodhpur, India, 2010.
2. Bhojwani S.S. and Razdan M.K. Plant Tissue Culture: Theory and Practice, a Revised Edition, Elsevier, 1996
3. Ian freshney, R., “Culture of Animal Cells”, Fifth Edition, Wiley Publications, New Delhi, India, 2006.
4. Suresh Kumar Gahlawat, Joginder Singh Duhan, Raj Kumar Salar, Priyanka Siwach, Suresh Kumar, PawanKaur,“Advances in Animal Biotechnology and its Applications”, Springer Nature Singapore Pvt. Ltd., 2018

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Course Contents and Lecture Schedule

S.No.	Topics	No. of hours
1	**Plant Cell Culture**	
1.1	Totpotency; Plant Growth Regulators	1
1.2	Regeneration and Micro propagation of Plants	1
1.3	Clonal Propagation, Organogenesis, Shoot-Tip and Meristem Culture	1
1.4	Haploid Culture, Triploid Culture, Protoplast Culture	1
1.5	Somaclonal Variation; Tissue Culture and Cell Suspension CultureSystem	1
1.6	Methodology, Growth Kinetics and Nutrient Optimization	1
1.7	Precursors and Elicitors;	1
1.8	Plant Products of Industrial Importance	1
1.9	Production of Secondary Metabolites	1
2	**Transgenic Plants**	
2.1	Organization and Expression of Chloroplast Genome	1
2.2	Mitochondrial Genome- Gene Transformation Techniques.	1
2.3	Direct Gene Transformation: Electroporation, Particle Gun Method	1
2.4	Lipofection, Microinjection, Fibre Mediated DNA Delivery and Laser Induced DNA Delivery	1
2.5	Biological Gene Transfer: Agrobacterium Mediated Gene Transformation Transgenic Plants	2
2.6	Disease Resistance; Insect Resistance	1
2.7	Virus Resistance, Biotic and Abiotic Stress Resistance	1
2.8	GM Crops- Prospects and Problems	1
3	**Animal Cell Culture**	
3.1	Animal Cell Culture; Media Composition and Growth Conditions.	1
3.2	Animal Cell and Tissue Preservation	1
3.3	Anchorage and Non-AnchorageDependent Cell Culture;	1
3.4	Primary and Secondary Culture; Animal Cell Growth Characteristics & Kinetics	1
3.5	Micro & Macro Carrier Culture	1
3.6	Hybridoma Technology; Stem Cell Technology;	1
3.7	Mechanisms of Drug Resistance	2
3.8	Cell Death	1
4	**Transgenic Animals**	
4.1	Cloning Techniques In Animals, Gene Transformation Techniques in Animals.	2
4.2	Transgenic Animals: Transgenic Mice, Transgenic Rabbits,Transgenic Cattle,	2
4.3	Transgenic Pig and Transgenic Fish, Ethical Issues Related to Transgenic Animals.	2
4.4	Organ Culture Technology- Production of Complete Organ.	1
4.5	Biotechnology in Animal Production, Manipulation of Growth Hormone,	1
4.6	Biotechnology in Animal Production - Somatotropic Hormone	1
5	**Secondary Metabolite Production**	
5.1	Principles, Design and Operation of Bioreactors: Specific Design Criteria For Mammalian and Plant Systems	1
5.2	Strategies For FermentationWith Recombinant Organisms; Isolation, Characterization.	1
5.3	Production of Secondary Metabolites From different Plant Cell Types;	1
5.4	Bioprocess Monitoring and Control: Current Practices in the Bioprocess	1
5.5	Industries, Advanced Methodologies.	2
5.6	Overview of DownstreamProcessing: Centrifugation, Filtration.	2
5.7	Overview of DownstreamProcessing: Chromatographic Techniques.	1
	Total	**45**

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Course Designer(s)

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BoS Chairman Signature

70 PDB 106	Introduction to Engineering Principles	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To learn basic Chemical Engineering concepts to apply for various systems
- To acquire knowledge to analyses balances for physical and chemical systems
- To understand the properties of substances and multiphase systems.
- To understand fluid behavior and momentum transfer
- To know heat and mass transport principles and applications

Pre-requisites

- **Principles of Chemical Engineering**

Course Outcomes

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

CO1	Develop balance equations for unit operations and unit processes	Understand
CO2	Analyze mass and energy balances calculations in reactive systems and unsteadystate balances	Analyze
CO3	Demonstrate the principles of single and multicomponent systems	Apply
CO4	Know the principle of momentum transfer and its applications	Apply
CO5	Analyze the mechanism of heat and mass transport operations	Analyze

Mapping with Programme Outcomes

Cos	POs					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	2	-
CO2	3	3	3	3	2	-
CO3	3	3	3	3	2	-
CO4	3	3	3	3	2	-
CO5	3	3	3	3	2	
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

Passed in BoS Meeting held on 20/06/2025
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PDB 106 - Introduction to Engineering Principles

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

Energy and Material Balances Unit Operations and Unit Processes: Historical and Recent Developments in Chemical Engineering; Process Variables and Degrees of Freedom; Differential and Integral Balances; Lumped and Distributed Balances; Balances in Systems Involving Physical Changes.	[9]
Steady State Energy and Material Balances Balances in Reacting Systems; Balances in Systems Involving Recycle, Purge and Bypass; Computer Aided Calculations; Generalization to Unsteady State Balances	[9]
Properties of Substances Single Component and Multicomponent Systems; Single and Multiphase Systems.	[9]
Introduction To Transport Phenomena: Momentum Transfer Viscosity; Molecular Theory of Gases and Liquids; Shell Balance: Falling Film, Circular Tube; Equations of Change for Isothermal Systems: Continuity, Motion, Energy, Substantial Derivatives; Unidirectional Flows: Pipe Flow, Variable Viscosity Falling Film, Couette Viscometer, Rotating Sphere; Unsteady Flows: Startup Plate Flow, Parallel Plates.	[9]
Introduction to Transport Phenomena: Heat and Mass Transfer Thermal Conductivity and Mechanism of Energy Transport; Shell Energy Balances and Temperature Distributions in Solids and Laminar Flow; Diffusivity and the Mechanisms of Mass Transport; Concentration Distributions in Solids and Laminar Flow; Equations of Change For Multicomponent Systems; Introduction to the Concept of Heat and Mass Transfer Coefficients; Dimensional Analysis (Buckingham Pi Theorem).	[9]
Total Hours(45)+Tutorial (15)	**60**

Text Book(s):

1. Felder, R.M. and R.W. Rousseau, “Elementary Principles of Chemical Processes”, 4th Edition, J. Wiley, NewYork, 2015.
2. Himmelblau, D.M. “Basic Principles and Calculations in Chemical Engineering”, 7th Edition, Prentice Hall ofIndia, New Delhi, 2003.

Reference(s):

1. Bhatt, B.I. and S.M.Vora, “Stoichiometry”, 3rd Edition, Tata McGraw Hill. New Delhi, 1996.
2. Byron Bird, R., Warren E. Stewart, Edwin N. Lightfoot, “Transport Phenomena”, 2nd Edition, Wiley, 2006.
3. Ghasem, N., Henda, R., “Principles of Chemical Engineering Processes: Material and Energy Balances”, CRCPress,2014.
4. Geankoplis, C.J.,”Transport Processes and Separation Process Principles (Includes Unit Operations)”, PrenticeHall; 4th edition, 2003.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
	Energy And Material Balance	
1.1	Unit Operations and Unit Processes	2
1.2	Historical and Recent Developments In Chemical Engineering	1
1.3	Process Variables	2
1.4	Degrees of Freedom	2
1.5	Differential and Integral Balances	2
1.6	Lumped and Distributed Balances	1
1.7	Balances in Systems Involving Physical Changes	2
2	**Steady State Energy and MaterialBalances**	
2.1	Balances in Reacting Systems	1
2.2	Balances in Systems Involving Recycle,	2
2.3	Purge and Bypass	2
2.4	Problems	2
2.5	Computer Aided Calculations	2
2.6	Generalization to Unsteady State Balances	2
2.7	Problems	1
3	**Properties of Substances**	
3.1	Single Component Systems	2
3.2	Multicomponent Systems	2
3.3	Problems on Single Component Systems	2
3.4	Problems on Multi Component Systems	2
3.5	Single Phase Systems.	2
3.6	Multiphase Systems	2
4	**Introduction to Transport Phenomena**	
4.1	Viscosity	1
4.2	Molecular Theory of Gases and Liquids	1
4.3	Shell Balance: Falling Film, Circular Tube	2
4.4	Equations of Change for Isothermal Systems	2
4.5	Continuity, Motion, Energy, Substantial Derivatives	2
4.6	Unidirectional Flows: Pipe Flow	2
4.7	Variable Viscosity Falling Film	2
4.8	Couette Viscometer, Rotating Sphere	1
4.9	Unsteady Flows: Startup Plate Flow, Parallel Plates etc.,	1
5	**Introduction to Transport Phenomena: Heat and Masstransfer**	
5.1	Thermal Conductivity and Mechanism of Energy Transport	1
5.2	Shell Energy Balances and Temperature Distributions in Solids and Laminar Flow	2
5.3	Diffusivity And The Mechanisms of Mass Transport	2
5.4	Concentration Distributions in Solids and Laminar Flow	2
5.5	Equations of Change for Multicomponent Systems	1
5.6	Introduction to the Concept of Heat And Mass Transfer Coefficients	2
5.7	Dimensional Analysis (Buckingham Pi Theorem)	1
	Total	**60**

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70 PDB 1P1	Biochemistry and Analytical Techniques Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To introduce students about the basic experiments in biochemistry.
- To teach utility of experimental methods in biochemistry in a problem oriented manner.
- To determine the characteristics features of various molecules with reference to its
- Analytical characters.
- To differentiate and extract the biological molecules through various methods.
- To evaluate and apply the molecular mechanism of protein using various Instrumentation

Pre-requisites

- **Biochemistry Laboratory**

Course Outcomes

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

CO1	Elaborate concepts of biochemistry with simple experiments;	Apply
CO2	Understand principle and working of basic laboratory instruments	Analyze
CO3	Perform the investigation for any kind of protein or enzyme	Analyze
CO4	Identify the biomolecules using laboratory techniques.	Apply
CO5	Critically analyze and differentiate the techniques that can be applied for Industrial production	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	3	2	3	3	2
CO2	2	3	2	3	2	3
CO3	2	2	2	2	3	2
CO4	2	3	3	3	3	-
CO5	2	3	3	-	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

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K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech - Biotechnology								
70 PDB 1P1 - Biochemistry and AnalyticalTechniques Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

List of Experiments: (Any Ten Experiments)

1. Hydrolysis of starch / glycogen and estimation of its purity by Somogy's Method.
2. Estimation of reducing sugars by DNS method.
3. Determination acid no and iodine number of an edible oil.
4. Estimation of cholesterol by Zak's method.
5. Preparation of buffers: Phosphate and Acetate buffers.
6. Titration of Amino Acids: Determination of pka of weak acids by pH metric titration.
7. Separation of aliphatic, aromatic and polar amino acids by thin layer chromatography
8. Quantification of proteins by lowry's method.
9. Determination of A/G Ratio by Biuret method.
10. Purification and characterization of an enzyme (such as Alkaline Phosphatase or Acid Phosphatase)
11. Effect of different temperature on the activity of enzyme (Alkaline Phosphatase or Acid Phosphatase)
12. Effect of different pH on the activity of enzyme (Alkaline Phosphatase or Acid Phosphatase)
13. Effect of different substrates on the activity of enzyme (Alkaline Phosphatase or Acid Phosphatase)
14. Identification of an unknown sample as DNA or RNA or Proteins using available laboratory tools.
15. Estimation of Inorganic phosphate by Fiske Subbarao method.

Lab Manual	
1.	"Laboratory Manual **Biochemistry and AnalyticalTechniques**", Department of Biotechnology, KSRCT.

Course Designer(s)

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

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BoS Chairman Signature

70 PDB 1P2	Advanced 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 for identification purpose
- To check differences in biochemical and physiological characteristics among different bacteria
- To evaluate the effect of environmental factors on bacterial growth
- To study the population of microorganism from environmental samples and to identify the effective method tocontrol microbes.

Pre-requisites

- **Microbiology Laboratory**

Course Outcomes

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

CO1	Outline 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	Analyze
CO3	Determine bacterial population in different samples	Analyze
CO4	Analysis for physiological biochemical characteristics of identification of Microorganisms	Apply
CO5	Check the effectiveness of antimicrobial agents and antimicrobial sensitivity test	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	3	2	3	3	2
CO2	2	3	2	3	2	3
CO3	2	2	2	2	3	2
CO4	2	3	3	3	3	-
CO5	2	3	3		2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

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K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech - Biotechnology								
70 PDB 1P2 - Advanced Microbiology Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

List of Experiments: (Any Ten Experiments)

1. Sterilization, disinfection and safety in microbiological laboratory, good laboratory practices
2. Preparation of nutrient media for cultivation of bacteria – liquid and agar.
3. Cultivation techniques - Pour plate, spread plate and streak plate.
4. Determination of Microbial growth-viable plate count and turbidity method.
5. Staining - Gram staining, capsule staining and endospore staining.
6. Fungal staining - Lacto phenol cotton blue staining of Mold
7. Determination of motility of bacteria
8. Biochemical test - IMViC test
9. Carbohydrate fermentation test - Sucrose and lactose fermentation
10. Starch and casein hydrolysis test
11. Antibiotic sensitivity test – demonstration of drug resistance
12. Environmental factors Effect of pH on growth of bacteria
13. Effect of temperature on growth of bacteria
14. Determination of Phenol coefficient and MIC (minimum inhibitory concentration) of antimicrobial agents.
15. Isolatison and identification of bacteria from soil/water samples.

Lab Manual

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

Course Designer(s)

Dr. Mythili Gnanamangai - mythilignanamangai@ksrct.ac.in

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K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637 215
(An Autonomous Institution affiliated to Anna University)

M.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2025-2026)

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	70 PDB 201	Advanced Genetic Engineering	2	40	60	100	45	100
2	70 PDB 202	Immunology	2	40	60	100	45	100
3	70 PDB 203	Bioprocess Engineering and Technology	2	40	60	100	45	100
4	70 PDB 204	Biopharmaceutical Technology	2	40	60	100	45	100
5	70 PDB 205	Bioreactor Operations	2	40	60	100	45	100
6	70 PDB 206	Computational Biology	2	40	60	100	45	100
7	70 PDB E1*	Professional Elective I	2	40	60	100	45	100
8	70 PAC 002	Disaster Management	2	100	-	100	-	100
PRACTICAL								
9	70 PDB 2P1	Molecular Biology and Genetic Engineering Laboratory	3	60	40	100	45	100
10	70 PDB 2P2	Immunology Laboratory	3	60	40	100	45	100

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

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

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70 PDB 201	Advanced Genetic Engineering	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To enrich the fundamental understanding of principles of Genetic Engineering.
- To impart knowledge on the various methods and technologies intended to gene libraries.
- To apply genetic engineering tools in biological research as well as in biotechnology industries.
- Tounderstand the technologies available for creating big data and genome materials.
- To familiarize the recent technologies in medical and health care applications.

Pre-requisites

- **Genetic Engineering**

Course Outcomes

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

CO1	Classify the tools for genetic engineering for the benefit of modern society	Understand
CO2	Understand the type of vectors and its application	Understand
CO3	Differentiate the working and application of different PCR	Apply
CO4	Comprehend the types of tools and its application in building cDNA libraries.	Apply
CO5	Carry out research or apply the techniques to relevant biotech industry	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	-
CO2	3	3	2	3	-	3
CO3	3	3	3	3	3	-
CO4	3	3	3	3	3	3
CO5	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	30	20	40
Understand	30	30	40
Apply	-	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB 201 – Advanced Genetic Engineering

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

Introduction and Tools for Genetic Engineering Impact of Genetic Engineering in Modern Society; General Requirements for Performing a Genetic Engineering Experiment; Restriction Endonucleases and Methylases; DNA Ligase, Klenow Enzyme, T4 DNA Polymerase, Polynucleotide Kinase, Alkaline Phosphatase Cohesive and Blunt End Ligation; Linkers; Adaptors; Homopolymeric Tailing; Labelling of DNA: Nick Translation, Random Priming, Radioactive and Non-Radioactive Probes; Hybridization Techniques: Northern, Southern, South- Western and Far-Western and Colony Hybridization, Fluorescence in Situ Hybridization.	. [9]
Different Types of Vectors Plasmids; Bacteriophages; M13 MP Vectors; PUC 19 and Blue script Vectors, Phagemids; Lambda Vectors; Insertion and Replacement vectors; Cosmids; Artificial Chromosome Vectors (YACs; BACss); Principles for Maximizing Gene Expression: Expression Vectors, PMAL, GST, PET-Based Vectors; Protein Purification: His-Tag; Gst-Tag; Mbp-Tag etc. Intein-Based Vectors; Inclusion Bodies Methodologies To reduce Formation of Inclusion Bodies; Mammalian Expression and Replicating Vectors; Baculovirus and Pichia Vector System, Plantbased Vectors, Ti And Ri Plasmids as Vectors, Yeast, Shuttle Vectors.	. [9]
Different Types of PCR Techniques Principles of PCR: Primer Design; Fidelity of Thermos table Enzymes; DNA polymerases; Types of PCR —— Multiplex Nested; Reverse Transcription PCR, Real time PCR, Touchdown PCR, Hot start PCR, Colony PCR, Asymmetric PCR, Cloning of PCR products; TA Cloning Vectors; Proof Reading Enzymes; PCR based Site Specific Mutagenesis; PCR in Molecular Diagnostics; Viral and Bacterial Detection; Sequencing Methods; Enzymatic DNA Sequencing; Chemical Sequencing of DNA; Automated DNA Sequencing; RNA sequencing; chemical synthesis of Oligonucleotides; Mutation Detection: SSCP DGGE, RFLP	. [9]
cDNA Analysis Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; isolation o mRNA and tota RNA; reverse transcriptase and cDNA synthesis; cDNA and genomic libraries; construction of microarrays — genomic arrays,cDNA arrays and oligo arrays; study of protein-DNA interactions: electrophoretic mobility shift assay; DNaseI footprinting; methylinterference assay, chromatin immunoprecipitation; protein-protein interactions	. [9]
Gene Silencing And Genome Editing Technologies Gene Silencing Techniques; Introduction to siRNA; siRNA Technology. Micro RNA; Construction of siRNA Vectors, Principle and Application of Gene Silencing; Gene Knockouts and Gene Therapycreation of Transgenic Plants; Debate Over GM Crops; Introduction to Methods of Genetic Manipulation in Different Model Systems E.G. FruitFlies (Drosophila), Worms (C.Elegans) Frogs (Xenopus), Fish (Zebra Fish) and Chick, Transgenic - Gene Replacement; Gene Targeting; Creation of Transgenic AndKnock-Out Mice Disease Model; Introduction to Genome Editing by CRISPR-CAS With Specific emphasis OnChinese and American Clinical Trials.	[9]
Total Hours:	**45**

Text Book(s):

1. Michael S.D. Kormann Modern Tools For Genetic Engineering. Intech. 2016
2. Brown, T. A. (2006). Genomes (3rd Ed.). New York: Garland Science Pub (2006.

Reference(S):

1. Green, M. R., & Sambrook, J. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor, NY: Cold SpringHarbor Laboratory Press. 2012.
2. Barh, D., Khan, Iqrar, A., Khan, and Muhammad S. Applied Molecular Biotechnology: The Next Generation of Genetic Engineering. CRC Press/Taylor & Francis 2015.
3. S. Primrose, R. Twyman, B. Old, and G. Bertola Principles Of Gene Manipulation and

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	Genomics, Blackwell Publishing Limited; 7th Edition 2006.
4.	Elena, P. And Andrea B. (2021). DNA Analysis: Technological Development and Innovative Applications

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Introduction and Tools** for **Genetic Engineering**	
1.1	Impact of Genetic Engineering in Modern Society; General Requirements for Performing a Genetic Engineering Experiment	1
1.2	Restriction Endonucleases and Methylases	1
1.3	DNA Ligase	1
1.4	Klenow Enzyme, T4 DNA Polymerase, Polynucleotide Kinase	1
1.5	Alkaline Phosphatase; Cohesive And Blunt End Ligation; Linkers, Adaptors; Homopolymeric Tailing	1
1.6	Labelling of DNA: Nick Translation, Random Priming	1
1.7	Radioactive and Non-Radioactive Probes	1
1.8	Hybridization Techniques: Northern, Southern	1
1.9	South-Western and Far-Western and Colony	1
2	**Different Types of Vectors**	
2.1	Plasmids; Bacteriophages; Baculovirus and Pichia Vectors system,	1
2.2	M13 Mp Vectors; PUC19 And Blue script Vectors	1
2.3	Phagemids; Lambda Vectors; Insertion and Replacement Vectors	1
2.4	Cosmids; Artificial Chromosome Vectors (YACs; BACs)	1
2.5	Expression Vectors, Pmal, GST, Pet-Based Vectors	1
2.6	Protein Purification: His-Tag; GST-Tag; MBP-Tag Etc. Intein-Based vectors, Inclusion Bodies; Methodologies to Reduce Formation of Inclusion Bodies	1
2.7	Principles For Maximizing Gene Expression , Mammalian Expression and Replicating Vectors	1
2.8	Baculovirus and Pichia Vectors System	1
2.9	Plant Based Vectors, Ti And Ri Plasmids As Vectors, Yeast Vectors, Shuttle Vector	1
3	**Different Types of PCR Techniques**	
3.1	Principles of PCR: Primer Design; Fidelity of Thermo Stable Enzymes	1
3.2	Types of PCR – Multiplex, Nested	1
3.3	Reverse- Transcription PCR, Real Time PCR	1
3.4	Touchdown PCR, Hot Start PCR, Colony PCR	1
3.5	Asymmetric PCR, Cloning of PCR Products; TA Cloning Vectors; Proof Reading Enzymes	1
3.6	PCR Based Site Specific Mutagenesis; PCR In Molecular diagnostics	1
3.7	Viral And Bacterial Detection, Sequencing Methods; Enzymatic DNA sequencing; Chemical Sequencing of DNA	1
3.8	Automated DNA Sequencing; RNA Sequencing; Chemicalsynthesis of Oligonucleotide	1
3.9	Mutation Detection: SSCP, DGGE, RFLP.	1
4	**cDNA Analysis**	
4.1	Insertion of Foreign DNA Into Host Cells; Transformation, Electroporation, Transfection	1

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4.2	Construction of Libraries; Isolation of Mrna and Total RNA	1
4.3	Reverse Transcriptase and Cdna Synthesis	1
4.4	cDNA and Genomic Libraries	1
4.5	Construction of Microarrays – Genomic Arrays	1
4.6	cDNA Arrays and Oligo Arrays	1
4.7	Study of Protein-DNA Interactions Electrophoretic Mobility Shift assay; DNase Foot printing	1
4.8	Methyl Interference Assay, Chromatin Immunoprecipitation	1
4.9	Protein-Protein Interactions; Phage Display.	1
5	**Gene Silencing And Genome Editing Technologies**	
5.1	Gene Silencing Techniques; Introduction to siRNA; Sirna Technology.	1
5.2	Micro RNA; Construction of siRNA Vectors	1
5.3	Principle and Application of Gene Silencing; Gene Knockouts and Gene Therapy	1
5.4	Creation of Transgenic Plants; Debate Over GM Crops;	1
5.5	Introduction to Methods of Genetic Manipulation in Different Model Systems E.G. FruitFlies (Drosophila), Worms (C.elegans)	1
5.6	Frogs (Xenopus), Fish (Zebra Fish) and Chick	1
5.7	Transgenic - Gene Replacement; Gene Targeting; Creation of Transgenic AndKnock-Out Mice	1
5.8	Disease Model; Introduction to Genome Editing By CRISPR-CAS With Specific emphasis onChinese And American Clinical Trials	1
	Total	45

Course Designer(s)

Dr.M.Nithya – nithyam@ksrct.ac.in

Passed in BoS Meeting held on 20/06/2025
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70 PDB 202	Immunology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To learn about structural features of components of immune system and their function
- To impart the knowledge in development of various cells involved in immunity
- To study about the response of natural immune system and reactions towards infectious diseases
- To understand the interaction of immune cells during transplantation procedures
- To emphasize their significance in developing therapeutic modalities for immunological disorders of human beings

Pre-requisites

- Basics of Immunology

Course Outcomes

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

CO1	Identify the features of cells, tissues, organs of immune system and nature of antigens.	Understand
CO2	Evaluate the effectiveness and need of immunology in different pharmaceutical companies	Apply
CO3	Identify proper research lab working in area of their own interests	Apply
CO4	Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic lymphocyte response and figure out kind of immune responses in the setting of infections (bacterial).	Apply
CO5	Assess the mechanism of transplant acceptance, rejection and functions of tumor antigens.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	2	3
CO2	3	3	2	3	2	3
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	2	2	2	3	2	1
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	30	30	40
Apply	10	10	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PDB 202- Immunology

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

Immunology: Fundamental Concepts and Anatomy of the Immune system Components of Innate and Acquired Immunity; Phagocytosis; Complement and in Fl A M Matory Responses; Pathogen Recognition Receptors (PRR) and Pathogen Associated Molecular Pattern (PAMP); Innate; Mucosal Immunity; Antigens: Immunogens, Haptens; Major Histocompatibility Complex: MHC Genes, MHC and Immune Responsiveness and Disease Susceptibility.	. [9]
Immune Responses Generated by B and T Lymphocytes Immunoglobulin's - Basic Structure, Classes & Subclasses of Immunoglobulin's, Antigenic Determinants; Multigame Organization of Immunoglobulin Genes; B-Cell Receptor; Immunoglobulin Superfamily; Principles of Cell Signaling; Basis of Self & Non-Self-Discrimination; Kinetics of Immune Response, Memory; B Cell Maturation, Activation and Differentiation; Generation of Antibody Diversity; T-Cell Maturation, Activation and Differentiation and T-Cell Receptors; Functional T Cell Subsets; Cell-Mediated immune Responses, ADCC; Cytokines: Properties, Receptors and Therapeutic Uses; Antigen Processing and Presentation- Endogenous Antigens, Exogenous Antigens, Non- Peptide Bacterial Antigens a and Super-Antigens; Cell-Cell Co-Operation, Hapten-Carrier System.	. [9]
Antigen-Antibody Interactions Precipitation, Agglutination and Complement Mediated Immune Reactions; Advanced Immunological Techniques Ria, Elisa, Western Blotting, Elispot Assay, Immunofluorescence Microscopy, Flow Cytometry and Immunoelectron Microscopy; Surface Plasmon Resonance, Biosensor Assays for Assessing Ligand –Receptors Interaction; cMITechniques: Lymph proliferation Assay, Mixed Lymphocyte Reaction, Cell Cytotoxicity Assays, Apoptosis, Microarrays, Transgenic Mice, Gene Knock Outs.	[9]
Vaccinology Active and Passive Immunization; Live, Killed, Attenuated, Subunit Vaccines; Vaccine Technology: Role and Properties of Adjuvants, Vaccines - Recombinant DNA, Protein Based Vaccines, Plant- Based Vaccines, Reverse Vaccinology; Monoclonal Antibodies; Catalytic Antibodies and Generation of Immunoglobulin Gene Libraries, Idiotic Vaccines and Marker Vaccines, Viral-Like Particles, Dendritic Cell Based Vaccines, Vaccine Diseases; Mechanism and Role of CD4+ T Cells; Treatment of Autoimmune Diseases; Transplantation: Immunological Basis of Graft Rejection; Clinical Transplantation and Immunosuppressive Therapy; Tumor Immunology: Tumor Antigens; Immune Response to Tumors and Tumor Evasion of The Immune System, Cancer Immunotherapy; Immunodeficiency: Primary Immunodeficiency's, Acquired or Secondary Immunodeficiency's, Anaphylactic Shock, Major Histocompatibility Complex Genes and Their Role In Autoimmune and Infectious Diseases, HLA Typing, Human Major Histocompatibility Complex (MHC), Genetic Studies of Rheumatoid Arthritis, Systemic Lupus Erythematous and Multiple Sclerosis against Cancer, T Cell Based Vaccine, Edible Vaccine and Therapeutic Vaccine.	. [9]
Clinical Immunology & Immunogenetics Immunity To Infection: Bacteria, Viral, Fungal and Parasitic Infections (With Examples From Each Group) Hypersensitivity: Type I-Iv; Autoimmunity; Types of Autoimmune Diseases; Mechanism and Role of Cd4+ T Cells; Treatment of Autoimmune Diseases; Transplantation: Immunological Basis of Graft Rejection; Clinical Transplantation and Immunosuppressive Therapy; Tumor Immunology: Tumor Antigens; Immune Response To Tumors and Tumor Evasion of The Immune System, Cancer Immunotherapy; Immunodeficiency: Primary Immunodeficiency's, Acquired Or Secondary Immunodeficiency's, Anaphylactic Shock, Major Histocompatibility Complex Genes and Their Role In Autoimmune and Infectious Diseases, HIA Typing, Human Majo Histocompatibility Complex (MHC), Genetic Studies of Rheumatoid Arthritis, Systemic Lupus Erythematosus and Multiple Sclerosis	. [9]

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Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

	Total Hours:	**45**
Text Book(s):		
1.	Owen, J., Punt, J andStrandford, S. “Kuby Immunology”, 7th Ed., W. H. Freeman Publication, New York, USA, 2012.	
2.	Roitt, I., Brostoff, J. andDavid, M. “Immunology”, 6th Ed., Mosby publishers Ltd., New York, USA, 2001.	
Reference(s):		
1.	Abbas, K. A., Litchman, A. H. andPober, J. S. “Cellular andMolecular Immunology”, 4th Ed., W. B. Saunders Co., Pennsylvania, USA, 2005	
2.	Tizard, R.I. “Immunology”, 4 th Ed., Saunders college publishing, Chennai Microprint Pvt. Ltd., Chennai, 2004.	
3.	Murphy, K., Travers, P., Walport, M., andJaneway, C. Janeway’s Immunobiology. New York:Garland Science,2012	
4.	Parham, P. The Immune System. New York: Garland Science,2005	

Course Contents and Lecture Schedule

S. No.	Topics	**No. of hours**
1	**Immunology: fundamental concepts and anatomy of the immune**	
1.1	Components of Innate and Acquired Immunity	1
1.2	Phagocytosis; Complement and Inflammatory Responses	1
1.3	Pathogen Recognition Receptors (PRR) and Pathogen Associated molecular Pattern (PAMP)	1
1.4	Innate Immune Response; Mucosal Immunity	1
1.5	Antigens: Immunogens, Haptens	1
1.6	Major Histocompatibility Complex: MHC Genes, MHC and immune responsiveness and disease Susceptibility	1
2	**Immune Responses Generated by B and T Lymphocytes**	
2.1	Immunoglobulin’s - Basic Structure, Classes & Subclasses of Immunoglobulin Ulins, Multigene Organization Of Immunoglobulin Genes	2
2.2	B-Cell Receptor; Immunoglobulin Superfamily; Principles of Cell Signaling; Basis of Self & Non-Self-Discrimination; Kinetics of Immune Response, Memory;	1
2.3	B Cell Maturation, Activation and differentiation; Generation of Antibody diversity	1
2.4	T-Cell Maturation, Activation and differentiation and T-Cell Receptors	2
2.5	Functional T Cell Subsets; Cell-Mediated Immune Responses.	1
2.6	Cytokines: Properties, Receptors and therapeutic Uses	1
2.7	Antigen Processing And Presentation- Endogenous Antigens, Exogenous Antigens	2
2.8	Non-Peptide Bacterial Antigens Andsuper-Antigens; Cell-Cell Co-Operation, Hapten-Carrier System	1
3	**Antigen-Antibody Interactions**	
3.1	Precipitation, Agglutination and complement Mediated Immunoreaction, Flow Cytometry And Immune electron Microscopy	2
3.2	Advanced Immunological Techniques: RIA, ELISA, Western Blotting, ELISPOT Assay, Immunofluorescence Microscopy	2
3.3	Surface Plasmon Resonance, Biosensor Assays for Assessing Ligand – Receptor Interaction	2
3.4	CMI Techniques: Lymph proliferation Assay, Mixed Lymphocyte Reaction	2
	Cell Cytotoxicity Assays, Apoptosis, Microarrays, Transgenic Mice, Gene knock Outs	1
4	**Vaccinology**	

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4.1	Active and passive Immunization; Live, Killed, Attenuated, Subunit vaccines	2
4.2	Vaccine Technology: Role and properties of Adjuvants, Vaccines	2
4.3	Recombinant DNA, Protein-Based Vaccines, Plant-Based Vaccines, Reverse Vaccinology	1
4.4	Monoclonal Antibodies; Catalytic Antibodies and generation of Immunoglobulin Gene Libraries	2
4.5	Idiotic Vaccines and marker Vaccines, Viral-Like Particles (VIP's)	2
4.6	Dendritic Cell-Based Vaccines, Vaccine Against Cancer	1
4.7	T Cell-Based Vaccine, Edible Vaccine and therapeutic Vaccine	1
5	**Clinical Immunology & Immunogenetics**	
5.1	Immunity To Infection: Bacteria, Viral, Fungal an parasitic Infections(With Examples From Each Group)	1
5.2	Hypersensitivity: Type I-IV	1
5.3	Autoimmunity; Types of Autoimmune Diseases; Mechanism and role of cd4+ T Cells; Treatment of Autoimmune Diseases	1
5.4	Transplantation: Immunological Basis of Graft Rejection; Clinical transplantation And immunosuppressive Therapy;	1
5.5	Tumor Immunology: Tumor Antigens; Immune Response to Tumors and tumor Evasion of The Immune System, Cancer Immunotherapy;	1
5.6	Immunodeficiency: Primary Immunodeficiency's, Acquired or Secondary Immunodeficiency's, Anaphylactic Shock	1
5.7	Major Histocompatibility Complex Genes and Their Role in Auto Immune and Infectious Diseases , HLA Typing, Human Major Histocompatibility Complex (MHC),	1
5.8	Genetic Studies of Rheumatoid Arthritis, Systemic Lupus Erythematous and Multiple Sclerosis	1
	Total	45

Course Designers

Dr.K. Syed Zameer Ahmed K - syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 20/06/2025
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70 PDB 203	Bioprocess Engineering and Technology	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To understand the fundamental concepts of bioprocess technology and its related applications.
- To meet the challenges of the new and emerging areas of biotechnology industry
- To design a kinetic parameters of cell growth of structured and unstructured models of
- Microbial growth to identify the mechanical aspects of reactor design with respect to the Construction of ancillaries.
- Determine the production and recovery process of novel bio based products for commercial aspects.

Pre-requisites

- **Bioprocess Technology**

Course Outcomes

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

CO1	Understand the design and operations of various fermenters.	Understand
CO2	Determine the stoichiometric calculations and specify models of their growth	Apply
CO3	Analyze any bioprocess from an economics/market point of view.	Apply
CO4	Analyze and interpret yield, oxygen transfer and production rates of biological production process.	Analyze
CO5	Investigate the importance of microbial/enzymatic industrial processes in food and fuel industry	Analyze

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	2	2	3	2	3
CO2	2	3	3	2	3	3
CO3	2	3	3	3	2	3
CO4	3	3	3	3	2	3
CO5	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 - Some						

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech - Biotechnology

70 PDB 203- Bioprocess Engineering and Technology

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

Biochemical Engineering and Stoichiometry Models of Microbial Growth Isolation, Screening and Maintenance of Industrially Important Microbes; Microbial Growth and Death Kinetics; Strain Improvement for Increased Yield and Other Desirable Characteristics. Elemental Balance Equations; Metabolic Coupling -Atp and Nad+; Yield Coefficients; Unstructured Models of Microbial Growth; Structured Models of Microbial Growth, Mat lab Basics for Modelling	**[9]**
Bioreactor Design and Analysis Batch and Continuous Fermenters; Modifying Batch and Continuous Reactors: chemo stat With Recycle, Multistage Chemostat Systems, Fed-Batch Operations; Immobilized Cell Systems; Large Scale Animal and Plant Cell Cultivation; Fermentation Economics; Upstream Processing: Media Formulation and Optimization; Sterilization; Aeration, Agitation and Heat Transfer in Bioprocess; Scale Up and Scale Down; Measurement and Control of Bioprocess Parameters.	**[9]**
Downstream Processing and Process Economics Separation of insoluble products - filtration, centrifugation, sedimentation, flocculation; Cell disruption; separation of soluble products: liquid-liquid extraction, precipitation, chromatographic techniques, reverse osmosis, ultra and micro filtration, electrophoresis; final purification: drying; crystallization; storage and packaging.	**[9]**
Applications of Enzyme Technology In Food Processing Mechanism of enzyme function and reactions in process techniques; enzymatic bioconversions e.g. starch and sugar conversion process and their downstream processing; baking, beer mashing and chill proofing; cheese making by various other enzyme catalytic actions in food processing. Fermented foods, beverages and their purification; bioconversion of other food wastes to useful products; bacteriocins from lactic acid bacteria: production and applications in food preservation; biofuels and bio refinery; single cell protein; probiotics and prebiotics.	**[9]**
Applications of Biotechnology in Production of Biologically Industrial Production of Penicillin Via Fungal Route, Insulin From Recombinant E. Coli; Production of Antibiotics in A Reactor; Production of Metabolites Such As Shikonin Using Plant Cell Culture, Astaxanthin From Algae, and Biotransformation Routes for Novel/Specialty Chemicals; Production of Hbs Ag Using Yeast Cultures, Erythropoietin Using CHO Cells, Monoclonal Antibodies Such As Humira Using Mammalian Cells	**[9]**
Total Hours:45+15(Tutorial)	60

Text Book(s):

1.	Rao, D.G., “Introduction to Biochemical Engineering”, Second Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, India, 2010.
2.	Shuler, M. L., & Kargi, F. Bioprocess Engineering: Basic Concepts. Upper Saddle River, NJ: Prentice Hall. 2002

Reference(s):

1.	Roger Harrison Bioseparations Science and Engineering, Oxford University Press. 2003
2.	Atkinson B and Mavitona F.“Biochemical Engineering - An Biotechnology Handbook, McGraw Hill,UK, 1991.
3.	Harrison, R.G., Todd, P., Rudge, S.R., and Petrides, D.P. Bioseparations Science and Engineering. 2nd Edition. Oxford University Press.) 2015.
4.	Roger Harrison Bio separations Science and Engineering, Oxford University Press. 2003

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1	**Biochemical Engineering and Stoichiometry Models of Microbial Growth**	
1.1	Isolation, Screening and Maintenance of Industrially Important microbes	2
1.2	Microbial Growth and Death Kinetics	1
1.3	Strain Improvement for Increased Yield and Other Desirable Characteristics	2
1.4	Elemental Balance Equations	1
1.5	Metabolic Coupling -ATP and NAD+; Yield Coefficients	2
1.6	Unstructured Models of Microbial Growth	2
	Structured Models of Microbial Growth, MATLAB Basics for Modelling	1
2	**Bioreactor Design and Analysis**	
2.1	Batch and Continuous Fermenters	2
2.2	Modifying Batch and Continuous Reactors: Chemostat With Recycle, Multistage Chemostat Systems	1
2.3	Fed-Batch Operations; Immobilized Cell Systems	1
2.4	Large Scale Animal and Plant Cell Cultivation	2
2.5	Fermentation Economics	2
2.6	Upstream Processing: Media Formulation and Optimization	2
2.7	Sterilization; Aeration, Agitation and Heat Transfer In Bioprocess	2
2.8	Scale Up and Scale Down	2
2.9	Measurement and Control of Bioprocess Parameters	2
3	**Downstream Processing and Process Economics**	
3.1	Separation of Insoluble Products - Filtration, Centrifugation, Sedimentation, Flocculation	2
3.2	Cell Disruption	2
3.3	Separation of Soluble Products: Liquid-Liquid Extraction, Precipitation	2
3.4	Chromatographic Techniques, Reverse Osmosis, Ultra and Microfiltration, Electrophoresis	2
3.5	Final Purification: Drying; Crystallization; Storage and Packaging.	2
4	**Applications Of Biotechnology In Production of Biological**	
4.1	Mechanism of Enzyme Function and Reactions In Process Techniques	2
4.2	Enzymatic Bioconversions *E.G.* Starch and Sugar Conversion Process and Their Downstream Processing	2
4.3	Baking, Beer Mashing and Chill Proofing	2
4.4	Cheese Making By Various Other Enzyme Catalytic Actions processing	2
4.5	Fermented Foods, Beverages and Their Purification; Bioconversion of Other Food Wastes to Useful Products	2
5	**Applications of Biotechnology in Production of Biologically**	
5.1	Industrial Production of Penicillin Via Fungal Route, Insulin From Recombinant E. Coli	2
5.2	Production of Antibiotics in a Reactor; Production of Metabolites Such as Shikonin Using Plant Cell Culture.	1
5.3	Astaxanthin From Algae, And Biotransformation Routes for Novel/Specialty Chemicals	2
5.4	Production of Hbs Ag Using Yeast Cultures	2
5.5	Erythropoietin Using CHO Cells	2
5.6	Monoclonal Antibodies Such as Humira Using Mammalian Cells	2
5.7	Monoclonal Antibodies Such as Using Mammalian Cells	2
	Total	60

Course Designers

1. Dr. Mythili Gnanamangai - mythilignanamangai@ksrct.ac.in

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70 PDB 204	Biopharmaceutical Technology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To Understand the basics concepts of pharmacology
- To know about the drug manufacturing process and kinetics
- To learn about the biopharmaceutical quality assurance
- To understand the concepts of dosage forms.
- To distinguish the roles and responsibilities of different regulatory bodies in manufacturing of drugs.

Pre-requisites

- **Basics of Biopharmaceutical**

Course Outcomes

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

CO1	Describe the classification of drugs and the different routes for drug Administration.	Understand
CO2	Illustrate the manufacturing facilities of drugs and quality control in drug manufacturing process.	Understand
CO3	Explicate the concepts of adsorption, distribution, biotransformation process and bioavailability of drugs.	Apply
CO4	Designate the classification of pharmaceutical dosage forms, use of semi- solid dosage form and inhalants	Apply
CO5	Determine the role of Quality assurance and regulatory affairs in biological	Apply

Mapping with Programme Outcomes

COs	POs					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	-	2	-	3
CO2	3	3	3	1	2	3
CO3	3	3	-	-	3	-
CO4	-	3	-	-	3	-
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	30	30	30
Understand	30	20	40
Apply	-	10	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Approved in Academic Council Meeting held on 19/07/2025

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB 204 - Biopharmaceutical Technology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	**3**	**0**	**0**	**45**	**3**	**40**	**60**	**100**

Introduction to Pharmacology Drug- Definition, Classification and Physiochemical Properties, Pharmaceutical Substances of Plant Origin- Pharmaceuticals of Animal Origin- Pharmaceuticals of Animal Origin, Pharmaceutical Substances of Microbial Origin - Routes of Administration of Drug.	**[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, Ointments Semi-Solid – Ointments, Creams, Gels, Inhalations and Inhalants, 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, Second Edition, 2003.
Reference(s):	
1.	Goodman & Gilman’s “The Pharmacological Basis of Therapeutics”,11th edition, Mc Graw-Hill MedicalPublishing 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”, Second edition, Wiley, 2013
4.	Kenneth E. Acis, Vincent L. Wu, “Biotechnology and Biopharmaceutical Manufacturing, Processingand reservation”, Drug Manufacturing Technology series-Vol.2, CRC Press, 2020

Course Contents and Lecture Schedule

S. No.	Topics	No. of Hours
1	**Introduction To Pharmacology**	
1.1	Drug- Definition, Classification and Physiochemical Properties	1

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1.2	Pharmaceutical Substances of Plant Origin	1
1.3	Pharmaceuticals of Animal Origin	1
1.4	Pharmaceutical Substances of Microbial Origin	1
1.5	Routes of Administration of Drug	1
1.6	Unstructured Models of Microbial Growth	1
2	**The Drug Manufacturing Process**	
2.1	The Manufacturing Facility, Cleaning, Decontamination and Sanitation (CDS)	2
2.2	Documentation, Specifications, Records	1
2.3	Compression and Granulation of Tablets	1
2.4	Coating of Pharmaceutical Dosage Forms- Film Coating,	2
2.5	Modified Release Film Coating-Coating Procedure and Equipment.	2
2.6	Quality Control and Practice	1
3	**Pharmacokinetics and Biotransformation**	
3.1	Basic Concepts of Pharmacokinetics: Absorption- Mechanism of Drug Absorption	2
3.2	Distribution- Biotransformation of Drug-Non Synthetic and Synthetic Reaction	2
3.3	Elimination	2
3.4	Organ Clearance- Hepatic Clearance, Renal Clearance	2
3.5	Bioavailability and Bioequivalence	1
4	**Pharmaceutical Dosage Forms**	
4.1	Definition of Dosage Forms, Classification of Dosage Forms -Solid Unit Dosages	2
4.2	Tablets, Capsules, Pills, Troches, Cachets, Liquids	2
4.3	Solutions, Lotions, Suspension, Elixirs, Emulsions	1
4.4	Ointments Semi-Solid – Ointments, Creams, Gels	2
4.5	Inhalations and Inhalants	2
4.6	Extracts- Tinctures and Fluid Extracts.	1
5	**Biopharmaceuticals Quality Assurance**	
5.1	The Role of FDA (Food and Drug Administration Process)	2
5.2	Role of Centre For Biological Evaluation and Research (CBER)	2
5.3	Role of Centre For Drug Evaluation and Research	2
5.4	Global Harmonization of Regulatory Affairs	2
5.5	European Medicine Evaluation Agency (EMEA)	2
5.6	Indian Pharmacopeia (IP)-United States Pharmacopeia (USP).	1
	Total	**45**

Course Designer(s)

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB 205	Bioreactor Operations	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To understand the biological reactions and elements of bioreactor design.
- To analyse the fundamentals of mass and energy balances in biological reactions.
- To design and analyse the important bioreactors for microbial, animal and plant cell processes.
- To identify various kinetic models and the mechanical aspects of reactor design.
- To make the students to undertake research / project work in designing of novel bioreactor forcommercial aspects.

Pre-requisites

- Bioprocess Technology

Course Outcomes

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

CO1	Understand the design and applications of various bioreactors.	Understand
CO2	Analyze bioprocess from an economics/market point of view.	Apply
CO3	Develop bioreactor geometry, their scale up and scale down.	Apply
CO4	Design consideration and process strategies for plant and animal bioreactors'	Analyze
CO5	Investigate the concept and the applications of enzyme immobilization and bioconversion	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	3	1	2	1	-
CO2	3	2	1	1	2	-
CO3	2	3	1	2	1	-
CO4	3	2	1	1	2	-
CO5	2	1	3	2	1	-
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	20	20	30
Apply	10	20	30
Analyze	-	10	20
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB 205 - Bioreactor Operations								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	**3**	**1**	**0**	**60**	**4**	**40**	**60**	**100**

Introduction to Bioreactor Design Introduction; General Design Information; Material and Energy Balance Calculations; Process Flow.	**[9]**
Scale Up and Scale Down Processes Scale Up and Scale Down Issues: Effect of Scale on Oxygenation, Mixing, Sterilization, pH, Temperature, Inoculum Development, Nutrient Availability and Supply; Bioreactor Scale-Up Based on Constant Power Consumption Per Volume, Mixing Time, Impeller Tip Speed (Shear), Mass Transfer Coefficients. Scale-Up of Downstream Processes: Adsorption (Lubmethod); Chromatography (Constant Resolution Etc.); Filtration (Constant Resistance Etc.); Centrifugation (Equivalent Times Etc.); Extractors (Geometry Based Rules). Scale-Down Related Aspects.	**[9]**
Design of Bioreactors Selection of Bioprocess Equipment (Upstream and Downstream); Specifications of Bioprocess Equipment; Mechanicaldesign of Reactors, Heat Transfer and Mass Transfer Equipment; Design Considerations for Maintaining Sterility of Process Streams and Process Equipment; Piping and Instrumentation; Materials of Construction for Bioprocess Plants.	**[9]**
Basic Bioreactor Operations Spectrum of Basic Bioreactor Operations: Immobilized Cell System, Animal Cells, Plant Cell Cultures and Waste Management; Enzyme Immobilization Techniques; Bioconversion Using Immobilized Enzyme Preparation; Bioconversion In Batch, Fed-Batch and Continuous Bioreactors; Mass Transfer In Immobilized Cell/Enzyme Reactor.	**[9]**
Bioreactor Facility Design Facility Design Aspects; Utility Supply Aspects; Equipment Cleaning Aspects; Culture Cell Banks; CGMP Guidelines; Validation;Safety; Process Economics; Case Studies.	**[9]**
Total Hours:45+15(Tutorial)	60

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, Second Edition, 2003.
Reference(s):	
1.	Goodman & Gilman’s “The Pharmacological Basis of Therapeutics”,11th edition, Mc Graw-Hill MedicalPublishing 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”, Second edition, Wiley, 2013.
4.	Kenneth E. Acis, Vincent L. Wu, “Biotechnology and Biopharmaceutical Manufacturing, Processingand reservation”, Drug Manufacturing Technology series-Vol.2, CRC Press, 2020.

Course Contents and Lecture Schedule

Passed in BoS Meeting held on 20/06/2025
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S. No.	Topics	No. of Hours
1	**Introduction to Bioreactor Design**	
1.1	Introduction; General Design Information	2
1.2	Material and Energy Balance	2
1.3	Material and Energy Balance Calculations	2
1.4	Process Flow	2
1.5	Process Flow - Calculation	2
2	**Scale Up and Scale Down Processes**	
2.1	Scale Up and Scale Down Issues: Effect of Scale on Oxygenation.	2
2.2	Mixing, Sterilization, pH, Temperature, Inoculum Development, Nutrient Availability and Supply	1
2.3	Bioreactor Scale-Up Based on Constant Power Consumption Per Volume.	2
2.4	Mixing Time, Impeller Tip Speed (Shear).	2
2.5	Mass Transfer Coefficients. Scale-Up of Downstream Processes:	2
2.6	Adsorption (Lubmethod); Chromatography (ConstantResolution etc	2
2.7	Filtration -Constant Resistance etc.	2
2.8	Centrifugation (Equivalent Times etc	1
2.9	Extractors (Geometry Based Rules).	2
	Scale-Down Related Aspects	2
3	**Design of Bioreactors**	
3.1	Selection of Bioprocess Equipment (Upstream and Downstream);.	2
3.2	Specifications of Bioprocess Equipment	2
3.3	Mechanical design of Reactors, Heat Transfer and Mass Transfer Equipment.	2
3.4	Design Considerations for Maintaining Sterility of Process Streams and ProcessEquipment.	2
3.5	Piping and Instrumentation; Materials of Construction for Bioprocess Plants	2
4	**Basic Bioreactor Operations**	
4.1	Spectrum of Basic Bioreactor Operations: Immobilized Cell System,	1
4.2	Animal Cells, Plant Cell Cultures and Waste Management;	2
4.3	EnzymeImmobilization Techniques; Bioconversion Using Immobilized Enzyme Preparation	2
4.4	Bioconversion in Batch, Fed-Batch.	2
4.5	Continuous Bioreactors; Mass Transfer In Immobilized Cell	2
4.6	Enzyme Reactor	2
5.	**Bioreactor Facility Design**	2
5.1	Facility Design Aspects	
5.2	Utility Supply Aspects;	2
5.3	Equipment Cleaning Aspects	1
5.4	Culture Cell Banks	2
5.5	CGMP Guidelines; Validation;Safety	2
5.6	Process Economics; Case Studies	2
	Total	60

Course Designer(s)

Dr.Philip Robinson J - philiprobinson@ksrct.ac.in

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB 206	Computational Biology	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To provide students with theory and practical experience of essentials to aid for genomic, proteomic andmetabolomics course
- To choose appropriate tools and databases for specific bioinformatics analysis
- To learn about the database structures used in biological databases
- To introduce basic genomic and transcriptomic sequence processing algorithms
- To expose the students to emerging areas in the field of new biology from a computational perspective.

Pre-requisites

- Bioinformatics

Course Outcomes

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

CO1	Get acquainted with various biological primary databases, secondary databases anddifferent sequence formats.	Understand
CO2	Characterize the optimal alignment of sequences either by local or global algorithm andapply Database searching algorithms to infer unknown sequences	Apply
CO3	Critically analyze and interpret results of their study with respect to Genome Analysis	Apply
CO4	Analyze the bio-molecular interactions, structure validation and optimization usingvisualization tools	Apply
CO5	Predict protein secondary and 3D structure from primary sequence with validation andanalyze the Force field parameters in molecular interaction	, Analyze

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	3	1	2	1	-
CO2	3	2	1	1	2	-
CO3	2	3	1	2	1	-
CO4	3	2	1	1	2	-
CO5	2	1	3	2	1	-
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	20	30
Apply	10	20	30
Analyze	-	-	20
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB 206 – Computational Biology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	**3**	**0**	**0**	**45**	**3**	**40**	**60**	**100**

Introduction to Computational Biology Basics and Biological Databases Computers in Biology and Medicine; Overview of Biological Databases, Nucleic Acid & Protein Databases, Primary, Secondary, Functional, Composite, Structural Classification Database, Sequence Formats & Storage, Access Databases, Extract and Create Sub Databases, Limitations of Existing Databases.	**[9]**
Pairwise and Multiple Sequence Alignments Local Alignment, Global Alignment, Scoring Matrices - PAM, Blosum, Gaps and Penalties, Dot Plots. DynamicProgramming Approach: Needleman and Wunsch Algorithm, Smith and Waterman Algorithm, Hidden Markov Model: Viterbi Algorithm. Heuristic Approach: Blast, Fasta. Building Profiles, Profile Based Functional Identification	**[9]**
Genome Analysis Polymorphisms in DNA Sequence, Introduction to Next Generation Sequencing Technologies, Whole genome Assembly and Challenges, Sequencing and Analysis of Large Genomes, Gene Prediction, Functional Annotation, Comparative Genomics, Probabilistic Functional Gene Networks, Human genome Project, Genomics and Crop Improvement. Study Available G was, Encode, Hugo Projects, Extract and Build Sub Databases; Visualization Tools Including Artemis and Vista for Genome Comparison; Functional Genomics Case Studies.	**[9]**
Structure Visualization Retrieving and Drawing Structures, Macromolecule Viewing Platforms, Structure Validation and Correction,Structure Optimization, Analysis of Ligand-Protein Interactions; Tools Such As Pymol or VMD	**[9]**
Molecular Modelling and Drug Development Significance and Need, Force Field Methods, Energy, Buried and Exposed Residues; Side Chains and neighbors; Fixed Regions; Hydrogen Bonds; Mapping Properties Onto Surfaces; rMS Fit of Conformers and Protein Chains, Assigning Secondary Structures; Sequence Alignment: Methods, Evaluation, Scoring; Protein Curation: Backbone Construction and Side Chain Addition; Different Types of Protein Chain Modelling: Ab Initio, Homology, Hybrid, Loop; Template Recognition and Alignments; Modelling Parameters and Considerations; Model Analysis and Validation; Molecular Docking: Types and Principles, Semi-Flexible Docking, Flexible Docking; Ligand and Protein Preparation, Macromolecule and Ligand Optimization, Quantitative Structure Activity Relationships	**[9]**
Total Hours:	**45**

Text Book(s):	
1.	Lesk, A. M. Introduction to Protein Science: Architecture, Function, and Genomics. Oxford: Oxford UniversityPress. 2004
2.	Rastogi, S.C., “Bioinformatics – Concepts, skills and applications”, CBS Publishers and Distributors, New Delhi, India, 2003.
Reference(s):	
1.	Mount, D. W. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2001
2.	Opera, T. Chemo informatics in Drug Discovery, Volume 23. Wiley Online Library. 2005
3.	Campbell, M & Heyer, L. J. Discovering Genomics, Proteomics and Bioinformatics, Pearson Education. 2006.
4.	Bourne, P. E., & Gu, J. Structural Bioinformatics. Hoboken, NJ: Wiley-Liss. 2009.

Course Contents and Lecture Schedule

S. No.	Topics	No. of

Passed in BoS Meeting held on 20/06/2025
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		Hours
1	**Introduction to Computational Biology Basics and Biological Databases**	
1.1	Computers in Biology and Medicine	1
1.2	Overview of Biological Databases	1
1.3	Nucleic Acid & Protein Databases	1
1.4	Primary, Secondary Databases	1
1.5	Functional, Composite, Structural Classification in Database,	1
1.6	Sequence Formats & Storage	1
1.7	Access Databases	1
1.8	Extract and Create Sub Databases	1
1.9	Limitations of Existing Databases.	1
2	**Pairwise And Multiple Sequence Alignments**	
2.1	Local Alignment, Global Alignment	1
2.2	Scoring Matrices - PAM, BLOSUM	1
2.3	Gaps and Penalties , Dot Plots	1
2.4	Dynamic Programming Approach: Needleman and Wunsch Algorithm	1
2.5	Dynamic Programming Approach: Smith and Waterman Algorithm	1
2.6	Hidden Markov Model: Viterbi Algorithm	1
2.7	Heuristic Approach: BLAST & FASTA	1
2.8	Building Profiles	1
2.9	Profile Based Functional Identification, Scale-Down Related Aspects	1
3	**Genome Analysis**	
3.1	Polymorphisms in DNA Sequence	1
3.2	Introduction to Next Generation Sequencing Technologies	1
3.3	Whole Genome Assembly and Challenges	1
3.4	Sequencing And Analysis of Large Genomes	1
3.5	Gene Prediction, Functional Annotation, Comparative Genomics	1
3.6	Probabilistic Functional Gene Networks	1
3.7	Human Genome Project	1
3.8	GWAS, ENCODE, HUGO Projects	1
3.9	Functional Genomics Case Studies	1
4	**Structure Visualization**	
4.1	Visualization tools - Artemis	1
4.2	Vista tool for genome comparison	1
4.3	Retrieving and drawing structures	1
4.4	Macromolecule viewing platforms	1
4.5	Structure validation and correction	1
4.6	Structure optimization	1
4.7	Analysis of ligand-protein interactions	1
4.8	Tools such as PyMol or VMD	1
4.9	Active Site Prediction - PyMol	1
5.	**Molecular Modelling and Drug Development**	
5.1	Significance And Need, Force Field Methods, Energy, Buried and exposed Residues;	1
5.2	Side Chains and Neighbours; Fixed Regions; Hydrogen Bonds;	1

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	Mapping properties ontoSurfaces	
5.3	RMS Fit of Conformers and Protein Chains, Assigning Secondary structures;	1
5.4	Sequence Alignment: Methods, Evaluation, Scoring;	1
5.5	Protein Curation: Backbone Construction and Side Chain Addition;	1
5.6	Different Types of Protein Chain Modelling: AB Initio, Homology, Hybrid, Loop; TemplateRecognition and Alignments; Modelling Parameters and Considerations; Model Analysis And Validation;	2
5.7	Molecular Docking: Types and Principles, Semi-Flexible Docking, Flexible Docking;Ligand and Protein Preparation,	1
5.8	Macromolecule and Ligand Optimization, Quantitative Structure Activity relationships	1
	Total	45

Course Designers

Dr.Puniethaa Prabhu – punithaa@ksrct.ac.in

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

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

Objectives

- To provide basic working and arrangement of operon concept
- To understand and implement gene off/on using mutagenesis and phage infection
- To impart the methods available for DNA extraction, amplification and quantification
- To handle gene transfer experiment and analyze the result
- To execute gene engineering experiments on their own with given transgene

Pre-requisites

- **Genetic Engineering Laboratory**

Course Outcomes

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

CO1	Perform and learn operon concept	Apply
CO2	Practice the mutagenesis and quantify the phage infection	Apply
CO3	Perform DNA extraction, amplification and quantification	Apply
CO4	Execute and interpret gene transfer experiments	Analyze
CO5	Engineer a cell/ microbe with r-DNA and perform the purification	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	2	2	2	-
CO2	3	2	2	2	-	3
CO3	3	2	2	2	2	-
CO4	3	2	2	2	-	2
CO5	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	15	50	75
Analyze	10	10	50	25
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech - Biotechnology								
70 PDB 2P1 - Molecular Biology and Genetic EngineeringLaboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

List of Experiments: (Any Ten Experiments)

1. Concept of lac-operon:

a. lactose induction of β-galactosidase.

b. Glucose Repression.

c. Diauxic growth curve of E. coli.

2. UV mutagenesis to isolate amino acid auxotroph.
3. Phage titre with λ phage/M13.
4. Genetic Transfer-Conjugation, gene mapping.
5. Plasmid DNA isolation and DNA quantitation.
6. Restriction Enzyme digestion of plasmid DNA.
7. Agarose gel electrophoresis.
8. Polymerase Chain reaction.
9. DNA Ligation.
10. Preparation of competent cells.
11. Transformation of E.coli with standard plasmids, Calculation of transformation efficiency.
12. Confirmation of the insert, Miniprep of recombinant plasmid DNA, Restriction mapping.
13. Expression of recombinant protein, concept of soluble proteins and inclusion body formation inE.coli,SDS-PAGE analysis
14. Purification of His-Tagged protein on Ni-NTA columns

a. Random Primer labeling

b. Southern hybridization.

Lab Manual

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

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 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB 2P2	Immunology Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To learn the basics of blood grouping antigens and its relation
- To know the components, present in of blood and its separation
- To identify and understand the concept of various immune cells present in blood
- To learn the significance of immune diffusion technique
- To understand the concepts of specific antigen and antibody reaction in identifying diseases

Pre-requisites

- **Immunology Laboratory**

Course Outcomes

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

CO1	Elaborate concepts of biochemistry with simple experiments	Apply
CO2	Understand principle and working of basic laboratory instruments	Apply
CO3	Perform the investigation for any kind of protein or enzyme	Apply
CO4	Identify the biomolecules using laboratory techniques.	Apply
CO5	Critically analyze and differentiate the techniques that can be appliedfor Industrial production	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	2	1	2	3	3
CO2	1	2	2	2	3	3
CO3	3	3	3	2	3	2
CO4	3	3	3	3	3	2
CO5	3	3	2	2	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech – Biotechnology								
70 PDB 2P2 - Immunology Laboratory								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	3	45	2	60	40	100

List of Experiments: (Any Ten Experiments)

1. Handling of animals like rabbits, mice.
2. Preparation of antigens, immunization and methods of blood collection, serum separation and storage.
3. Antibody titre by ELISA method.
4. Double diffusion, Immunoelectrophoresis
5. Radial Immuno diffusion.
6. Complement fixation test.
7. Isolation and purification of IgG from serum or IgY from chicken egg.
8. SDS-PAGE
9. Immunoblotting
10. Dot blot assays.
11. Blood smear identification of leucocytes by Giemsa stain.
12. Culture of Hela/J774 cells and phagocytosis.
13. Separation of mononuclear cells by Ficoll-Hypaque.
14. Differential leucocyte count under a microscope.

Lab Manual

1.	Immunology Laboratory manual, Department of Biotechnology, KSRCT.

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 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637 215
(An Autonomous Institution affiliated to Anna University)

M.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2025-2026)

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	70 PDB 301	Stem Cell Research and Applications	2	40	60	100	45	100
2	70 PDB 302	Bioentrepreneurship	2	40	60	100	45	100
3	70 PDB 303	Downstream Processing in Biotechnology	2	40	60	100	45	100
4	70 PDB 304	Research Methodology and Scientific Communication Skills	2	40	60	100	45	100
5	70 PDB 305	Intellectual property rights, Biosafety and	2	40	60	100	45	100
6	70 PDB E2*	Professional Elective II	2	40	60	100	45	100
PRACTICAL								
7	70 PDB 3P1	Downstream Processing in Biotechnology Laboratory	3	60	40	100	45	100
8	70 PDB 3P2	Project Work Phase -I	3	60	40	100	45	100
9	70 PDB3 P3	Internship / Industrial Training	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 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

70 PDB 301	Stem Cell Research and Applications	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To impart knowledge about stem cells and its sources.
- To know the difference of stem cells form their source.
- To develop the skills in the area of stem cell research and its applications.
- To widen the knowledge about the isolation of stem cell.
- To develop the culturing procedure and applications of stem cells to treat diseases.

Pre-requisites

- Cell Biology

Course Outcomes

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

CO1	Summarize the process of embryogenesis in humans and to discuss the various type's sources, characterization and plasticity of stem cells.	Understand
CO2	Identification of different stem cell growing patterns for maintenance of stem cell in bank based on the regulations of European and non-European countries	Apply
CO3	Understand the steps involved in the isolation and preparation of aerosphere mesenchyme stem cells and bone marrow stem cells	Understand
CO4	Summarize the stem cell based drug discovery and toxicological studies	Apply
CO5	Applications of stem cells in Parkinson's disease, Huntington's disease and Alzheimer's disease.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	-	-	1	1	-
CO2	3	2	1	2	3	3
CO3	3	3	3	1	3	2
CO4	3	3	-	1	3	-
CO5	3	3	1	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	20	10	30
Understand	20	30	40
Apply	20	20	30
analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB 301 - Stem Cell Research and Applications								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	**3**	**0**	**0**	**45**	**3**	**40**	**60**	**100**

Basics of Stem Cells Introduction to Tissue Organization on and Stem Cells - Unique Properties of Stem Cells - Differentiation of Stem Cells - Origin and Characterization of Human Stem Cells - Sources of Stem Cells: Cord Blood and Bone Marrow - Similarities and Differences Between Adult and Embryonic Stem Cells.	**[9]**
Human Embryonic Stem Cells In Vitro Fertilization on - Collection and Culturing of Embryos - Isolation Protocol – Importance of Blastocyst and Inner Cell Mass - Culturing, Identification and Characterization of HES Cells - Cloning and Controlled Differentiation of HES - Regulations in European Member and Non-European Countries Regarding HESc Research - Ethical Issues.	**[9]**
Adult Stem Cells Somatic Stem Cells - Different Types of Adult Stem Cells: Hematopoietic Stem Cells, Bone Marrow Stromal Stem Cells, Liver Stem Cells, Skeletal Muscle Stem Cells, Bone Marrow Derived Stem Cells - Tests for Identification - Trans Differentiation: Plasticity - Differentiation of Adult Stem Cells - Induced Pluripotent Cells.	**[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 Vs 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 -Development of Organs Such as Cornea, Wind Pipe and Pancreas - Application of Stem Cells in Bone Regeneration	**[9]**
Total Hours:	**45**

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.	Deb K.D and Totey S.M., "Stem cells basics and applications", Tata McGraw Hill Education Pvt. Ltd., New Delhi,2009.
2.	Gary S Stein et al., "Human stem cell Technology and Biology" a Research guide and Laboratory manual Wiley- Blackwell2011
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.

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Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Basics of Stem Cells**	
1.1	Introduction to Tissue Organization and Stem Cells	1
1.2	Unique Properties of Stem Cells	1
1.3	Differentiation of Stem Cells	1
1.4	Origin and Characterization of Human Stem Cells	1
1.5	Sources of Stem Cells: Cord Blood and Bone Marrow	2
1.6	Similarities and Differences Between Adult and Embryonic Stem Cells	2
2	**Human Embryonic Stem Cells**	
2.1	In Vitro Fertilization	1
2.2	Collection and Culturing of Embryos	2
2.3	Isolation Protocol	1
2.4	Importance of Blastocyst and inner Cell Mass	1
2.5	Culturing, Identification and Characterization of HES Cells	1
2.6	Cloning and Controlled Differentiation of HES	1
2.7	Regulations in European Member And Non-European Countries Regarding HES Cell	2
3	**Adult Stem Cells**	
3.1	Somatic Stem Cells	1
3.2	Different Types of Adult Stem Cells ,Hematopoietic Stem Cells	1
3.3	Bone Marrow Stromal Stem Cells, Liver Stem Cells, Skeletal Muscle Stem Cells	2
3.4	Bone Marrow Derived Stem Cells	1
3.5	Tests for Identification	1
3.6	Trans Differentiation: Plasticity	2
3.7	Differentiation of Adult Stem Cells - Induced Pluripotent Cells	1
4	**Stem Cell Therapy**	
4.1	Novel Stem Cell Based Gene Therapy	1
4.2	Genetically Engineered Stem Cells	1
4.3	Stem Cells and Animal Cloning	1
4.4	Transgenic Animals and Stem Cells	1
4.5	Stem Cell Therapy Vs Cell Protection	2
4.6	Stem Cell in Cellular Assays for Screening	1
4.7	Stem Cell Based Drug Discovery and Toxicological Studies	1
4.8	Hematopoietic Stem Cell Transplantation	1
5	**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,	1
5.3	Huntington's Disease and Alzheimer's Disease	1
5.4	Treatment of Cardiac Arrest	2
5.5	Development of Organs Such as Cornea, Wind Pipe and Pancreas	2
5.6	Application of Stem Cells in Bone Regeneration	1
	Total	45

Course Designer(s)

1. Dr.K.Syed Zameer Ahmed - syedzameerahmed@ksrct.ac.in

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB 302	Bioentrepreneurship	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To teach students about concepts and scope of bio entrepreneurship
- To design the strategy and operations of bio-sector firms
- To identify business strategy and marketing
- To acquire knowledge on finance and accounting
- To gain the aid from knowledge centre and technology transfer agencies

Pre-requisites

- Startups and Entrepreneurship

Course Outcomes

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

CO1	Gain Entrepreneurial Skills in Bio-Business.	Remember
CO2	Understand the Strategy and Operations Involved in Bio-Sector Firms.	Understand
CO3	Acquire the Knowledge on Designing the Strategy and Marketing in Bio-Business	Apply
CO4	Prepare Business Plan Towards Finance and Accounting and to Make Collaborations and Partnership With Companies	Apply
CO5	Pertaining Knowledge From Various Knowledge Centre And Technology Transfer Agencies To Become A Successful Bio entrepreneur	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	1	1	1	1	1	2
CO2	2	2	2	1	1	3
CO3	3	3	3	2	1	3
CO4	3	3	3	2	2	3
CO5	2	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	30	20	30
Understand	30	30	40
Apply	-	10	30
analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB 302 – Bioentrepreneurship								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Innovation and Entrepreneurship in Bio Business Introduction and Scope in Bio-Entrepreneurship, Types of Bio-Industries and Competitive Dynamics Between the Sub-Industries of the Bio-Sector (E.G. Pharmaceuticals Vs. Industrial Biotech), Entrepreneurship Development Programs of Public and Private Agencies (MSME, DBT, BIRAC, Make in India), Strategic Dimensions of Patenting & Commercialization Strategies.	**[9]**
Strategy and Operations of Bio-Sector Firms Factors Shaping Opportunities For Innovation and Entrepreneurship in Bio-Sectors, and the Business Implications of Those Opportunities, Alternatives Faced By Emerging Bio-Firms and the Relevant Tools For Strategic Decision.	**[9]**
Bio Markets: Business Strategy and Marketing Negotiating the Road From Lab to the Market (Strategies and Processes of Negotiation With Financers, Government and Regulatory Authorities), Pricing Strategy, Challenges in Marketing in Bio Business (Market Conditions & Segments; Developing Distribution Channels, the Nature, Analysis and Management of Customer Needs), Basic Contract Principles, Different Types of Agreement and Contract Terms Typically Found in Joint Venture and Development Agreements, Dispute Resolution Skills.	**[9]**
Finance and Accounting Business Plan Preparation Including Statutory and Legal Requirements, Business Feasibility Study, and Financial Management Issues of Procurement of Capital and Management of Costs, Collaborations & Partnership, and Information Technology.	**[9]**
Technology Management Technology – Assessment, Development & Up gradation, Managing Technology Transfer, Quality Control & Transfer of Foreign Technologies, Knowledge Centres and Technology Transfer Agencies, Understanding of Regulatory Compliances and Procedures (CDSCO, NBA GCP, GLA, GMP).	**[9]**
Total Hours:	**45**

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 Brutoniiiiiii, “Entrepreneurship: The Art, Science, and Process for Success”, 2nd Edition, Tata Mc Grawhill Company, New Delhi, 2016.

Reference(s):

1.	Onetti, A., & Zucchella, A.“Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge”. Routledge, 2014
2.	Jordan, J. F. “Innovation, Commercialization, and Start-Ups in Life Sciences”. London: CRC Press, 2014.
3.	Charles Bamford and Garry Bruton, “ENTREPRENEURSHIP: The Art, Science, and Process for Success”, 2nd Edition, Tata McGraw Hill Company, New Delhi, 2016
4.	Edward D. Hess, Growing an Entrepreneurial Business: Concepts and Cases, Stanford Business Books, 2011.

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Course Contents and Lecture Schedule

S.No	Topic	No. Of Hours
1	**Innovation and Entrepreneurship in Bio-Business**	
1.1	Introduction and Scope in Bio-Entrepreneurship	1
1.2	Types of Bio-Industries and Competitive Dynamics Between The Sub-Industries of The Bio- Sector	1
1.3	Case Studies on Pharmaceuticals Vs Industrial Biotech	1
1.4	Entrepreneurship Development Programs of Public and Private Agencies - MSME	1
1.5	DBT	1
1.6	BIRAC	1
1.7	Make in India	1
1.8	Strategic Dimensions of Patenting	1
1.9	Commercialization Strategies	1
2	**Strategy and Operations of Bio-Sector Firms**	
2.1	Factors Shaping Opportunities For Innovation and Entrepreneurship in Bio-Sectors	2
2.2	Business Implications of The Opportunities	2
2.3	Alternatives Faced By Emerging Bio-Firms	2
2.4	Tools For Strategic Decision.	2
2.5	Case Studies on Strategy and Operations of Bio-Sector Firms	1
3	**Bio Markets: Business Strategy and Marketing**	
3.1	Negotiating The Road From Lab to The Market (Strategies and Processes of Negotiation With Financers, Government and Regulatory Authorities)	2
3.2	Pricing Strategy	1
3.3	Challenges in Marketing in Bio Business - Market Conditions & Segments, Developing Distribution Channels	1
3.4	Challenges in Marketing in Bio Business - The Nature, Analysis and Management of Customer Needs	1
3.5	Basic Contract Principles	1
3.6	Different Types of Agreement and Contract Terms Typically Found in Joint Venture and Development Agreements	2
3.7	Dispute Resolution Skills	1
4	**Finance and Accounting**	
4.1	Business Plan Preparation Including Statutory and Legal Requirements	2
4.2	Business Feasibility Study	2
4.3	Financial Management Issues of Procurement of Capital and Management of Costs	2
4.4	Collaborations & Partnership	2
4.5	Information Technology	1
5	**Technology Management**	
5.1	Technology – Assessment, Development & Up gradation	2
5.2	Managing Technology Transfer	1
5.3	Quality Control & Transfer of Foreign Technologies	1
5.4	Knowledge Centers and Technology Transfer Agencies	2
5.5	Understanding of Regulatory Compliances and Procedures – CDSCO	1
5.6	Understanding of Regulatory Compliances and Procedures – NBA, GCP	1
5.7	Understanding of Regulatory Compliances and Procedures – GLA, GMP	1
	Total	**45**

Course Designer(s)

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70 PDB 303	Downstream Processing in Biotechnology	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To provide an overview of various aspects of recovery and processing of biological products.
- To understand the diversified applications of unit operations in bio separation
- To acquire knowledge on bio product concentration methods
- To understand bio product characterization
- To know process synthesis, analysis and design

Pre-requisites

- NIL

Course Outcomes

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

CO1	Identify and Design Relevant Unit Operations for Recovery of a Biological Product	Understand
CO2	Understand the Principle and Configuration of Solid-Fluid Recovery Methods	Apply
CO3	Demonstrate Product Concentration Methods and Scale up Strategies	Apply
CO4	Know Product Characterization and Stability Assays	Understand
CO5	Apply the Knowledge of Separation Strategies to Design Process Synthesis	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	2	2	2	-	2
CO2	-	-	-	-	-	-
CO3	-	-	-	-	3	-
CO4	-	-	-	-	-	-
CO5	-	-	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	20	20	30
Apply	10	20	30
Analyze	-	-	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech - Biotechnology

70 PDB 303 - Downstream Processing in Biotechnology

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

Biomass Removal and Cell Disruption Characteristics of Biological Materials: Pre-treatment Methods; Separation of Cell Mass: Centrifugation, Sedimentation, Flocculation and Filtration; Continuous Operation. Mechanical Approaches: Sonication, Bead Mills, and Homogenizers; Non-Mechanical Approaches: Freeze/Thaw, Osmotic Shock, Chemical Lysis, Enzymatic Lysis; Measurement of Cell Disruption.	**[9]**
Membrane Process, Adsorption and Chromatography Filtration Theory; Micro and Ultrafiltration; Reverse Osmosis; Dialysis; Electro dialysis, Infiltration; Evaporation; Protraction; Multistage and Continuous Operation. Adsorption Equilibrium, Van Demeter Equation; Chromatography: Size, Charge, Polarity, Shape, Hydrophobic Interactions; Biological Affinity; Process Configurations (Packed Bed, Expanded Bed, Simulated Moving Beds).	**[9]**
Extraction Process and Concentration Steps Solvent Extraction: Phase Equilibrium and Distribution, Counter- Current Operation, Dissociative Extraction, Multiple Stage Analysis; Reciprocating-Plate and Centrifugal Extractors; Reverse Micellar Extraction; Aqueous Two Phase, Super Critical Fluid Extraction. Precipitation: Effect of Size and Charge, Solvent Effects, Ionic Strength Effects, Precipitate Growth and Aging Models. Crystallization: Nucleation and Growth Aspects; Drying: Solvent Removal Aspects, Dryers (Vacuum, Freeze, Spray); Scale Up Aspects.	**[9]**
Product Characterization Biophysical Characterization, Chemical Characterization, Modern Spectroscopy, Qbd, Stability Bioassays: Cell Based Assay, Receptor Mediated Assay, In *Vivo* Evaluation, Immunogenicity.	**[9]**
Process Design Process Synthesis: Identification and Ordering of Unit Operations Relevant for A Case Study. Analysis: Comparison of Different Process Synthesis Steps. Case Studies Such As Production and Recovery of Therapeutics, Metabolites and Antibodies.	**[9]**
Total Hours:45+15(Tutorial)	60

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. Doran P., Bioprocess Engineering Principles. 2nd Edition. Oxford. Academic Press, 2013
2. Belter, P.A., CusslerE.L. and Wei-Shou Hu., Bioseparations- Downstream Processing for Biotechnology, Wiley- Interscience Publication., 1988.
3. Nooralabettu Krishna Prasad, “Downstream Process Technology - A New Horizon in Biotechnology”, PHI Learning Pvt. Ltd, New Delhi, 2012.
4. Sivasankar B., “Bioseparations - Principles and Techniques”, Prentice Hall of India Private Limited, New Delhi, 2006.

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Course Contents and Lecture Schedule

S.N	Topic	No.of
1	**BIOMASS REMOVAL And CELL DISRUPTION**	
1.1	Characteristics of Biological Materials: Pre-treatment Methods	1
1.2	Separation of Cell Mass: Centrifugation	1
1.3	Separation of Cell Mass: Sedimentation, Flocculation	1
1.4	Filtration; Continuous Operation	2
1.5	Mechanical Approaches: Sonication, Bead Mills	2
1.6	Mechanical Approaches: Homogenizers	2
1.7	Non-Mechanical Approaches: Freeze/Thaw, Osmotic Shock	2
1.8	Non-Mechanical Approaches: Chemical Lysis, Enzymatic Lysis	1
1.9	Measurement of Cell Disruption	1
2	**Membrane Process, Adsorption and Chromatography**	
2.1	Filtration Theory	1
2.2	Micro and Ultrafiltration	2
2.3	Reverse Osmosis, Dialysis, Electro dialysis	2
2.4	Dia filtration, Pervaporation; Perstraction	2
2.5	Multistage And Continuous Operation	2
2.6	Adsorption Equilibrium, Van Demeter Equation	2
2.7	Chromatography: Size, Charge, Polarity, Shape, Hydrophobic Interactions; Biological Affinity;	1
2.8	Process Configurations (Packed Bed, Expanded Bed)	1
2.9	Process Configurations (Simulated Moving Beds).	1
3	**Extraction Process and Concentration Steps**	
3.1	Solvent Extraction: Phase Equilibrium and Distribution	1
3.2	Counter- Current Operation, Dissociative Extraction, Multiple Stage Analysis	1
3.3	Reciprocating-Plate and Centrifugal Extractors	2
3.4	Reverse Micellar Extraction	2
3.5	Aqueous Two Phase, Super Critical Fluid Extraction	2
3.6	Precipitation: Effect of Size and Charge, Solvent Effects, Ionic Strength Effects, Precipitate Growth and Aging Models	1
3.7	Crystallization: Nucleation and Growth Aspects	1
3.8	Drying: Solvent Removal Aspects	1
3.9	Dryers (Vacuum, Freeze, Spray); Scale Up Aspects	1
4	**Product Characterization**	
4.1	Biophysical Characterization	2
4.2	Chemical Characterization	2
4.3	Modern Spectroscopy	2
4.4	Qbd	2
4.5	Stability Bioassays: Cell Based Assay	1
4.6	Receptor Mediated Assay	1
4.7	*In Vivo* Evaluation, Immunogenicity	1
5	**Process Design**	
5.1	Process Synthesis	2
5.2	Identification and Ordering of Unit Operations Relevant For a Case Study	2
5.3	Analysis: Comparison of Different Process Synthesis Steps	2
5.4	Case Studies Such as Production And Recovery of Therapeutics	1
5.5	Case Studies Such as Production and Recovery Of Metabolites	2
5.6	Case studies such as production and recovery of antibodies	1
	Total	**60**

Course Designer(s)

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Passed in BoS Meeting held on 20/06/2025
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70 PDB 304	Research Methodology and Scientific Communication Skills	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To provide the basis of methodologies followed in scientific research.
- To understand the concept of research problem identification and analysis.
- To describe the various methods of scientific communications.
- To illustrate the different forms of research presentation skills.
- To develop knowledge on effective lab practices and scientific communications.

Pre-requisites

- NIL

Course Outcomes

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

CO1	Analysing the History of Scientific Methods and Manipulation of Experiments.	Apply
CO2	Demonstrate the Practice of Designing Research Problems Through Available Datas	Apply
CO3	Develop the Effective Communication Skills and to Deliver Research Concepts.	Analyze
CO4	Show Case the Research Findings Using Scientific Tools and Collaborate With Scientific Community	Apply
CO5	Express the Research Finding Through Technical Writing and Appreciate Scientific Ethics.	Analyze

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	3	-	2	-
CO2	3	2	3	-	2	-
CO3	3	3	3	2	2	-
CO4	3	3	3	-	3	-
CO5	3	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	10	30
Understand	20	20	30
Apply	20	20	30
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech - Biotechnology

70 PDB 304 - Research Methodology and Scientific Communication Skills

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

History of science and science methodologies Empirical science; scientific method; manipulative experiments and controls; deductive and inductive reasoning; descriptive science; reduction Vs holistic biology.	**[9]**
Preparation for research Choosing a mentor, lab and research question; requisite, design, and selection of the research problem; research article collections, significance of literature review in defining a problem, sources of literature review articles, monograph, patents, research databases; identifying gap areas from literature and research database, development of working hypothesis. Maintaining a lab notebook.	**[9]**
Process of communication Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication-interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences.	**[9]**
Process of Presentation Presentation skills-formal presentation skills; preparing and presenting using over- head projector, PowerPoint; defending interrogation; scientific poster preparation &presentation; participating in group discussions; Computing skills for scientific research – web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.	**[9]**
Scientific communication Technical writing skills- types of reports; layout of a form al report; scientific writing skills-importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing :elements of a scientific paper including abstract, introduction, materials &methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers- peer review process and problems, recent developments such as open access and non- blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.	**[9]**
Total Hours:	**45**

Text Book(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

Reference(s):

1.	Kothari C R, “Research Methodology – Methods and techniques”, New Age Publications, New Delhi, 2009.
2.	Trochim, W.M.K., “Research Methods: the concise knowledge base”, Atomic DogPublishing, 2005
3.	Mohan, K.,and Singh,N.P. “Speaking English Effectively”. Delhi: Macmillan India, 2010
4.	Fink, A. “Conducting Research Literature Reviews: From the Internet to Paper”. Sage Publications,2009

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**History of Science and Science Methodologies**	
1.1	Empirical Science With Case Study	1
1.2	Scientific Method	2
1.3	Experiments and Controls	1
1.4	Deductive and Inductive Reasoning	2
1.5	Descriptive Science	1
1.6	Reduction Vs Holistic Biology	2
2	**Preparation for Research**	
2.1	Pre-Requisite, Design and Selection of the Research Problem	1
2.2	Research Article Collections, Significance of Literature Review and Sources of Literature Review Articles	2
2.3	Monograph, Patents and Research Databases	1
2.4	Identifying Gap Areas From Literature and Research Database	2
2.5	Development of Working Hypothesis	2
2.6	Maintaining A Lab Notebook / Observation	1
3	**Process of Communication**	
3.1	Concept of Effective Communication	1
3.2	Determining Outcomes and Results; Initiating Communication	2
3.3	Breakdowns While Communicating	1
3.4	Value in Conversation	1
3.5	Barriers to Effective Communication	1
3.6	Non-Verbal Communication-Interpreting Non-Verbal Cues	2
3.7	Importance of Body Language	1
3.8	Power of Effective Listening and Cultural Differences	1
4	**Process of Presentation**	
4.1	Presentation and Formal Presentation Skills	1
4.2	Scientific Poster Preparation & Presentation	1
4.3	Computing Skills for Scientific Research – Web Browsing	1
4.4	Search Engines and Their Mechanism of Searching	2
4.5	Hidden Web and Its Importance In Scientific Research	1
4.6	Internet As A Medium of Interaction	1
4.7	Effective Email Strategy	1
5	**Scientific Communication**	
5.1	Technical Writing Skills and Characteristics of Effective Technical Communication	1
5.2	Types of Reports; Layout of A Form Al Report	1
5.3	Scientific Writing Skills-Importance of Communicating Science	1
5.4	Problems While Writing A Scientific Document	1
5.5	Plagiarism, Software For Plagiarism	1
5.6	Scientific Paper Including Abstract, Introduction, Materials &Methods, Results, Discussion, References	1
5.7	Publishing Scientific Papers- Peer Review Process and Problems	1
5.8	Open Access and Non- Blind Review	1
5.9	Ethical Issues and Scientific Misconduct	1
	Total	**45**

Course Designer(s)

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Passed in BoS Meeting held on 20/06/2025
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70 PDB 305	Intellectual Property Rights, Biosafety and Bioethics	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To impart knowledge on intellectual property rights and their implications in biological research and product development
- To become familiar with National and International IPR Policy
- To provide knowledge on biosafety and risk assessment of products derived from biotechnology
- To let know the existing regulations and guidelines on commercial release and research on Biotechnology products
- To sensitize about the necessity on ethical issues in biological research.

Pre-requisites

- Basic of **Biosafety and Bioethics**

Course Outcomes

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

CO1	Understand the rationale for and against IPR and especially patents	Understand
CO2	Recognize why India has adopted an IPR Policy and be familiar with broad outline of patent regulations	Apply
CO3	Differentiate the types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents	Understand
CO4	Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environmental release of genetically modified organisms, national and international regulations	Apply
CO5	Practice ethical aspects related to biological, biomedical, health care and biotechnology research.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	3	-	2	-
CO2	3	2	3	-	2	-
CO3	3	3	3	2	2	-
CO4	3	3	3	-	3	-
CO5	3	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	30	30	40
Apply	10	10	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB 305 – Intellectual Property Rights, Biosafety and Bioethics								
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 IPR Introduction To Intellectual Property; Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New Gmos; International Framework for the Protection of IP; IP as A Factor in R&D; IPS of Relevance To Biotechnology and Few Case Studies; Introduction To History of GATT, WTO, WIPO and TRIPS; Plant Variety Protection and Farmers Rights Act; Concept of 'Prior Art': Invention in Context of "Prior Art"; Patent Databases - Country-Wise Patent Searches (USPTO, EPO, India).	**[9]**
Patenting Basics of Patents: Types of Patents; Indian Patent Act 1970; Recent Amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT); Procedure for Filing a PCT Application; Role of A Country Patent Office; Filing of A Patent Application; Precautions Before Patenting-Disclosure/Non-Disclosure - Forms and Guidelines Including Those of National Bio-Diversity Authority (NBA) and Other Regulatory Bodies, Fee Structure, Time Frames; Types of Patent Applications: Provisional and Complete Specifications; PCT and Conventional Patent Applications; International Patenting-Requirement, Procedures and Costs; Financial Assistance for Patenting; Publication of Patents-Gazette of India, Status in Europe and US; Patent Infringement and Case Studies; Commercialization of Patented Innovations; Licensing; Patenting By Research Students and Scientists- University/Organizational Rules in India and Abroad, Collaborative Research - Backward and Forward IP; Benefit/Credit Sharing Mechanism.	**[9]**
Biosafety Biosafety and Biosecurity - Introduction; Historical Background; Introduction To Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; GRAS Organisms, Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Definition of GMOS & LMOS; Principles of Safety Assessment of Transgenic Plants – Sequential Steps in Risk Assessment; Concepts of Familiarity and Substantial Equivalence; Risk – Environmental Risk Assessment and Food and Feed Safety Assessment; Problem Formulation – Protection Goals, Compilation of Relevant Information, Risk Characterization and Development of Analysis Plan; Risk Assessment of Transgenic Crops Vs Cis Genic Plants or Products Derived From RNAi, Genome Editing Tools.	**[9]**
National and International Regulations International Regulations – Cartagena Protocol, OECD Consensus Documents and Codex Aliment Arius; Indian Regulations – EPA Act and Rules, Guidance Documents, Regulatory Framework – RCGM, GEAC, IBSC and Other Regulatory Bodies; Draft Bill of Biotechnology Regulatory Authority of India - Containments – Biosafety Levels and Category of rRNA Experiments; Field Trails – Biosafety Research Trials – Standard Operating Procedures - Guidelines of State Governments; GM Labelling – Food Safety and Standards Authority of India (FSSAI).	**[9]**
Bioethics Introduction, Ethical Conflicts in Biological Sciences - Interference With Nature, Bioethics in Health Care - Patient Confidentiality, Informed Consent, Euthanasia, Artificial Reproductive Technologies, Prenatal Diagnosis, Genetic Screening, Gene Therapy, and Transplantation. Bioethics in Research – Cloning and Stem Cell Research, Human and Animal Experimentation, Animal Rights/Welfare, Agricultural Biotechnology - Genetically Engineered Food, Environmental Risk, Labelling and Public Opinion. Sharing Benefits and Protecting Future Generations - Protection of Environment and Biodiversity – Bio piracy.	**[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.	Complete Reference to Intellectual Property Rights Laws. Snow White Publication Oct. 2007

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2.	Kuhse, H. “Bioethics: an Anthology”. Malden, MA: Blackwell, 2010.
3.	Deepa Goel, Shomini Parashar, “IPR, Biosafety and Bioethics”, Pearson Education, 2013.
4.	Padma Nambisan, “An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology” Academic Press, 2017.

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**Introduction to IPR**	
1.1	Introduction to intellectual property; types of IP: patents, trademarks, copyright &	1
1.2	Industrial design, traditional knowledge, geographical indications	1
1.3	International framework for the protection of IP; IP as a factor in R&D	1
1.4	IPs of relevance to biotechnology and few case studies	1
1.5	Introduction to history of GATT, WTO, WIPO and TRIPS	1
1.6	Plant variety protection and farmers rights act	1
1.7	Patent databases	1
1.8	Patent searches (USPTO, EPO, and India).	1
1.9	Protection of new GMOs	1
2	**Patenting**	
2.1	Basics of patents: types of patents	1
2.2	Indian Patent Act 1970; recent amendments, WIPO Treaties; Budapest Treaty	1
2.3	Patent Cooperation Treaty (PCT); procedure for filing a PCT application	1
2.4	Types of patent applications: provisional and complete specifications	1
2.5	International patenting-requirement, procedures and costs; financial assistance for patenting	1
2.6	Patent infringement and case studies	1
2.7	Commercialization of patented innovations; licensing	1
2.8	Patenting by research students and scientists-university/organizational rules in India and abroad	1
2.9	Backward and forward IP, benefit/credit sharing Mechanism	1
3	**Biosafety**	
3.1	Biosafety and Biosecurity	1
3.2	Biological safety cabinets; primary containment for biohazards; biosafety levels	1
3.3	GRAS organisms, biosafety levels of specific microorganisms	1
3.4	Definition of GMOs & LMOs; principles of safety assessment of transgenic	1
3.5	Sequential steps in risk assessment; concepts of familiarity and substantial equivalence	1
3.6	Environmental risk assessment and food and feed safety assessment; problem formulation	1
3.7	Protection goals, compilation of relevant information, risk characterization and development of analysis plan	1
3.8	Risk assessment of transgenic crops vs cisgenic plants	1
3.9	Products derived from RNAi and genome editing tools	1
4	**National and international regulations**	
4.1	International regulations	1
4.2	Cartagena protocol, OECD consensus documents and Codex Alimentarius	1
4.3	EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies	1
4.4	Draft bill of Biotechnology Regulatory authority of India	1
4.5	Biosafety levels and category of rDNA experiments	1
4.6	Field trails and biosafety research trials	1

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4.7	Standard operating procedures - guidelines of state governments	1
4.8	GM labelling	1
4.9	Food Safety and Standards Authority of India (FSSAI)	1
5	**Bioethics**	
5.1	Introduction, Ethical Conflicts in Biological Sciences.	1
5.2	Interference With Nature, Bioethics in Health Care - Patient Confidentiality,	1
5.3	Informed Consent, Euthanasia, Artificial Reproductive Technologies, Prenatal Diagnosis, Genetic Screening, Gene Therapy, and Transplantation.	1
5.4	Bioethics in Research – Cloning and Stem Cell Research, Human and Animal Experimentation, Animal Rights/Welfare	1
5.5	Agricultural Biotechnology - Genetically Engineered Food,	1
5.6	Environmental Risk, Labelling and Public Opinion	1
5.7	Sharing Benefits and Protecting Future Generations	1
5.8	Protection of Environment and Biodiversity – Bio piracy.	1
	Total	45

Course Designer(s)

Dr.Puniethaa Prabhu - punithaa@ksrct.ac.in

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70 PDB 3P1	Downstream Processing in Biotechnology Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To design purification strategy for bio products
- To provide hands on knowledge of primary unit operations involved in downstream processing.
- To learn different various modes of unit operations
- To acquire basic operational requirements of various unit operations
- To learn sequential operations involved in bio product purification

Pre-requisites

- NIL.

Course Outcomes

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

CO1	Gain hands-on experience on the primary separation of bio products	Apply
CO2	Demonstrate solid-liquid operations for the separation of bio products	Analyze
CO3	Understand protein precipitation and chromatography techniques	Analyze
CO4	Know solid-fluid and liquid-liquid separation methods	Apply
CO5	Apply partial purification and high-resolution techniques for bio separation	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	2	1	2	3	1
CO2	3	2	2	2	3	1
CO3	3	3	3	2	3	1
CO4	3	3	3	3	3	1
CO5	3	3	2	2	3	1
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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech – Biotechnology								
70 PDB 3P1 - Downstream Processing in Biotechnology 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. Studies on cell disruption methods
2. Conventional filtration
3. Centrifugation in batch and continuous centrifuges
4. Protein precipitation and its recovery
5. Ion-exchange chromatography
6. Membrane based filtration-ultra filtration in cross flow modules and micro filtration
7. Adsorption in batch and continuous mode
8. Aqueous two-phase extraction of proteins
9. Lyophilization
10. Studies on drying characteristics

Lab Manual

1.	**Downstream Processing in Biotechnology Laboratory** manual, Department of Biotechnology, KSRCT.

Course Designer(s)

1. Ms. P. Divya – divyap@ksrct.ac.in

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70 PDB 3P2	Project Work Phase – I	Category	L	T	P	Credit
		EEC	0	0	10	05

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 analyse the results and thesis writing

Pre-requisites

- NIL

Course Outcomes

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

CO1	Capability to critically and systematically integrate knowledge to identify issues that must be issues that must be addressed within framework of specific thesis.	Analyze
CO2	Addressed within framework of specific thesis.	Analyze
CO3	Competence in research design and planning.	Apply
CO4	Capability to create, analyse and critically evaluate different technical solutions.	Apply
CO5	Ability to conduct research independently.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	-
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech – Biotechnology								
70 PDB 3P2 - Project Work Phase-I								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	**0**	**0**	**10**	**150**	**5**	**100**	**00**	**100**

- **List of Experiments:**
- **Planning & performing experiments**
- Based on the project proposal submitted in earlier semester, students should be able to plan, and engage in, an independent and sustained critical investigation and evaluate a chosen research topic relevant to biological sciences and society.
- They should be able to systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions.
- Senior researchers should be able to train the students such that they can work independently and are able to understand the aim of each experiment performed by them.
- They should also be able to understand the possible outcomes of each experiment.

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70 PDB 3P3	Internship / Industrial Training	Category	L	T	P	Credit
		EEC	0	0	0	2

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 causes and problem-solving process	Apply
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					
	1	2	3	4	5	6
CO1	3	3	2	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	2	3	3	2
CO4	3	3	2	3	2	2
CO5	2	3	2	3	2	2
3 - Strong; 2 - Medium; 1 – Some						

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech – Biotechnology								
70 PDB 3P3 - Internship / Industrial Training								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
III	0	0	10	150	2	100	00	100

1. Students undergo internship during second semester summer vacation
2. Students should submit an internship / industrial training report along with observation note book at the beginning of third semester
3. The observation note book of the students after the training with their personal comments / suggestions and attested by the trainer at industry or R&D
4. A technical presentation to be done by the students to the committee, immediately after submission of the report at the beginning of third semester

A committee constitute a senior faculty, HoD and along with industry person

Course Designer(s)

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

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

(An Autonomous Institution affiliated to Anna University)

M.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted in 2025-2026)

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
PRACTICAL								
1	70 PDB 4P1	Project Work Phase - II	3	60	40	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 work End Semester Examination.

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70 PDB 4P1	Project Work Phase - II	Category	L	T	P	Credit
		EEC	0	0	34	17

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.	Analyze
CO5	Develop skills of project management, report writing, problem solving, communication and interpersonal.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	-
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	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				

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K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech - Biotechnology								
70 PDB 4P1 – Project Work Phase – II								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
VIII	0	0	34	510	17	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

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70 PDB E11	Bioreaction Engineering	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand bioreaction engineering principles.
- To provide knowledge on kinetics of biocatalysis.
- To demonstrate modes of bioreactor operation.
- To make aware of bioreactor simulation.
- To learn thermodynamic aspects of bio reactions.

Pre-requisites

- NIL

Course Outcomes

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

CO1	Understand growth kinetics of cell cultures	Understand
CO2	Apply the mass transfer limitations in catalytic reactions	Apply
CO3	Apply the design aspects for optimal bioreactor operation	Apply
CO4	Learn the dynamic simulation of bioprocesses	Understand
CO5	Analyze the stoichiometry of bio reactions and metabolic flux analysis	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	1	-	-	2
CO2	2	3	1	-	-	-
CO3	3	2	1	2	2	-
CO4	2	3	1	2	2	-
CO5	3	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	20	20
Understand	40	20	60
Apply	10	20	20
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech - Biotechnology

70 PDB E11- Bioreaction Engineering

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

Growth Kinetics of Cell Cultures Kinetics of Cell Growth and Product Formation, Mass and Energy Balances in Biological Systems, Structured Growth Models; Compartmental Models; Cybernetic Models.	**[9]**
Biocatalyst Immobilized Biocatalysts: External Mass Transfer; Internal Diffusion; Reaction Within Catalysts; Kinetic Analysis of Batch Processes.	**[9]**
Bioreactor Design Reactor Design (Batch, Continuous, Fed-Batch, Plug Flow, Packed Bed, Airlift, Immobilized Enzyme/Cell etc.); Optimal Bioreactor Operation Using Simple Reaction Kinetics.	**[9]**
Bioreactor Process Dynamic Simulation of Bioreactor Processes (Batch, Fed-Batch, Continuous Etc.); Reactors In Series	**[9]**
Stoichiometry of Bioreactions Pathway Analysis: Stoichiometric Analysis; Thermodynamics-Derived Constraints; Flux Balancing Techniques; Metabolic Control Analysis.	**[9]**
Total Hours:	**45**

Text Book(s):

1.	Nielsen, J, Villadsen, J Liden, G Bioreaction Engineering Principles, 2nd Edition, Kluwer Academic. 2003.
2.	Irving J. Dunn, Elmar Heinzle, John Ingham, Jiri E. Prenosil, Biological Reaction Engineering: Dynamic Modelling Fundamentals with Simulation Examples, 2nd Edition, Wiley-VCH. 2003.

Reference(s):

1.	Levenspiel, O., “Chemical Reaction Engineering”, 3rd Edition. John Wiley and Sons, New Delhi,2010
2.	Fogler, H.S., “Elements of Chemical Engineering”, 4th Edition, Prentice Hall of India, New Delhi, 2005.
3.	Dawande, S.D., “Principles of Reaction Engineering”, 1st Edition, Central Techno Publications, 2001.
4.	Hayes, R.E., Mmbaga, J.P., “Introduction to Chemical Reactor Analysis”, 2nd Edition, CRC Press, New York, 2013.
5.	Panda, T. Bioreactors: Analysis and Design, McGraw Hill Education, 2011.

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Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**Growth Kinetics of cell cultures**	
1.1	Kinetics of Cell Growth and Product Formation	1
1.2	Mass and Energy Balances In Biological Systems	2
1.3	Structured Growth Models	2
1.4	Compartmental Models	1
1.5	Cybernetic Models	1
1.6	Problems	2
2	**Biocatalyst**	
2.1	Immobilized Biocatalysts	1
2.2	External Mass Transfer	1
2.3	Internal Diffusion	2
2.4	Reaction Within Catalysts	1
2.5	Kinetic Analysis of Batch Processes	2
2.6	Problems	2
3	**Bioreactor Design**	
3.1	Reactor Design	1
3.2	Batch	1
3.3	Continuous	1
3.4	Fed-Batch	1
3.5	Plug Flow	1
3.6	Packed Bed	1
3.7	Airlift	1
3.8	Immobilized Enzyme	1
3.9	Optimal Bioreactor Operation Using Simple Reaction Kinetics	1
4	**Bioreactor Process**	
4.1	Dynamic Simulation of Bioreactor Processes	2
4.2	Batch	1
4.3	Continuous	2
4.4	Fed-Batch	2
4.5	Reactors In Series	1
4.6	Problems	1
5	**Stoichiometry of Bio reactions**	
5.1	Pathway Analysis	1
5.2	Stoichiometric Analysis	2
5.3	Thermodynamics-Derived Constraints	1
5.4	Flux Balancing Techniques	2
5.5	Metabolic Control Analysis	1
5.6	Problems	2
	Total	**45**

Course Designer(s)

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

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70 PDB E12	Computational Programming	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To provide exposure to biological problem-solving through programming.
- To understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc
- To know the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc
- To know the fundamentals of C++, Python and scripting language Perl.
- Have the ability to write a computer program to solve specified problems.

Pre-requisites

- NIL

Course Outcomes

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

CO1	Identify situations where computational methods and computers would be useful.	Understand
CO2	Given a computational problem, identify and abstract the programming task involved.	Apply
CO3	Choose the right data representation formats based on the requirements of the problem.	Understand
CO4	Write the program on a computer, edit, compile, debug, correct, recompile and run it.	Apply
CO5	Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	3	3	3	-
CO2	3	3	3	3	2	3
CO3	2	2	3	-	2	2
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB E12 –Computational Programming								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Introduction Higher Level Programming Concepts, Assembly Level Programming Concepts, Libraries, Compilers, STDIN, STDOUT; Integrated Programming Environments.	[9]
Variables Number Representations, Variables, Data Types, Declarations, Operators (Assignment).	[9]
Loops & Subroutines Control Structures and Conditional Statements; Do, While, Until Constructs. Functions, Arrays. Recursive Functions.	[9]
Object-Oriented Programming Structures And Objects; Object-Oriented Programming And Classes.	[9]
Applications Sample Problems In Science, Engineering and Text Processing.	[9]
Total Hours:	**45**

Text Book(s):	
1.	Ranade, A. An Introduction to Programming through C++, McGraw Hill Education. 2014
2.	Lutz, M. Programming Python. O'Reilly media. 2011
Reference(s):	
1.	Schwartz, R.L., Foy, B.D., Phoenix, T. Learning Perl, O'Reilly media. 2011
2.	Stroustrup, B. (2013) The C++ Programming Language, Addison-Wesley Professional Publishers 2013

Course Contents and Lecture Schedule

S.No	Topic	No. of
1	Introduction	
1.1	Higher Level Programming Concepts	2
1.2	Assembly Level Programming Concepts,	2
1.3	Libraries	1
1.4	Compilers	2
1.5	STDIN, STDOUT	1
1.6	Integrated Programming Environments.	1
2	Variables	
2.1	Number Representations	2
2.2	Variables	2
2.3	Data Types Variables	2
2.4	Declarations	1
2.5	Operators (Assignment).	2
3	Loops & Subroutines	
3.1	Control Structures and Conditional Statements	1
3.2	Do, While, Until Constructs.	2
3.3	Functions of Control Structures	1
3.4	Arrays	3
3.5	Recursive Functions.	1
3.6	Comparison Of Control Structures	1
4	Object-Oriented Programming	
4.1	Structures - Oriented Programming	1
4.3	Object-Oriented Programming	2

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4.4	Classes - Oriented Programming	1
4.5	Friend Function	2
4.6	Polymorphism	1
4.7	Threading	1
4.8	Sample Programs – Bioinformatics Concepts	1
5	**Applications**	
5.1	Sample Problems In Science, Engineering And Text Processing.	3
5.2	DNA Pattern Matching Program	1
5.3	Convert DNA to Protein, RNA to Protein	1
5.4	Structure Analysis Programs	1
5.5	Microarray Data Analysis Programs	1
5.6	File Handling Programs	2
	Total	**45**

Course Designer(s)

Dr.Puniethaa Prabhu punithaa@ksrct.ac.in

Passed in BoS Meeting held on 20/06/2025

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70 PDB E13	Environmental Biotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To familiarize the learners with the impacts of pollution on the environment and human health.
- To comprehend different forms of bioremediation and biodegradation available to treat waste.
- To enlighten the learners about solid waste management.
- To understand the importance of degradation of xenobiotic in environment and its necessity for implementation
- To enable students to learn the basic concepts of interactions of radiation with environment.

Pre-requisites

- NIL.

Course Outcomes

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

CO1	Understand the types and sources of air and water pollution and to determine the measures to be undergone to control pollution.	Understand
CO2	Describe the types of bioremediation technologies.	Understand
CO3	Analysis the various types of soil microbes and their growth, ecological adaptability and their enzyme activity.	Apply
CO4	Demonstrate the bioremediation consequence of pesticides, hydrocarbons, heavy metals, oil spilled, salt affected soils and its degradation pathways.	Apply
CO5	Describe the radiation types, measurement, exposure, environmental hazards and non- ionizing impact on health.	Understand

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	3	-	3
CO2	3	3	3	3	-	3
CO3	2	3	2	3	2	-
CO4	3	3	3	2	3	3
CO5	3	2	3	2	1	-
3 - Strong; 2 - Medium; 1 – Some						

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB E13 – Environmental Biotechnology								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Environmental Pollution Types and Sources of Air, Water and Soil Pollution, Monitoring of Air and Water Pollution, Noise Pollution, Impact of Pollution on Human Health, Environment and Assets; Water and Air Pollution Control Technologies.	[9]
Bioremediation Technologies Remediation Technologies - Bioventing - Biosparging and Bio slurping - Phytoremediation - Bio absorption and Bioleaching of Heavy Metals: Cadmium, Lead, Mercury, Metal Binding Targets and Organisms, Metal Microbial Interaction, Bio methylation of Elements (Methylation of Mercury and Arsenic), Commercial Biosorbants, Metal Precipitation, Advantages and Disadvantages of Bioleaching.	[9]
Solid Waste Management Solid Waste Management: Introduction, Management of Municipal, Agricultural, Industrial, Mining, Hazardous (Biomedical) Waste, Waste Treatment Methods (Incineration, Pyrolysis) and Solid Waste Management Methods (Composting, Worm culture and Methane Production) Landfill. Hazardous Waste Treatment. Biofuels.	[9]
Biodegradation Remediation of Degraded Ecosystems, Degradation of Xenobiotic in Environment, Decay Behaviour and Derivative Plasmids, Hydrocarbons, Substituted Hydrocarbons, Oil Pollution, Surfactants, Pesticides and Heavy Metals Derivative Pathways.	[9]
Interactions of Nuclear Radiation Ionizing and Non-Ionizing Radiation -Types/Sources of Ionizing Radiation (E.G., X-, Gamma Rays; Radon, Caesium, Strontium), Measurement of Ionizing Radiation, Health Effects of Ionizing Radiation (Burns, Mutations, Cancers), Sources of Environmental Exposure to Ionizing and Non Ionizing Radiation, Environmental Hazards of Disposal of Ionizing Wastes. Nonionizing Radiation and Its Impact on Health (UV Light, Electromagnetic Radiation, Cell-Phone RF Radiation).	[9]
Total Hours:	**45**

Text Book(s):	
1.	Baird, C. And Cann, M. Environmental Chemistry. W.H. Freeman And Company 2008
2.	Botkin, Daniel B. And Keller, Edward A. Environmental Science: Earth As A Living Planet. 6th Ed. John Wiley & Sons, USA. 2007
Reference(s):	
1.	Environmental Biotechnology. Concepts And Applications. Edited By H.-J. Jördening And J. Winter 2015
2.	Friis, Robert H.Essentials Of Environmental Health. Jones And Bartlett, Inc., Sudbury, MA 2014
3.	Theodore, L. & Dupont, R. R. Environmental Health And Hazard Risk Assessment. Environmental Health And Hazard Risk Assessment, 2017.
4.	S. B. Utham Kumar, Fundamentals Of Environmental Biotechnology, Lambert Academic Publishing, New Delhi, 2011
5.	Nicolas R. Dalezios. “Environmental Hazards Methodologies for Risk Assessment and Management”, IWA Publishing, London, UK. 2014.

Passed in BoS Meeting held on 20/06/2025
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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Environmental Pollution**	
1.1	Types and Sources of Air, Water and Soil Pollution	2
1.2	Monitoring of Air and Water Pollution	2
1.3	Noise Pollution	1
1.4	Impact of Pollution on Human Health	1
1.5	Environment and Assets	1
1.6	Water and Air Pollution Control Technologies	1
2	**Bioremediation Technologies**	
2.1	Remediation Technologies - Bioventing - Biosparging and Bio slurping	2
2.2	Phytoremediation	1
2.3	Bio absorption and Bioleaching of Heavy Metals: Cadmium, Lead, Mercury, Metal Binding Targets and Organisms	1
2.4	Metal Microbial Interaction	1
2.5	Bio methylation of Elements (Methylation of Mercury and Arsenic	1
2.6	Commercial Biosorbants	1
2.7	Metal Precipitation	1
2.8	Advantages and Disadvantages of Bioleaching.	1
3	**Solid Waste Management**	
3.1	Solid Waste Management: Introduction, Management of Municipal	1
3.2	Agricultural, Industrial, Mining	1
3.3	Hazardous (Biomedical) Waste,	1
3.4	Waste Treatment Methods (Incineration, Pyrolysis)	2
3.5	Solid Waste Management Methods (Composting, Wormiculture and Methane Production) Landfill	1
3.6	Hazardous Waste Treatment	1
3.7	Biofuels	1
4s	**Biodegradation**	
4.1	Remediation of Degraded Ecosystems	1
4.2	Degradation of xenobiotic In Environment	2
4.3	Decay Behaviour and derivative Plasmids	1
4.4	Hydrocarbons	2
4.5	Substituted Hydrocarbons	2
4.6	Oil Pollution	1
4.7	Surfactants	1
4.8	Pesticides and Heavy Metals derivative Pathways	1
5	**Interactions of Nuclear Radiation**	
5.1	Ionizing and Non-Ionizing Radiation -Types/Sources of Ionizing Radiation (E.G., X-, Gamma Rays; Radon, Cesium, Strontium)	3
5.2	Measurement of Ionizing Radiation	1
5.3	N, Health Effects of Ionizing Radiation (Burns, Mutations, Cancers)	1
5.4	Sources of Environmental Exposure To Ionizing and Non Ionizing Radiation	1
5.5	Environmental Hazards of Disposal of Ionizing Wastes	1
5.6	Nonionizing Radiation and Its Impact on Health (Uv Light, Electromagnetic Radiation, Cell-Phone Rf Radiation).	2
	Total	45

Course Designer(s)

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

Passed in BoS Meeting held on 20/06/2025
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70 PDB E14	Enzyme Engineering and Technology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To familiarize the learners with the impacts of pollution on the environment and human health.
- To comprehend different forms of bioremediation and biodegradation available to treat waste.
- To enlighten the learners about solid waste management.
- To understand the importance of degradation of xenobiotics in environment and its necessity for implementation
- To enable students to learn the basic concepts of interactions of radiation with environment.

Pre-requisites

- Protein and Enzyme Technology.

Course Outcomes

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

CO1	Understand the types and sources of air and water pollution and to determine the measures to be undergone to control pollution.	Understand
CO2	Describe the types of bioremediation technologies.	Understand
CO3	Analysis the various types of soil microbes and their growth, ecological adaptability and their enzyme activity.	Apply
CO4	Demonstrate the bioremediation consequence of pesticides, hydrocarbons, heavy metals, oil spilled, salt affected soils and its degradation pathways.	Apply
CO5	Describe the radiation types, measurement, exposure, environmental hazards and non- ionizing impact on health.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	3	-	3
CO2	3	3	3	3	-	3
CO3	2	3	2	3	2	-
CO4	3	3	3	2	3	3
CO5	3	2	3	2	1	-
3 - Strong; 2 - Medium; 1 – Some						

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech - Biotechnology

70 PDB E14 – Enzyme Engineering and Technology

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

Introduction To Proteins and Enzymes Introduction - Basic Structural Principles: Amino Acids and Their Conformational Accessibilities - Motifs of Protein Structures and Their Packing - Structural Characterization of Proteins: Primary and Three Dimensional Structure Determination - Ramachandran Plot - Protein Folding: Structure of Chaperones and Role of Chaperones in Protein Folding - Enzymes: Definition, Nomenclature and Types (Constitutive and Induced Enzyme), Intracellular and Extracellular enzymes.	[9]
Mechanism and Kinetics of Enzyme Catalysis Concept of Active Site -Mechanism of Enzyme Action - Specificity of Enzyme Action - Enzyme Inhibition - Mechanism and Kinetics of Single Substrate Reaction: Michaelis Menton Equation and Its Transformations, Turn Over Number - Mechanism and Kinetics of Multi Substrate Reaction Mcw Model - Analytical Problems in Single Substrate Reactions, Turn Over Number, Transformations of Mm Equations, MCW Model.	[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, Design of Enzyme Electrodes - Case Studies on Protein Engineering Applications in Food, Detergent, Environment and Healthcare Industries.	[9]
Total Hours:	**45**

Text Book(s):

1.	Baird, C., And Cann, M. Environmental Chemistry. W.H. Freeman And Company 2008
2.	Botkin, Daniel B. And Keller, Edward A. Environmental Science: Earth As A Living Planet. 6th Ed. John Wiley & Sons, USA. 2007

Reference(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”, Second Edition, Oxford University Press, New Delhi, India, 2014.
3.	Branden, C. and Tooze, J., “Introduction to Protein structure”, Second Edition, Garland Publishing, New York, US, 1999.
4.	Anton Torres, “Handbook of Protein Engineering” Calisto Reference, 2015.
5.	Allan Svendesen, “Understanding Enzymes – Function, Design, Engineering and Analysis” Pan Stanford Publishing, 2016.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction To Proteins and Enzymes**	
1.1	Introduction - Basic Structural Principles	2
1.2	Amino Acids and Their Conformational Accessibilities	1
1.3	Motifs of Protein Structures and Their Packing	1
1.4	Structural Characterization of Proteins: Primary and Three Dimensional Structure Determination -	1
1.5	Ramachandran Plot - Protein Folding: Structure of Chaperones and Role of Chaperones in Protein Folding	2
1.6	Enzymes: Definition, Nomenclature and Types (Constitutive and Induced Enzyme), Intracellular and Extra-Cellular Enzymes.	2
2	**Mechanism and Kinetics of Enzyme Catalysis**	
2.1	Concept of Active Site -Mechanism of Enzyme Action	1
2.2	Specificity of Enzyme Action - Enzyme Inhibition - Mechanism and Kinetics	2
2.3	Michaelis- Menton Equation and Its Transformations, Turn Over Number	1
2.4	Mechanism and Kinetics of Multi Substrate Reaction MCW Model	1
2.5	Analytical Problems in Single Substrate Reactions,	1
2.6	Turn Over Number, Transformations of MM Equations, MCM Model.	2
3	**Production and Purification of Proteins and Enzymes**	
3.1	Production and Purification of Enzyme from Plant	1
3.2	Production and Purification of Enzyme from Animal	1
3.3	Production and Purification of Enzyme from Microbial Source	2
3.4	Extraction, Precipitation	1
3.5	Dialysis, Ion Exchange Chromatography	1
3.6	Hydrophobic Interaction Chromatography	2
3.7	Gel Filtration Chromatography. Types of Enzyme immobilization.	1
4	**Strategies For Protein and Enzyme Engineering**	
4.1	Protein Engineering Cycle, Protein Splicing	2
4.2	Random and Site Directed Mutagenesis	1
4.3	Peptidomimetics, in Vitro Protein Evolution (DNA Shuffling, Error Prone PCR)	1
4.4	Cell Surface Display Technology	2
4.5	Rational Enzyme Design: Reshaping Enzyme Specificity	2
4.6	Reengineering Catalytic Mechanisms,	1
4.7	Engineering By molecular assembling.	1
5	**Application of Proteins and Enzymes**	
5.1	Importance of Recombinant Enzymes and Proteins	2
5.2	Industrial Applications of Enzymes	1
5.3	Design of Enzyme Electrodes	1
5.4	Case Studies on Protein Engineering Applications in Food,	1
5.5	Case Studies on Protein Engineering Applications in Detergent	2
5.6	Case Studies on Protein Engineering Applications Environment and Healthcare Industries	2
	Total	45

Course Designer(s)

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70 PDB E15	Metabolic and Systems Biology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To provide essential knowledge to make career in bioprocess industries and infield of computational systems biology.
- To implement, simulate and analyze biology-related mathematical models using available software packages in a programming language of their choice
- To reconstruct gene regulatory networks from time series and perturbation gene expression data
- To analyse large-scale networks using graph-theoretical pattern matching and clustering algorithms
- To recognize, exemplify and explain typical network motifs for signalling pathways, protein interaction networks, metabolic networks and gene regulatory networks

Pre-requisites

- NIL.

Course Outcomes

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

CO1	Analyze raw Omics data (e.g. Proteomics, Transcriptomics, Metabolomics, Metagenomics)	Understand
CO2	Design the right statistical method for the right omics analysis and compare the results using different methods	Apply
CO3	Generate biological networks using biochemical information and omics data	Apply
CO4	Integrate multiple omics data using biological networks and analyse multiple omics data from different disease or environmental conditions.	Understand
CO5	Analyze simulations by choosing appropriate numerical methods for the solution of the equations	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3		2	2	2	-
CO2	3	2	1	2	3	3
CO3	3	3	3	1	3	2
CO4	3	3		1	3	-
CO5	3	3	1	3	1	3
3 - Strong; 2 - Medium; 1 – Some						

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

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech - Biotechnology								
70 PDB E15- Metabolic and Systems Biology								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	**3**	**0**	**0**	**45**	**3**	**40**	**60**	**100**

Introduction to Systems Biology Systems Level Understanding of Biological Systems. Networks and Graph Theory: Basic Properties of Network: Degree, Average Degree and Degree Distribution. Adjacency Matrix, Weighted and Unweight Networks, Bipartite Network, Paths and Distances, Random Networks: Erdos-Renyimodel, Small-World Effect, Clustering Coefficient, Scale- Free Networks: Power Laws, Hubs, Ultra-Small Property, Degree Exponent, Barabasi-Albert Model; Degree Correlations: Assortativity and Disassortativity.	**[9]**
Metabolic Flux Analysis Introduction to Flux Balance Analysis, Construction of Stoichiometric Matrices, Constraint Based Models. Network Basics, Examples of Mathematical Reconstruction of Transcriptional Networks and Signal Transduction Networks; to Oils for Metabolic Flux Analysis-Monitoring and Measuring The Metabolite, Methods for The Experimental Determination of Metabolic Fluxes By Isotope Labelling Metabolic Fluxes Using Various Separation analytical Techniques; GC-MS for Metabolic Flux Analysis, Genome Wide Technologies: DNA/Phenotypic Microarrays and Proteomics; Basics of MATLAB	**[9]**
Kinetic Modelling Kinetic Modelling of Biochemical Reactions, Describing Dynamics With Odes, Rate Equations, Deriving Rate Equation, Incorporating Regulation of Enzyme Activity By Effectors, E-Cell Platform and Erythrocyte Modelling, Case Studies In *E.Coli, S.Cerevisiae* Metabolic Network Reconstruction Methods, Optimization of Metabolic Network, Identification of Targets for Metabolic Engineering; Software and Databases for Genome Scale Modelling; Use of Computational Techniques to Solve Odes	**[9]**
Networks In Biological Systems Network Motifs, Feed forward Loop Network Motif. Gene Circuits, Robustness of Models, Chemo taxis Model, Integration of Data From Multiple Sources: Building Genome Scale Models.	**[9]**
Tools and Case Studies Data Bases for Modelling: Pathway Databases KEGG, EMP, Metacyc, Enzyme Kinetics Database BRENDA, Gene Expression Databases, Bio models Database, Basics of Systems Biology Markup Language (SBML), and SBML Editors. Transcriptomics: Microarray Technology, Expression Profiles, Data Analysis; SAGE; Proteomics: 2Dgel Electrophoresis; Mass Spectrometry; Protein Arrays; Metabolomics: 13CNMR Based Metabolic Flux Analysis Model; Degree Correlations: Assortativity and Disassortativity	**[9]**
Total Hours:	**45**

Text Book(S):

1.	Stephanopoulos, G.N. (1998), Metabolic Engineering: Principles and Methodologies. Academic Press / Elsevier.
2.	Urialon,(2007).An introduction to systems biology: Design principles of biological Circuits,Chapmanandhall / CRC.

Reference(S):

1.	Eddaklipp,Wolfram Liebermeister, Christophwierlin."Systems biology, Text book", Wiley-Black Well Publication, 2009
2.	Eddaklipp,Ralfherwig,Axelkowald, Christophwierling,Hanslehrach,2005. Systems Biology in Practice:Concepts,Implementation and Application,Wiley–VCH
3.	Jonathan Pevsner,Bioinformatics and Functional Genomics,1 Stedition, Wiley-Liss.2003

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction to Systems Biology**	
1.1	Systems Level Understanding of Biological Systems.	1
1.2	Networks and Graph Theory: Basic Properties of Network: Degree, Average Degree and Degree Distribution.	1
1.3	Adjacency Matrix, Weighted and Unweight Networks, Bipartite Network, Paths and	1
1.4	Random Networks: Erdos-Renyimodel, Small-World Effect, Clustering Coefficient	1
1.5	Scale- Free Networks: Power Laws, Hubs, Ultra-Small Property, Degree Exponent	1
1.6	Barabasi-Albert Model; Degree Correlations: Assortativity and Disassortativity.	2
2	**Metabolic Flux Analysis**	
2.1	Introduction to Flux Balance Analysis, Construction of Stoichiometric Matrices	1
2.2	Constraint Based Models. Network Basics, Examples of Mathematical	2
2.3	Self-Assembly	1
2.4	Tools For Metabolic Flux Analysis-Monitoring and Measuring The Metabolise	1
2.5	Methods For The Experimental Determination of Metabolic Fluxes By Isotope Labelling Metabolic Fluxes Using Various Separation- Analytical Techniques;	1
2.6	Gc-Ms For Metabolic Flux Analysis,	1
2.7	Genome Wide Technologies: DNA/Phenotypic Microarrays and Proteomics	1
2.8	Basics of MATLAB	2
3	**Kinetic Modelling**	
3.1	Kinetic Modelling of Biochemical Reactions, Describing Dynamics With Odes, Rate Equations, Deriving Rate Equation, Incorporating Regulation of Enzyme Activity By Effectors	2
3.2	E-Cell Platform and Erythrocyte Modelling.	2
3.3	Case Studies In *E.Coli, S.Cerevisiae* Metabolic Network Reconstruction Methods	1
3.4	Optimization of Metabolic Network, Identification of Targets For Metabolic Engineering.	1
3.5	Software and Databases For Genome Scale Modelling.	2
3.6	Use of Computational Techniques to Solve Odes.	1
4	**Networks In Biological Systems**	
4.1	Network Motifs, Feed Forward Loop Network Motif	2
4.2	Gene Circuits, Robustness of Models, Chemo taxis Model	2
4.3	Integration of Data From Multiple Sources: Building Genome Scale Models.	2
5	**Tools and Case Studies**	
5.1	Tools and Data Bases For Modelling: Pathway Databases KEGG, EMP, Megacycle, Enzyme Kinetics Database Brenda	2
5.2	Gene Expression Databases, Bio models Database	2
5.3	Basics of Systems Biology Mark-up Language (SBML)	2
5.4	SBML Editors	2
5.5	Transcriptomics: Microarray Technology, Expression Profiles, Data Analysis;	1
5.6	Sage; Proteomics: 2dgel Electrophoresis	2
5.7	Mass Spectrometry; Protein Arrays	1
5.8	Metabolomics: 13 CNMR Based Metabolic Flux Analysis	1
	Total	**45**

Course Designer(s)

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

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70 PDB E21	Medical Devices	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To Understand the Rationale of Biosensors and Transducers
- To Provide the Basic Knowledge on the Biological Recognition Systems
- To Elaborate the Knowledge on Functioning of Electrodes and Concepts of Immobilization
- To Familiarize With Emerging Trends on Micro fabrication Techniques
- To Enhance the Knowledge on Selection of Appropriate Devices and Specimens for Early Detection of Diseases..

Pre-requisites

- NIL

Course Outcomes

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

CO1	Understand the challenges of integrating sensors and transducers in a system platform	Remember
CO2	Describe the basic configuration of optical sensors and membrane receptors.	Apply
CO3	Demonstrate the general principles of immobilization and functioning of various electrodes	Understand
CO4	Analyze the fundamentals and applications of electro kinetics and micro fabrication techniques.	Apply
CO5	Describe the emerging trends in medical devices for early detection, selection of appropriate treatment, monitoring treatment effectiveness and disease surveillance.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	2	1	3	2	1	3
CO2	1	2	3	3	3	2
CO3	1	1	3	3	3	2
CO4	2	3	3	3	2	2
CO5	1	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	30	10
Understand	20	20	40
Apply	10	10	30
analyze	-	-	20
Evaluate	-	-	-
Create	-		-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB E21 – Medical Devices

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

Sensors and Transducers Rationale of Electronic Biosensors; Essence of Three Types of Electronic Biosensors (*i.e.*,Potentiometric, Amperometric and Cantilever-Based Sensors); Three Essential Metrics That Define Modern Electronic Sensors; Detection Time, Sensitivity and Selectivity; Physics of Detection Time that Allows One to Organize Very Available Sensor in a Systematic Way; Fundamental Limits of Detection of Various Classes of Sensors; Opportunities and Challenges of Integrating Sensors in a System Platform. Principles and Applications of Calorimetric, Piezoelectric, Semiconductor, Impedimetric, Based Transducers; Biochemical Transducers: Electrode theory: Electrode- Tissue Interface, Metal-Electrolyte Interface, Electrode-Skin Interface, Electrode Impedance, Electrical Conductivity of Electrode Jellies and Creams.	**[9]**
Optical Sensors and Bio recognition Systems Photo detectors, Optical Fiber Sensors, Indicator Mediated Transducers; General Principles of Optical Sensing, Optical Fiber Temperature Sensors; Pulse Sensor: Photo Electric Pulse Transducer, Strain Gauge Pulse Transducer. Enzymes; Oligonucleotides Nucleic Acids; Lipids (Langmuir-Blodgett Bilayers, Phospholipids, Liposomes); Membrane Receptors and Transporters; Immuno Receptors; Chemoreceptors.	**[9]**
Electrodes and Immobilization Microelectrodes, Body Surface Electrodes, Needle Electrodes, pH Electrode, Specific Ion Electrodes/ Ion Exchange Membrane Electrodes, Enzyme Electrodes; Reference Electrodes: Hydrogen Electrodes, silver-Silver Chloride Electrodes, Calomel Electrodes; Enzyme Immobilization; Peptide Immobilization; Antibody Immobilization; Oligo Nucleotides and Nucleic Acid Immobilization; Cell Immobilization; Mono-Enzyme Electrodes; Bi-Enzyme Electrodes: Enzyme Sequence Electrodes and Enzyme Competition Electrodes.	**[9]**
Fundamentals and Applications of Microfluidics Capillary Flow and Electro Kinetics; Micropump, Micro mixers, Micro Reactors, Micro Droplets, Microparticle Separators; Micro fabrication Techniques (Different Types of Lithography Methods); Application of Micro-Fluidics (*e.g.* Lab-in–Chip).	**[9]**
Clinical Applications Biomarkers: Disease and Pathogen Specific Information, Availability by Sample Type (Blood, Serum, Urine, Sputum, Saliva, Stool, Mucus); Specificity, Sensitivity, Shelf Life, Portability; Clinical Chemistry; Test-Strips for Glucose Monitoring; Urea Determination; Implantable Sensors for Long-Term Monitoring; Drug Development and Detection; Environmental Monitoring; Examples of Various Diseases (Cancer, HIV/AIDS, Tuberculosis, Malaria, Lymphatic Filariasis, Schistosomiasis, Dengue, Chikungunya)	**[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, Second Edition, 2003.

Reference(s):

1. GarethJenkins,ColinD.Mansfield, “MicrofluidicDiagnostics:Methods andProtocols”,Springer, 2013.
2. Alice Cunningham, “Introduction to Bio Analytical Sensors”, John Wiley & Sons, 1998.
3. Ligler F., C. Rowe Taitt,”Optical Biosensors. Present & Future”,Elsevier, 2002.
4. Jiri Janata,”Principles of Chemical Sensors”, 2nd Ed., Plenum Press,2009.
5. Berthier Jean, and Silberzan Pascal,” Microfluidics for Biotechnology”, 2nd Ed. Artech House,2010.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1.	**Sensors and Transducers**	
1.1	Rationale of Electronic Biosensors; Essence of Three Types of Electronic Biosensors	2
1.2	Three Essential Metrics That Define Modern Electronic Sensors; Detection Time, Sensitivity and Selectivity	1
1.3	Physics of Detection Time That Allows One to Organize Very Available Sensor In A Systematic Way	1
1.4	Fundamental Limits of Detection of Various Classes of Sensors; Opportunities and Challenges of Integrating Sensors In A System Platform..	2
1.5	Principles and Applications of Calorimetric, Piezoelectric, Semiconductor, Impedimetric, Based Transducers;	1
1.6	Biochemical Transducers: Electrodetheory: Electrode- Tissue Interface, Metal-Electrolyte Interface, Electrode-Skin Interface,	1
1.7	Electrode Impedance, Electrical Conductivity of Electrode Jellies and Creams	1
2	**Optical Sensors and Biorecognition Systems**	
2.1	Photodetectors, Optical Fiber Sensors, Indicator Mediated Transducers;.	1
2.2	General Principles of Optical Sensing, Optical Fiber Temperature Sensors;	1
2.3	Pulse Sensor: Photo Electric Pulse Transducer, Strain Gauge Pulse Transducer.	2
2.4	Enzymes; Oligonucleotides Nucleic Acids; Lipids (Langmuir-Blodgett Bilayers, Phospholipids, Liposomes	2
2.5	Membrane Receptors and Transporters	2
2.6	Immuno Receptors; Chemoreceptors	1
3	**Electrodes and Immobilization**	
3.1	Microelectrodes, Body Surface Electrodes, Needle Electrodes,	1
3.2	Ph Electrode, Specific Ion Electrodes/ Ion Exchange Membrane Electrodes,.	2
3.3	Enzyme Electrodes; Reference Electrodes: Hydrogen Electrodes, Silver-Silver Chloride Electrodes, Calomel Electrodes;	2
3.4	Enzyme Immobilization; Peptide Immobilization; Antibody Immobilization;	1
3.5	Oligo Nucleotides and Nucleic Acid Immobilization; Cell Immobilization;	1
3.6	Mono-Enzyme Electrodes; Bi-Enzyme Electrodes: Enzyme Sequence Electrodes and Enzyme Competition Electrodes	2
4	**Fundamentals and Applications of Microfluidics**	
4.1	Capillary Flow and Electro Kinetics	2
4.2	Micropump, Micromixers,	1
4.3	Micro Reactors, Micro Droplets,	2
4.4	Microparticle Separators	1
4.5	Microfabrication Techniques (Different Types of Lithography Methods);	2
4.6	Application of Micro-Fluidics (E.G. Lab-In–Chip).	1
5	**Clinical Applications**	
5.1	Clinical Applications	2
5.2	Specificity, Sensitivity, Shelf Life, Portability;	1
5.3	Clinical Chemistry; Test-Strips For Glucose Monitoring; Urea Determination	2
5.4	Implantable Sensors For Long-Term Monitoring	1
5.5	Drug Development and Detection	1
5.6	Environmental Monitoring; Examples of Various Diseases (Cancer, HIV/AIDS, Tuberculosis, Malaria, Lymphatic Filariasis, Schistosomiasis, Dengue, Chikungunya)	2
	Total	45

Course Designer(s)

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB E22	Molecular Diagnostics	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To Sensitize Students About Recent Advances in Molecular Biology and Various Components of Molecular Medicine
- To Learn Many Aspects of Modern Medicine Including Pre- or Post-Natal Analysis of Genetic Diseases
- Identification of Individuals Predisposed to Disease Ranging from Common Cold to Cancer
- To Understand the Development in Identifying Inherited Diseases.
- To Study the Policy and Regulations of Approved Testing for Maintaining Quality.

Pre-requisites

- Genetic Engineering.

Course Outcomes

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

CO1	Identify the Nature of Biology and Cause of Adverse Reactions Due to Drug	Understand
CO2	Understand Various Components of Molecular Procedures and Basics of Genomics Proteomics Employed in Early Diagnosis	Understand
CO3	Understand Historical Developments in the Field of Molecular diagnostics.	Apply
CO4	Identify the role and importance of Molecular Diagnostics Such as Real-time PCR, epidemiological Genotyping, Microfluidics, Bio-Imaging and Sequencing Technologies	Apply
CO5	Detection Advancements in Recognizing Microbial Diseases, Inherited Diseases and Cancer.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	2	1	1	3
CO2	3	2	1	2	3	3
CO3	3	3	3	1	3	2
CO4	3	3	2	1	3	1
CO5	3	3	1	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	30	20	30
Understand	30	20	40
Apply	-	20	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB E22 - Molecular Diagnostics

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

Genome Biology in Health and Disease DNA, RNA and Protein: An overview; chromosomal structure & mutations; DNA polymorphism: human identity; clinical variability and genetically determined adverse reactions to drugs.	[9]
Genome: Resolution, Detection and Analysis PCR: Real-time; ARMS; Multiplex; ISH; FISH; ISA; RFLP; DHPLC; DGGE; CSCE; SSCP; Nucleic Acid Sequencing: New Generations of Automated Sequencers; Microarray Chips; EST; SAGE; Microarray Data Normalization & Analysis; Molecular Markers: 16S rRNA Typing; Diagnostic Proteomics: SELDI-TOF MS; Bioinformatics Data Acquisition & Analysis.	[9]
Diagnostic Metabolomics Metabolite Profile for Biomarker Detection in the Body Fluids/Tissues Under Various Metabolic Disorders By Making Use of LCMS & NMR Technological Platforms **Detection and Identity of Microbial Diseases** Direct Detection & Identification of Pathogenic-Organisms That are Slow Growing or Currently Lacking a System of in Vitro Cultivation as Well as Genotypic Markers of Microbial Resistance to Specific Antibiotics.	[9]
Detection of Inherited Diseases Exemplified by Two Inherited Diseases for Which Molecular Diagnosis has Provided a Dramatic Improvement of Quality of Medical Care: - Fragile X Syndrome: Paradigm of the New Mutational Mechanism of the Unstable Triplet Repeats, Von-Hippel Lindau Disease: Recent Acquisition in the Growing Number of Familial Cancer Syndromes.	[9]
Molecular Oncology Detection of Recognized Genetic Aberrations in Clinical Samples from Cancer Patients; Types of Cancer-Causing Alterations Revealed by Next-Generation Sequencing of Clinical Isolates; Predictive Biomarkers for Personalized Oncotherapy of Human Diseases Such as Chronic Myeloid Leukemia, Colon, Breast, Lung Cancer and Melanoma as Well as Matching Targeted Therapies With Patients and Preventing Toxicity of Standard Systemic Therapies. **Quality Assurance and Control** Quality Oversight; Regulations and Approved Testing.	[9]
Total Hours:	**45**

Text Book(s):

1. Campbell, A. M. and Heyer, L. J. 'Discovering Genomics, Proteomics, and Bioinformatics'. San Francisco: Benjamin Cummings. 2006
2. Brooker, R. J. 'Genetics: Analysis & Principles'. New York, NY: McGraw-Hill. 2009.

Reference(s):

1. Glick, B. R., Pasternak, J. J., and Patten, C. L. 'Molecular Biotechnology: Principles and Applications of Recombinant DNA'. Washington, DC: ASM Press. 2010
2. Coleman, W. B., and Tsongalis, G. J. 'Molecular Diagnostics: for the Clinical Laboratorian'. Totowa, NJ: Humana Press. 1997.
3. Coleman, W. B., and Tsongalis, G. J. 'Molecular Diagnostics: for the Clinical Laboratorian'. Totowa, NJ: Humana Press. 1997.
4. Williamson, M.A. and Michael L.S. 'Wallach's Interpretation of Diagnostic Tests'.10 th Edn. Walters Kluwer Publications, 2014.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Genome Biology in Health and Disease**	
1.1	DNA, RNA and Protein: An Overview:	1
1.2	An Overview :Chromosomal Structure	1
1.3	An Overview: Mutations	1
1.4	DNA Polymorphism: Human Identity	1
1.5	DNA Polymorphism: Clinical Variability.	2
1.6	DNA Polymorphism: Genetically Determined Adverse Reactions to Drugs.	2
2	**Genome: Resolution, Detection and Analysis**	
2.1	PCR: Real-Time; ARMS; Multiplex; ISH	1
2.2	Fish; Isa; Rflp,Dhplc; Dgge; Csce	2
2.3	SSCP; Nucleic Acid Sequencing	1
2.4	New Generations of Automated Sequencers; Microarray Chips	1
2.5	EST; SAGE; Microarray Data Normalization & Analysis	1
2.6	Molecular Markers: 16S Rrna Typing; Diagnostic Proteomics:	1
2.7	SELDI-TOF MS; Bioinformatics Data Acquisition & Analysis	2
3	**Diagnostic Metabolomics & Detection and Identity of Microbial Diseases**	
3.1	Bio-Marker.	1
3.2	Metabolite Profile for Biomarker Detection In The Body Fluids/Tissues Under Various Metabolic Disorders By Making Use of LCMS Platforms	1
3.3	Metabolite Profile for Biomarker Detection In The Body Fluids/Tissues Under Various Metabolic Disorders By Making Use of LCMS	2
3.4	Direct Detection & Identification of Pathogenic-Organisms.	1
3.5	Direct Detection & Identification of Pathogenic-Organisms That Are Slow Growing Or Currently Lacking A System of In Vitro Cultivation.S	1
3.6	Direct Detection & Identification of Pathogenic-Organisms -Genotypic Markers to Specific Antibiotics.	2
3.7	Direct Detection & Identification of Pathogenic-Organisms That Are Slow Growing Or Currently Lacking A System of In Vitro Cultivation As Well As of Microbial Resistance to Specific Antibiotics.	1
4	**Detection of Inherited Diseases**	
4.1	Exemplified By Two Inherited Diseases	1
4.2	Exemplified By Two Inherited Diseases for Which Molecular Diagnosis.	1
4.3	Exemplified By Two Inherited Diseases for Which Molecular Diagnosis Has Provided A Dramatic Improvement of Quality of Medical Care	1
4.4	Fragile X Syndrome.	1
4.5	Fragile X Syndrome: Paradigm of The New Mutational Mechanism of The Unstable Triplet Repeats,	2
4.6	Von-Hippel Lindau Disease.	1
4.7	Recent Acquisition In The Growing Number of Familial Cancer Syndromes.	1
4.8	Revision Detection of Recognized Genetic Aberrations In Clinical Samples From Cancer Patients.	1
5	**Molecular Oncology & Quality Assurance and Control**	
5.1	Types of Cancer-Causing Alterations Revealed By Next-Generation Sequencing of Clinical Isolates;	2
5.2	Predictive Biomarkers for Personalized Oncotherapy of Human Diseases Such As Chronic Myeloid Leukemia, Colon, Breast, Therapies.	1
5.3	Predictive Biomarkers Lung Cancer and Melanoma.	1
5.4	Matching targeted therapies with patients.	1
5.5	Preventing toxicity of standard systemic	2
5.6	Quality oversight; regulations and approved testing.	2
	Total Hours	**45**

Course Designer(s)

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

Passed in BoS Meeting held on 20/06/2025

Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

70 PDB E23	Nanobiotechnology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To Introduce the Multi-Disciplinary Scope in the Field of Nanotechnology.
- To Familiarize Students About the Different Approaches of Nanomaterial Synthesis
- To Stimulate New and Exciting Cross-Disciplinary Research Fields and Technologies
- To Sensitize Complete Systems Where Nanotechnology Can be used to improve Everyday Life.
- To Make Aware on its Experimentation and Behavior in Environment.

Pre-requisites

- NIL

Course Outcomes

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

CO1	Know the Basic Science Behind the Properties of Materials at the Nanometer Scale	Understand
CO2	Enumerate the Principles Behind Advanced Experimental	Apply
CO3	List out Computational Techniques for Studying Nanomaterial's	Apply
CO4	Gain Knowledge on the use of Various Nanomaterial's in Biomedical Application	Understand
CO5	Analyze the Potential toxicity of Nanomaterial's and the Concerns About it	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3		2	2	2	
CO2	3	2	1	2	3	3
CO3	3	3	3	1	3	2
CO4	3	3		1	3	
CO5	3	3	1	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	20	20	30
Understand	30	30	40
Apply	10	10	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-		-
Total	60	60	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M.Tech – Biotechnology								
60 PDB E23 – Nanobiotechnology								
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 Nano biotechnology Introduction to Nano biotechnology; Concepts, Historical Perspective; Different Formats of Nanomaterial's and Applications With Example for Specific Cases; Cellular Nanostructures; Nano pores; Bimolecular Motors; Bio - Inspired Nanostructures, Synthesis and Characterization of Different Nanomaterial's.	**[9]**
Nano – Films and Materials Thin films; Colloidal Nanostructures; Self Assembly, Nano vesicles; Nano spheres; Nano capsules and Their Characterization. Nanomaterial's for Catalysis, Development and Characterization of Nano biocatalysts, Application of Nano scaffolds in Synthesis, Applications of Nanobiocatalysis in the Production of Drugs.	**[9]**
Nano – Particles Nanoparticles for Drug Delivery, Concepts, Optimization of Nanoparticle Properties for Suitability of Administration Through Various Routes of Delivery, Advantages, Strategies for Cellular Internalization and Long Circulation, Strategies for Enhanced Permeation Through Various Anatomical Barriers.	**[9]**
Applications of Nano – Particles Nanoparticles for Diagnostics and Imaging (Theranostics); Concepts of Smart Stimuli Responsive Nanoparticles, Implications in Cancer Therapy, Nano devices for Biosensor Development.	**[9]**
Nano – Toxicity Introduction to Safety of Nanomaterials, Basics of Nanotoxicity, Models and Assays for Nanotoxicity Assessment; Fate of Nanomaterials in Different Stratas of Environment; Ecotoxicity Models and Assays; Life Cycle Assessment, Containment.	**[9]**
Total Hours:	**45**

Text Book(s):	
1.	Anil Kumar Anal."Bio nanotechnology: Principles and Applications", CRC Press2019
2.	David S. Goodsell."Bio nanotechnology: Lessons from Nature", Wiley-Liss 2004.
Reference(s):	
1.	Neelina H. Malsch."Biomedical Nanotechnology", CRC Press2005.
2.	Greg T. Hermanson. "Bioconjugate Techniques", (3rd Edition); Elsevier2013.
3.	Dhawan, Alok, Kumar, Ashutosh, Shanker, Rishi, Singh, Sanjay."Nanobiotechnology: Human Health and the Environment", CRC Press2018.
4.	Nicolini, Claudio. "Nanobiotechnology in Energy, Environment and Electronics: Methods and Application",Pan Stanford Pub2015.

Passed in BoS Meeting held on 20/06/2025
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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction to Nano biotechnology**	
1.1	Introduction to Nanobiotechnology; Concepts, Historical Perspective	1
1.2	Different Formats of Nanomaterials and Applications With Example for Specific	1
1.3	Cellular Nanostructures	1
1.4	Nano pores; Bimolecular Motors	2
1.5	Bio-Inspired Nanostructures, Synthesis and Characterization of Different Nanomaterial's.	2
2	**Nano – Films and Materials**	
2.1	Thin Films	1
2.2	Colloidal Nanostructures	1
2.3	Self-Assembly	1
2.4	Nanovesicles;Nanospheres; Nano capsules	2
2.5	Nanomaterial's for Catalysis, Development and Characterization of Nano	2
2.6	Application of Nanos scaffolds In Synthesis	2
2.7	Applications of Nanobiocatalysis In The Production of Drugs and Drug Intermediates.	2
3	**Nano- Particles**	
3.1	Nanoparticles for Drug Delivery, Concepts	2
3.2	Optimization of Nanoparticle Properties for Suitability of Administration Through Various Routes of Delivery	2
3.3	Advantages, Strategies for Cellular Internalization and Long Circulation	2
3.4	Strategies for Enhanced Permeation Through Various Anatomical Barriers.	2
4	**Applications of Nano – Particles**	
4.1	Nanoparticles for Diagnostics and Imaging (Theranostics)	2
4.2	Concepts of Smart Stimuli Responsive Nanoparticles Implications In Cancer Therapy	2
4.3	Nano devices for Biosensor Development	2
5	**Applications of Stem Cells**	
5.1	Introduction to Safety of Nanomaterial's	2
5.2	Basics of Nano toxicity	2
5.3	Models and Assays for Nano toxicity Assessment	3
5.4	Fate of Nanomaterial's In Different Strata of Environment	2
5.5	Eco toxicity Models and Assays	2
5.6	Life Cycle Assessment	2
	Total	**45**

Course Designer(s)

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PDB E24	Production of Biotherapeutics	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To Gain Knowledge in Bio manufacturing Principles, Design and Formulation
- To Learn Good Manufacturing Practices for Production of Bio therapeutics
- To Assess the Practical Importance of Document Management System
- To Understand the Main Elements of Quality System and its Significance
- To Understand the Guidelines of Various Pharmaceutical Association

Pre-requisites

- NIL

Course Outcomes

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

CO1	Understand the Fundamentals of Stabilization of Bio therapeutics Including Mechanisms, Rational Design, and Formulation	Understand
CO2	Evaluate the Maintenance of GMP and Documentation in Pharmaceutical Industry	Apply
CO3	Study the Principles, Practice and Significance of GMP in Production Process	Apply
CO4	Identify Various Pharmaceutical Regulatory Acts and its Guidelines for Progressing a New Drug to Market	Understand
CO5	Implementation of Quality System in Bio therapeutics to Streamline the Quality	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	1	1	2	1	3	3
CO2	1	-	3	2	1	2
CO3	1	2	-	3	1	3
CO4	1	-	2	1	-	-
CO5		2	-	2	1	1
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	30	20	40
Apply	10	20	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-		-
Total	60	60	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB E24 – Production of Biotherapeutics

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

Biomanufacturing principles Overview and Design of Biomanufacturing, Quality by Design Approach, Technical Considerations, Phases and Scale Up: Life Cycle of Manufacturing, Raw Material Considerations, Compliance and Quality in Biomanufacturing, Lean Biomanufacturing; Process Analytical Technology (PAT) During Biomanufacturing: Background and Need Tools for Data Acquisitions Software in Fermenters, Flow Filtrations, Chromatography, Analysis and Design Process Analyzers, Process Control Tools and Continuous Improvement and Knowledge Management; Standard Manufacturing Operating Procedures of Biotechnology, Including Upstream and Downstream Processing of Proteins.	**[9]**
Sterile Production and Packaging Air Lock Concepts, Manufacture of Terminally Sterilized Products, Sterilization Processes: Aseptic Processing, Freeze- Drying, Testing for Sterility, Testing for Endotoxins, Testing for Leakage and for Particles, Microbiological Monitoring, Packaging Material and Process, Qualification of a Servo-Controlled Blister Packaging Line, Blow-Fill-Seal Technology (BFS technology); Documentation: Official Requirements, GMP-Compliant Documentation, Batch Documentation, Standard Operating Procedures (SOPs), Site Master File, Electronic Batch Recording and Batch Release, CAPA, Document Management Systems.	**[9]**
Principles and Practice of GMP **Personnel:** Principles of Human Resource Management, Duties of Senior Management, Organizational Structures, Qualification and Profiles Requirement, Workplace and Job Descriptions, Health Monitoring and Occupational Health Safety and Training. **Premises:** Official Requirements, Material & Personnel Flow and Layout, air Cleanliness Classes and Grades, Construction Elements, Barrier Systems, Isolators and Safety Cabinets, Building Services, Heating Ventilation Air Conditioning (HVAC), Process Gases, Qualification of Premises and HVAC Systems, Pharma Monitoring of HVAC Systems.	**[9]**
Cleaning Validation Official Requirements, How to Validate Cleaning Procedures, Cleaning Validation Master Plan, Establishing the Scope of Validation, Acceptance Criteria and Limit Calculation, Sampling Procedures, Analytical Procedure, Maintenance of the Validated Status, Cleaning Validation Documentation; Production: Sanitation, Personnel Hygiene, Production Hygiene, Sanitation Programme, Environmental Monitoring, GMP in the Production Process, Weigh-In, Identification, In-Process Control Prevention of Cross-Contamination, Empty Chapter, Reworking, Warehouse and Logistics.	**[9]**
Quality System and GMP Regulation Introduction to Quality System, Main Elements of a Quality System; Essential of Quality System; Practical Implementation of a Quality System; Structure of Quality Manual, Correlation Between GMP Requirements (WHO) and ISO 9001:2000. Qualification Documentation, Design Qualification (DQ), Installation Qualification (IQ), Operational Qualification (OQ), Performance Qualification (PQ), Special Cases of Qualification; Process Validation: Official Requirements, Validation - a Key Element of Quality Management, Validation Planning and Procedure, Validation Documentation.	**[9]**
Total Hours:	**45**

Text Book(s):

1.	Dhawan, Alok, Kumar, Ashutosh, Shanker, Rishi, Singh, Sanjay."Nanobiotechnology: Human Health and the Environment", CRC Press2018.
2.	Nicolini, Claudio. "Nanobiotechnology in Energy, Environment and Electronics: Methods and Application", Pan Stanford Pub2015.

Reference(s):

1.	Introduction to Biomanufacturing. By North east Biomanufacturing Center and collaboration, 2012.
2.	Rodney J. Y. Ho 'Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs', 2n Edition. John Wiley & Sons, Inc. 2013.
3.	Gary Walsh.' Pharmaceutical Biotechnology: Concepts and Applications'. John Wiley & Sons, Inc.2007.
4.	Chabrabarthy, Chiranjb and Bhattacharyya, Atane, "Pharmacogenomics: An Approachto New Drugs Development" 2004.

Passed in BoS Meeting held on 20/06/2025

Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1.	**Biomanufacturing Principles**	
1.1	Overview and Design of Biomanufacturing, Quality By Design Approach,.	2
1.2	Technical Considerations, Phases and Scale Up: Life Cycle of Manufacturing,	2
1.3	Compliance and Quality In Biomanufacturing, Lean Biomanufacturing;	1
1.4	Process Analytical Technology (Pat) During Biomanufacturing: Background and Need Tools For Data Acquisitions ,Software In Fermenters, Flow Filtrations,	1
1.5	Chromatography, Analysis and Design Process Analyzers.	1
1.6	Process Control Tools and Continuous Improvement and Knowledge Management;	1
1.7	Standard Manufacturing Operating Procedures of Biotechnology, Including Upstream and Downstream Processing of Proteins	1
2	Sterile Production and Packaging	
2.1	Air Lock Concepts, Manufacture of Terminally Sterilized Products, Sterilization Processes: Aseptic Processing	1
2.2	Freeze-Drying, Testing For Sterility, Testing For Endotoxins, Testing For Leakage and For Particles, Microbiological Monitoring	1
2.3	Packaging Material and Process, Qualification of A Servo-Controlled Blister Packaging Line, Blow-Fill-Seal Technology (Bfs Technology)	2
2.4	Documentation: Official Requirements, Gmp-Compliant Documentation	1
2.5	Batch Documentation	2
2.6	Standard Operating Procedures (Sops), Site Master File	1
2.7	Electronic Batch Recording and Batch Release, Capa, Document Management Systems	1
3	Principles and Practice of Gmp	
3.1	Personnel: Principles of Human Resource Management, Duties of Senior Management,	1
3.2	Organizational Structures, Qualification and Profiles Requirement, Workplace and Job Descriptions, Health Monitoring and Occupational Health Safety	2
3.3	Premises: Official Requirements, Material & Personnel Flow and Layout, Air Cleanliness Classes and Grades	2
3.4	Construction Elements, Barrier Systems, Isolators and Safety Cabinets,	2
3.5	Building Services, Heating Ventilation Air Conditioning (Hvac), Process Gases.	1
3.6	Qualification of Premises and Hvac Systems, Pharma Monitoring of Hvac Systems	1
4	Cleaning Validation	
4.1	Official Requirements, How To Validate Cleaning Procedures, Cleaning Validation Master Plan	2
4.2	Establishing The Scope of Validation, Acceptance Criteria and Limit Calculation,	1
4.3	Sampling Procedures, Analytical Procedure, Maintenance of The Validated Status	1
4.4	Cleaning Validation Documentation; Production: Sanitation, Personnel Hygiene, Production Hygiene,	1
4.5	Sanitation Programme, Environmental Monitoring, Gmp In The Production Process.	2
4.6	Weigh-In, Identification, In-Process Control Prevention of Cross-Contamination, Empty Chapter, Reworking, Warehouse and Logistics	2
5	Quality System and Gmp Regulation	
5.1	Introduction To Quality System, Main Elements of A Quality System; Essential of Quality System;	1
5.2	Practical Implementation of A Quality System; Structure of Quality Manual,	1
5.3	Correlation Between Gmp Requirements (Who) and Iso 9001:2000.	1
5.4	Qualification Documentation, Design Qualification (Dq), Installation Qualification (Iq), Operational Qualification (Oq)	2
5.5	Performance Qualification, Special Cases of Qualification;	1
5.6	Process Validation:Official Requirements, Validation - A Key Element of Quality Management	2
5.7	Validation Planning and Procedure, Validation Documentation	1
	Total	45

Course Designer(s)

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

Passed in BoS Meeting held on 20/06/2025

Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

70 PDB E25	OMICS Technologies	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- The aim of this course is to give an overview of genomics, proteomics and metabolomics to the students.
- The students should be able to gain working knowledge of these technologies and appreciate their ability to impart a global understanding of biological systems and processes in health and disease.
- To Assess the Practical Importance of Document Management System.
- To Understand the Main Elements of Quality System and its Significance.
- To Understand the Guidelines of Various Pharmaceutical Association.

Pre-requisites

- Basic knowledge in sequencing technologies and data analysis is needed to attend the course

Course Outcomes

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

CO1	Understand High Throughput Analysis	Understand
CO2	Gain Knowledge of Current Cutting Edge Technologies;	Understand
CO3	Know the Application of Various Omics Technologies.	Understand
CO4	Demonstrate Knowledge, Skills and Appropriate Practices in the Area of the Biology of Organisms and Bio systems.	Apply
CO5	Integrate Clinical and Omics Data for a Greater Understanding of Biological Phenomena.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	3	3	3	-
CO2	3	3	3	3	2	3
CO3	2	2	3	-	2	2
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M.Tech – Biotechnology

70 PDB E 25 – OMICS Technologies

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

Genomics: Major Genome Sequencing Projects, Next Generation Sequencing Technologies, File Formats, Basic Pipeline for Data Analysis – Quality Check, Adaptor Trimming, Genome Assembly, Genome Annotation, Concepts of Sequencing Coverage and Sequencing Depth, Phred Score, N50, Introduction to Different Tools and Algorithms, Data Repositories and Databases, Choice of Sequencing Platforms, Applications of Genomics Using Case Studies	**[9]**
Transcriptomics: Introduction to Typical Wet Lab Workflow, Library Preparation, and Analysis Pipeline, Choice of Sequencing Methods and Tools for Read Mapping, Assembly, Identification of Splicing Variants and Differential Expression Analysis, Tools Available for Pathways Analysis, Gene Ontology, Hypergeometric Enrichment Analysis, Biogenesis, Characteristics and Analysis of Small RNA Like micrornas and Phasi RNAs, Analysis of Long Non-Coding RNAs, Target Prediction and functional prediction for small RNAs and lnc RNAs, Applications of Transcriptomics Using Case Studies	**[9]**
Proteomics: Basic Tools and Techniques for Protein Separation and Analysis, Mass Spectrometry Based Proteomics: Basic Workflow and Analysis Pipeline, Quantitative Proteomics and Multiplexing, Large Scale Analysis of Protein Modifications. Software Packages and Available Tools for Proteomics Data Analysis. Applications of Mass Spectrometry and Proteomics Using Case Studies.	**[9]**
Methods in proteomics: Over-view of Strategies Used for the Identification and Analysis of Proteins; Protein Extraction From Biological Samples (Mammalian Tissues, Yeast, Bacteria, and Plant Tissues); 2-DE of Proteins for Proteome Analysis; Liquid Chromatography Separations in Proteomics (Affinity, Ion Exchange, Reversed-Phase, and Size Exclusion); Enzymatic Cleavage of Proteins. Analysis of Complex Protein Mixtures using Nano-Liquid Chromatography (Nano-LC) Coupled to Mass-Spectrometry Analysis. Over-View of Strategies Used for the Identification and Analysis of Proteins; Protein Extraction from Biological Samples (Mammalian Tissues, Yeast, Bacteria, and Plant Tissues); 2-DE of Proteins for Proteome Analysis; Liquid Chromatography Separations in Proteomics (Affinity, Ion Exchange, Reversed-Phase, and Size Exclusion); Enzymatic Cleavage of Proteins.	**[9]**
Metabolomics: Tools and Techniques Available for Metabolomics Analysis, Targeted vs Non-Targeted Metabolomics, Experimental Design and Sample Preparation, Workflow, 10 Data Analysis Tools and Repositories, Data Formats and Key Challenges, Metabolite Identification, Metabolic Fingerprinting, Applications of Metabolomics.	**[9]**
Total Hours:	**45**

Text Book(s):

1.	Bioinformatics for omics data: methods and protocols (2011), Mayer, B., New York: Humana Press. ISBN 978-1617790270
2.	Omics: Applications in Biomedical, Agricultural, and Environmental Sciences (2013), Barh D., Zambare V., Azevedo V. CRC Press. Taylor and Francis Group. ISBN

Reference(s):

1.	9781138074750 3. Applications of Advances Omics Technologies: from Genes to Metabolites (2014), Wilson and Wilsons. Elsevier. ISBN: 9780444626509
2.	Genomics, Proteomics and Metabolomics in Nutraceuticals and Functional Foods (2015), Bagchi D., Swaroop A., Bagchi M. Wiley Blackwell. ISBN:9781118930427
3.	Principles of Proteomics (2013), Twyman, R., Garland Science, ISBN: 978- 0815344728

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Approved in Academic Council Meeting held on 19/07/2025

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Course Contents and Lecture Schedule

S.No.	Topic	No. Of
1	**Genomics:**	
1.1	Major Genome Sequencing Projects, Next Generation Sequencing Technologies	3
1.2	File Formats,	2
1.3	Basic Pipeline for Data Analysis – Quality Check, Adaptor Trimming,	1
1.4	Genome Assembly, Genome Annotation, Concepts of Sequencing Coverage and Sequencing Depth, Phred Score, N50,	1
1.5	Introduction To Different Tools and Algorithms, Data Repositories and Databases,	1
1.6	Choice of Sequencing Platforms, Applications of Genomics Using Case Studies	1
2	**Transcriptomics:**	
2.1	Introduction To Typical Wet Lab Workflow,	2
2.2	Library Preparation, and Analysis Pipeline,	1
2.3	Choice of Sequencing Methods and Tools for Read Mapping, Assembly,	1
2.4	Identification of Splicing Variants and Differential Expression Analysis, Tools Available for Pathways Analysis,	1
2.5	Gene Ontology, Hypergeometric Enrichment Analysis, Biogenesis, Characteristics and Analysis of Small RNA Like Micrornas and Phasi Rnas,	2
2.6	Analysis of Long Non-Coding Rnas, Target Prediction and Functional Prediction for Small Rnas and Lnc Rnas,	1
2.7	Applications of Transcriptomics Using Case Studies	1
3	**Proteomics:**	
3.1	Basic Tools and Techniques for Protein Separation and Analysis,	
3.2	Mass Spectrometry Based Proteomics: Basic Workflow and Analysis Pipeline	1
3.3	Quantitative Proteomics and Multiplexing,	1
3.4	Large Scale Analysis of Protein Modifications	1
3.5	Software Packages and Available Tools for Proteomics Data Analysis.	3
3.6	Applications of Mass Spectrometry and Proteomics Using Case Studies.	1
3.7	Proteomics Tools – Demo	1
4	Methods In Proteomics:	
4.1	Over-View of Strategies Used for The Identification and Analysis of Proteins;	1
4.2	Protein Extraction From Biological Samples (Mammalian Tissues, Yeast, Bacteria, And Plant Tissues);	1
4.3	2-DE of Proteins for Proteome Analysis; Liquid Chromatography Separations In Proteomics (Affinity, Ion Exchange, Reversed-Phase, and Size Exclusion);	1
4.4	Enzymatic Cleavage of Proteins. Analysis of Complex Protein Mixtures Using Nano-Liquid Chromatography (Nano-LC) Coupled To Mass-Spectrometry Analysis.	1
4.5	Over-View of Strategies Used for The Identification and Analysis of Proteins;	2
4.6	Protein Extraction From Biological Samples (Mammalian Tissues, Yeast, Bacteria, And Plant Tissues);	1
4.7	2-DE of Proteins for Proteome Analysis; Liquid Chromatography Separations In Proteomics (Affinity, Ion Exchange, Reversed-Phase, and Size Exclusion);	1
4.8	Enzymatic Cleavage of Proteins.	1
5	**Metabolomics**	
5.1	Tools and Techniques Available for Metabolomics Analysis,	3
5.2	Targeted Vs Non-Targeted Metabolomics,	1
5.3	Experimental Design and Sample Preparation, Workflow,	1
5.4	10 Data Analysis Tools and Repositories, Data Formats and Key Challenges,	1
5.5	Metabolite Identification, Metabolic Fingerprinting,	1
5.6	Applications of Metabolomics.	2
	Total	45

Course Designer(s)

Dr.Puniethaa Prabhu punithaa@ksrct.ac.in

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70 PDB E26/ 70 PIS 001	**Research Methodology and IPR**	**Category**	**L**	**T**	**P**	**Credit**
		PE	**3**	**0**	**0**	**3**

Objectives

- To understand the principles research process.
- To develop knowledge in analytical skills for collection of research data.
- To understand the procedure in the preparation of reports.
- To accomplish basic idea about the process involved in intellectual property rights.
- ATo enlighten the process of patent filling

Pre-requisites

- NIL

Course Outcomes

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

CO1	To Understand the Research Process and Design.	Understand
CO2	To Gain the Knowledge About Sources and Collection of Research Data	Understand
CO3	To Understand the Procedure of Data Analysis and Preparation of Reports and Checking Plagiarism.	Understand
CO4	To Gain the Knowledge on Trade Mark and Functions of UNESCO in IPR.	Apply
CO5	To Enlighten the Benefits, E-filing and Examinations Related to Patents.	Apply

Mapping with Programme Outcomes

Cos	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	2	2	2	2
CO2	3	3	2	2	2	2
CO3	3	3	2	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	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	30	40
Understand	30	20	30
Apply	-	10	30
Analyse	-	-	-
Evaluate	-	-	0
Create	-	-	0
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PDB E26/ 70 PIS 001- Research Methodology and IPR

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

Research Design Overview of Research Process and Design, Use of Secondary and Exploratory Data to Answer the Research Question, Qualitative Research, Observation Studies, Experiments and Surveys, Selection of the Right Medium and Journal of Publication, Translation of Research.	**[9]**
Data Collection and Sources Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and Methods. Data - Preparing, Exploring, Examining and Displaying.	**[9]**
Data Analysis and Reporting Overview of Multivariate Analysis, Hypotheses Testing and Measures of Association. Presenting Insights and Findings Using Written Reports and Oral Presentation. Checks for Plagiarism, Falsification, Fabrication and Misrepresentation.	**[9]**
Intellectual Property Rights Intellectual Property – The concept of IPR, Evolution and Development of Concept of IPR, IPR Development Process, Trade Secrets, Utility Models, IPR & Bio Diversity, Role of WIPO and WTO in IPR Establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance	**[9]**
Patents Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.	**[9]**
Total Hours:	**45**

Text Book(s):

1.	David I. Bainbridge, “Intellectual Property”, Longman, 9th Edition, 2012.
2.	Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).

Reference(s):

1.	Chawla H S., “Introduction to Intellectual Property Rights”, CBS PUB & DIST PVT Limited, INDIA, 2019.
2.	Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007
3.	David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007
4.	Arun K. Narasani, Kankanala K.C., Radhakrishnan V., “Indian Patent Law and Practice”, Oxford University Press, 2010.
5.	Richard Stim, “Patent, Copyright & Trademark - An Intellectual Property Desk Reference”, NOLO Publishers, 2020.
6.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

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Course Contents and Lecture Schedule

S.No.	Topics	No.of hours
1.0	**Research Design**	
1.1	Overview of research process and design	1
1.2	Use of Secondary and exploratory data to answer the research question	2
1.3	Qualitative research	1
1.4	Observation studies	1
1.5	Experiments and Surveys	1
1.6	Selection of the Right Medium and Journal for publication	2
1.7	Translation of Research	1
2.0	**Data Collection and Sources**	
2.1	Measurements, Measurement Scales	2
2.2	Questionnaires and Instruments	2
2.3	Sampling and methods	2
2.4	Data - Preparing, Exploring, examining and displaying	3
3.0	**Data Analysis and Reporting**	
3.1	Overview of Multivariate analysis	1
3.2	Hypotheses testing and Measures of Association	2
3.3	Presenting Insights	1
3.4	Findings using written reports and oral presentation	2
3.5	Checks for Plagiarism	1
3.6	Falsification	1
3.7	Fabrication, and Misrepresentation	1
4.0	**Intellectual Property Rights**	
4.1	Intellectual Property – The concept of IPR	1
4.2	Evolution and development of concept of IPR, IPR development process	2
4.3	Trade secrets, utility Models, IPR & Bio diversity	2
4.4	Role of WIPO and WTO in IPR establishments	1
4.5	Right of Property, Common rules of IPR practices	1
4.6	Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR Maintenance	2
5.0	Patents	
5.1	Patents – objectives and benefits of patent, Concept, features of patent	2
5.2	Inventive step, Specification, Types of patent application	2
5.3	Process E-filling, Examination of patent	1
5.4	Grant of patent, Revocation	1
5.5	Equitable Assignments, Licences, Licensing of related patents	2
5.6	Patent agents, Registration of patent agents	1
	Total	45

Course Designer(s)

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70 PAC 001	English For ResearchPaper Writing	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- Teach how to improve writing skills and level of readability.
- Tell about what to write in each section.
- Summarize the skills needed when writing a Title.
- Infer the skills needed when writing the Conclusion.
- Ensure the quality of paper at very first-time submission.

Pre-requisites

- -NIL-

Course Outcomes

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

CO1	Understand that how to improve your writing skills and level of readability	Apply
CO2	Learn about what to write in each section	Apply
CO3	Understand the skills needed when writing a Title	Apply
CO4	Understand the skills needed when writing the Conclusion	Apply
CO5	Ensure the good quality of paper at very first-time submission	Apply

Mapping with Programme Outcomes

Cos	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	40	40
Understand	40	40
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PAC 001 - English For Research Paper Writing

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

Introduction to Research Paper Writing Planning and Preparation, Word Order, Breaking up Long Sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	[6]
Presentation Skills Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing andPlagiarism, Sections of a Paper, Abstracts, Introduction	[6]
Title Writing Skills Key skills are needed when writing a Title, Key Skills are Needed When Writing an Abstract, Key Skills are Needed When Writing an Introduction, Skills Needed When writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	[6]
Result Writing Skills Skills are Needed When Writing the Methods, Skills Needed When Writing the Results, Skills are Needed When writing the Discussion, Skills are Needed When Writing the Conclusions	[6]
Verification Skills Useful phrases, checking Plagiarism, How to Ensure Paper is as Good as it Could Possibly be the Firsttime Submission	[6]
Total Hours:	**30**

Text Book(s):

1.	Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2.	Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006

Reference(s):

1.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
2.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.
3.	Phill Williams, Advanced Writing skills for students of English, Rumian Publishers, 2018
4.	Sudhir S. Pandhye, English Grammar and Writing Skills, Notion Press, 2017.

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Course Contents and Lecture Schedule		
S.No.	**Topics**	**No.of hours**
1.0	**Introduction to Research Paper Writing**	
1.1	Planning and Preparation, Word Order	2
1.2	Breaking up Long Sentences, Structuring Paragraphs and Sentences	1
1.3	Being Concise and Removing Redundancy	2
1.4	Avoiding Ambiguity and Vagueness	1
2.0	**Presentation Skills**	
2.1	Clarifying Who Did What, Highlighting Your Findings	2
2.2	Hedging and Criticizing	2
2.3	Paraphrasing and Plagiarism, Sections of a Paper	1
2.4	Abstracts, Introduction	1
3.0	**Title Writing Skills**	
3.1	Key Skills are Needed When Writing aTitle	1
3.2	Key Skills are Needed When Writing an Abstract, Key Skills are Needed When Writing an Introduction	2
3.3	Skills Needed When Writing a Review of the Literature	2
3.4	Methods, Results, Discussion, Conclusions, the Final Check	1
4.0	**Result Writing Skills**	
4.1	Skills are Needed When Writing the Methods	1
4.2	Skills Needed When Writing the Results	1
4.3	Skills are Needed When Writing the Discussion	2
4.4	Skills are Needed When Writing the Conclusions	2
5.0	**Verification Skills**	
5.1	Useful Phrases	2
5.2	Checking Plagiarism	2
5.3	How to Ensure Paper is as Good as it Could Possibly be the First Time Submission	2
	Total	30

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70 PAC 002	Disaster Management	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- Summarize basics of disaster.
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice frommultiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevancein specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches Teach howto improve writing skills and level of readability

Pre-requisites

- NIL

Course Outcomes

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

CO1	Ability to summarize basics of disaster	Apply
CO2	Ability to explain a critical understanding of key concepts in disaster risk reductionand humanitarian response.	Apply
CO3	Ability to illustrate disaster risk reduction and humanitarian response policy andpractice from multiple perspectives.	Apply
CO4	Ability to describe an understanding of standards of humanitarian response andpractical relevance in specific types of disasters and conflict situations.	Apply
CO5	Ability to develop the strengths and weaknesses of disaster managementapproaches	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30
Apply	40	40
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PAC 002 - Disaster Management

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

Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.	[6]
Repercussions of Disasters and Hazards Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents,Oil Slicks and Spills, Outbreaks Of Disease and Epidemics, War And Conflicts.	[6]
Disaster Prone Areas In India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; AreasProne to Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-DisasterDiseases and Epidemics	[6]
Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.	[6]
Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	[6]
Total Hours:	**30**

Text Book(s):

1.	Goel S. L., Disaster Administration and Management Text And Case Studies", Deep & DeepPublication Pvt. Ltd., New Delhi,2009.
2.	NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.

Reference(s):

1.	Sahni, Pardeepet.al.," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, 2001.
2.	Subramanian R,"Disaster Management", Vikas publishing Housing Pvt. Ltd., 2018.
3.	Chu-huaKuei, Christian N Madu, Handbook of Disaster Management Risk Reduction & Management:Climate change and Natural Disaster, world scientific, 2017.
4.	JankiAndharia, Disaster studies: Exploring Intersectional ties in Disaster Discourse, Springer, 2020.

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Course Contents and Lecture Schedule		
S.No.	**Topics**	**No. of hours**
1.0	**Introduction**	
1.1	Disaster: Definition, Factors and Significance	1
1.2	Difference between Hazard and Disaster	1
1.3	Natural and Manmade Disasters	1
1.4	Difference, Nature	2
1.5	Types and Magnitude	1
2.0	**Repercussions of Disasters and Hazards**	
2.1	Economic Damage, Loss of Human and Animal Life	1
2.2	Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones	1
2.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	1
2.4	Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents	1
2.5	Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts	2
3.0	**Disaster Prone Areas In India**	
3.1	Study of Seismic Zones	1
3.2	Areas Prone to Floods and Droughts	1
3.3	Landslides and Avalanches	1
3.4	Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami	1
3.5	Post-Disaster Diseases and Epidemics	2
4.0	**Disaster Preparedness and Management**	
4.1	Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard	2
4.2	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	1
4.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	1
4.4	Application of Remote Sensing, Data from Meteorological and other Agencies	1
4.5	Media Reports: Governmental and Community Preparedness	1
5.0	**Risk Assessment**	
5.1	Disaster Risk: Concept and Elements	
5.2	Disaster Risk Reduction, Global and National Disaster Risk Situation	1
5.3	Techniques of Risk Assessment	1
5.4	Global Co-Operation in Risk Assessment and Warning	1
5.5	People's Participation in Risk Assessment. Strategies for Survival	1
4.5	Media Reports: Governmental and Community Preparedness	1
	Total	30

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70 PAC 003	Constitution of India	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

Pre-requisites

- -NIL-

Course Outcomes

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

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indiansbefore the arrival of Gandhi in Indian politics.	Apply
CO2	Discuss the intellectual origins of the framework of argument that informed theconceptualization of social reforms leading to revolution in India	Apply
CO3	Discuss the circumstances surrounding the foundation of the Congress SocialistParty [CSP] under the leadership of Jawaharlal Nehru and the eventual failure ofthe proposal of direct elections through adult suffrage in the Indian Constitution.	Apply
CO4	Discuss the passage of the Hindu Code Bill of 1956.	Apply
CO5	Discuss the role and functioning of election commission of India.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 - Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30
Apply	40	40
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Passed in BoS Meeting held on 20/06/2025
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech- Biotechnology								
70 PAC 003 – Constitution of India								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
	2	0	0	30	0	100	-	100

History of Making of The Indian Constitution History, Drafting Committee, (Composition & Working), Philosophy of The Indian Constitution, Preamble, Salient Features	[6]
Contours of Constitutional Rights and Duties Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	[6]
Organs of Governance Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.	[6]
Local Administration District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of Grass root democracy.	[6]
Election Commission ElectionCommission: Role and Functioning. Chief Election Commissioner and ElectionCommissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	[6]
Total Hours:	30

Text Book(s):	
1.	The Constitution of India, 1950 (Bare Act),Government Publication.
2.	Busi S N, Ambedkar B R, "Framing of Indian Constitution",1st Edition, 2015.
Reference(s):	
1.	Jain, M P, "Indian Constitution Law", 7th Edition, Lexis Nexis,2014
2.	Basu, D D, "Introduction to the Constitution of India", Lexis Nexis, 2015.
3.	Bhansali S R., "Textbook on The Constitution of India", Universal Publishers, 2015
4.	Jain, M P., "Outlines of Indian Legal and Constitutional History", Lexis Nexis, 2014

Course Contents and Lecture Schedule

S.No.	Topics	No. of hours
1.0	**History of Making of The Indian Constitution**	
1.1	History	1
1.2	Drafting Committee, (Composition & Working)	2
1.3	**Philosophy of The Indian Constitution**	1
1.4	Preamble, Salient Features	1
2.0	**Contours of Constitutional Rights and Duties**	
2.1	Fundamental Rights, Right to Equality, Right to Freedom	1
2.2	Right against Exploitation, Right to Freedom of Religion	1
2.3	Cultural and Educational Rights	1
2.4	Right to Constitutional Remedies	1
2.5	Directive Principles of State Policy, Fundamental Duties	2

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3.0	**Organs of Governance**	
3.1	Parliament, Composition, Qualifications and Disqualifications	2
3.2	Powers and Functions, Executive	1
3.3	President, Governor, Council of Ministers	1
3.4	Judiciary, Appointment and Transfer of Judges	1
3.5	Qualifications, Powers and Functions	1
4.0	**Local Administration**	
4.1	District's Administration head: Role and Importance Municipalities	1
4.2	Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation	1
4.3	Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles	1
4.4	CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Differentdepartments)	1
4.5	Village level: Role of Elected and Appointed officials, Importance of grass rootdemocracy	2
5	**Election Commission**	
5.1	ElectionCommission: Role and Functioning	2
5.2	Chief Election Commissioner and ElectionCommissioners	2
5.3	Institute and Bodies for the welfare of SC/ST/OBC and women.	2
	Total	30

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Approved in Academic Council Meeting held on 19/07/2025 BoS Chairman Signature

70 PAC 004	Value Education	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- To know value of education and self- development
- To Imbibe good values in students
- To let the should know about the importance of character
- To gain knowledge on moral values
- To inculcate the habit of ethics and behavior

Pre-requisites

- Professional English

Course Outcomes

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

CO1	Explain about knowledge of self- development	Apply
CO2	Describe the importance of Human values	Apply
CO3	Develop the overall personality	Apply
CO4	Ability to work with ethics in work place	Apply
CO5	Demonstrate moral values and behavior in practice	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	50	50
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025

M. Tech – Biotechnology

70 PAC 004 - Value Education

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

Introduction to Value Education Definition, meaning, nature and scope of value. Value and value education, positive and normative dichotomy of values, intrinsic and extrinsic values, personal and social values, hierarchy of values.	[6]
Values and Self-Development Social Values and Individual Attitudes. Work Ethics, Indian, Vision of Humanism. Moral and non- moral Valuation. Standards and Principles. Value Judgements	[6]
Importance of Cultivation of Values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of Faith, National Unity. Patriotism. Love for Nature, Discipline	[6]
Personality and Behavior Development: Soul and Scientific Attitude. Positive Thinking, Integrity and Discipline, Punctuality, Love and Kindness.Avoid Fault Thinking, Free From Anger, Dignity of Labour, Universal brotherhood and Religious Tolerance. True Friendship. Happiness Vs Suffering, Love for Truth. Aware of Self-Destructive Habits.Association and Cooperation. Doing Best for Saving Nature	[6]
Character and Competence –Holy books vs Blind Faith. Self-Management and Good Health, Science of Reincarnation, Equality, Nonviolence, Humility, Role of Women. All Religions and Same Message, Mind your Mind, Self-Control, Honesty, Studying Effectively	[6]
Total Hours:	30

Text Book(s):

1.	Chakroborty S K, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, NewDelhi 2016
2.	Ghose D N, “A Textbook of Value Education”. Dominant Publishers, 2005

Reference(s):

1.	Venkataiah N., “Value Education”, APH Publishing, 1998
2.	Venkataiah N., “Research in Value Education”, APH Publishing, 1996
3.	Shukla R. P., “Value education and human rights”, Sarup & Sons, 2004
4.	Satya Pal Ruhela, “The Emerging Concept of Education in Human Values”, Daya Books, 1996

Course Contents and Lecture Schedule

S.No.	Topics	No. ofhours
1.0	**Introduction to Value Education.**	
1.1	Definition, meaning, nature and scope of value.	1
1.2	Value and value education.	1
1.3	Positive and normative dichotomy of values.	1
1.4	Intrinsic and extrinsic values, personal and	2
1.5	Social values, hierarchy of values	1
2.0	**Values and Self-Development**	
2.1	Social Values and Individual Attitudes.	2
2.2	Work Ethics, Indian, Vision of Humanism.	1
2.3	Moral and non- moral Valuation.	1
2.4	Standards and Principles and Value Judgements	2
3.0	**Importance of Cultivation of Values**	
3.1	Sense of duty. Devotion.	1
3.2	Self-reliance. Confidence, Concentration.	1
3.3	Truthfulness, Cleanliness.	1

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3.4	Honesty, Humanity.	1
3.5	Power of Faith, National Unity.	1
3.6	Patriotism, Love for Nature, Discipline	1
4	**Personality and Behavior Development:**	
4.1	Soul and Scientific Attitude. Positive Thinking.	1
4.2	Integrity and Discipline, Punctuality, Love and Kindness.	1
4.3	Avoid Fault Thinking, Free From Anger, Dignity of Labour, Universal	1
4.4	Brotherhood and Religious Tolerance. True Friendship. Happiness Vs Suffering,	1
4.5	Love for Truth. Aware of Self-Destructive Habits.	1
4.6	Association and Cooperation. Doing Best for Saving Nature	1
5	**Character and Competence –Holy books vs Blind Faith.**	
5.1	Self-Management and Good Health, Science of Reincarnation	1
5.2	Equality, Nonviolence, Humility, Role of Women.	1
5.3	All Religions and Same Message.	1
5.4	Mind your Mind, Self-Control.	1
5.5	Honesty, Studying Effectively	2
	Total	30

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70 PAC 005	Pedagogy Studies	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- To understand the language background of students.
- To learnt about the nature of classroom discourse.
- To learnt about the methodology for the in depth Stage
- To describe the nature and need of informational reading.
- To understand the importance and role of language for content areas

Pre-requisites

- **NIL**

Course Outcomes

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

CO1	Develop and document their own personal learning network.	Apply
CO2	Create a concept map to identify layers of understanding.	Apply
CO3	Develop a project-based lesson plan that emphasizes student exploration, interaction, creation, andfeedback cycles.	Apply
CO4	Compare strengths and weaknesses of online tools and methods.	Apply
CO5	Articulate a personal philosophy for teaching and learning.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	50	50
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Passed in BoS Meeting held on 20/06/2025
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025							
M. Tech – Biotechnology							
60 PAC 005- Pedagogy Studies							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
	2	**0**	**0**	**30**	**0**	**100**	**-**	**100**

Introduction and Methodology: Aims and Rationale, Policy Background, Conceptual Framework and Terminology, Theories of Learning, Curriculum, Teacher Education. Conceptual Framework, Research Questions**.** Overview of Methodology and Searching.	[6]
Thematic Overview: Pedagogical Practices are Being Used by Teachers in Formal and Informal Classrooms in Developing Countries. Curriculum, Teacher Education. Evidence on The Effectiveness of Pedagogical Practices	[6]
Methodology for the in Depth Stage: Quality Assessment of Included Studies, How Can Teacher Education (Curriculum and Practicum) and the School Curriculum and Guidance Materials Best Support Effective Pedagogy? Theory of Change. Strength and Nature of The Body of Evidence for Effective Pedagogical Practices. Pedagogic Theory and Pedagogical Approaches. Teachers' Attitudes and Beliefs and Pedagogic Strategies.	[6]
Professional Development: Alignment With Classroom Practices and Follow-Up Support, Peer Support, Support From the Head Teacher and the Community., Curriculum and Assessment, Barriers To Learning: Limited Resources and Large Class Sizes	[6]
Research Gaps and Future Directions Research Design, Contexts, Pedagogy, Teacher Education, Curriculum and Assessment, Dissemination and Research Impact	[6]
Total Hours:	**30**

Text Book(s):	
1.	Anderson, T., & Elloumi, F. (Eds.). "Theory and practice of online learning" *(*2nd ed.*)* Athabasca, AB, Canada: AthabascaUniversity. 2008
2.	Fink, L. D. "Creating significant learning experiences: An integrated approach to designing college courses". San Francisco,CA: Jossey-Bass, 2013.
Reference(s):	
1.	Akyeampong K., "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER)country report 1". London: DFID, 2003.
2.	Akyeampong K, Lussier K, Pryor J, Westbrook J. "Improving teaching and learning of basic maths and reading in Africa:Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282, 2013.
3.	Alexander RJ. "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell, 2001.
4.	Chavan M. "Read India: A mass scale, rapid, 'learning to read' campaign" 2003.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction and Methodology:** **Overview of methodology and Searching**.	
1.1	Theories of Learning, Curriculum, Teacher Education.	2
1.2	Aims and Rationale, Policy Background, Conceptual Framework and Terminology	2
1.3	Conceptual Framework, Research Questions**.**	2
2.0	**Thematic Overview:**	
2.1	Pedagogical Practices are Being Used by Teachers in Formal and Informal Classrooms in Developing Countries.	2
2.2	Curriculum, Teacher Education.	2
2.3	Evidence on The Effectiveness of Pedagogical Practices	2
3.0	**Methodology for the in Depth Stage:**	
3.1	Quality Assessment of Included Studies.	1
3.2	How Can Teacher Education (Curriculum and Practicum) and the School Curriculum and Guidance Materials Best Support Effective Pedagogy?	1
3.3	Theory of Change	1
3.4	Strength And Nature of The Body of Evidence for Effective Pedagogical Practices.	1
3.5	Pedagogic Theory and Pedagogical Approaches.	1
3.6	Teachers' Attitudes and Beliefs and Pedagogic Strategies.	1
4.0	**Professional Development:**	
4.1	Alignment With Classroom Practices and Follow-Up Support	2
4.2	Peer Support	1
4.3	Support From the Head Teacher and the Community.	1
4.4	Curriculum and Assessment.	1
4.5	Barriers To Learning: Limited Resources and Large Class Sizes	1
5	**Research Gaps and Future Directions**	
5.1	Research Design, Contexts.	2
5.2	Pedagogy, Teacher Education.	1
5.3	Curriculum and Assessment.	1
5.4	Dissemination and Research Impact	1
	Total	30

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70 PAC 006	Stress Management by Yoga	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- To gain knowledge on overall health of body and mind.
- To know how to overcome stress.
- To inculcate the habit of yoga practice
- To perform yoga Exercises
- To manage stress at work place

Pre-requisites

- NIL

Course Outcomes

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

CO1	Develop healthy mind in a healthy body	Apply
CO2	Improve social health	Apply
CO3	Ability to prove their efficiency	Apply
CO4	Handle stress a work places	Apply
CO5	Practice yoga exercise	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	50	50
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025							
M. Tech – Biotechnology							
70 PAC 006 - Stress Management by Yoga							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
	2	0	0	30	0	100	-	100

Introduction of Yoga : Meaning and Definition of Stress. Types: Eutress, Distress, Anticipatory Anxiety, Intense Anxiety and Depression. Meaning of Management – Stress Management.	[6]
Concept of Stress: Concept of Stress according to Yoga: Patanjali aphorism (PYS II - 3) Avidya Asmita. Bhagavad – Gita (Gita II 62-63) Dhayato Visayam Punsah. Yoga Vasistha and Upanishad.	[6]
Physiology of Stress Management: Physiology of Stress on: Autonomic Nervous System (ANS), Endocrine System, Hypothalamus, Cerebral Cortex and Neurohumours.	[6]
Mechanism of Stress related diseases: Psychic, Psychosomatic, Somatic and Organic phase. Role of Meditation & Pranayama on stress – physiological aspect of Meditation. Constant stress & strain, anxiety, conflicts resulting in fatigue among Executive. Contribution of Yoga to solve the stress related problems of Executive.	[6]
Yoga for health Meaning and definition of Health – various dimensions of health (Physical, Mental, Social and Spiritual) – Yoga and health – Yoga as therapy. Physical fitness. Stress control exercise – Sitting meditation, Walking meditation, Progressive muscular relaxation, Gentle stretches and Massage.	[6]
Total Hours:	**30**

Text Book(s):	
1.	Yogic Asanas for Group Training-Part-I", Janardan Swami Yoga bhyasi Mandal, Nagpur.2016
2.	"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (PublicationDepartment), Kolkata. 2018
Reference(s):	
1.	Acharya Yatendra, "Yoga & Stress Management", The Picnic Basket 2019
2.	Udupa, K.N., Stress management by Yoga. New Delhi: Motilal Banaridass Publishers Private Limited. 1996.
3.	Udupa K. N., "Stress and Its Management by Yoga", Motilal Banarsidass Publ., 1985
4.	Udupa K. N., "Disorders of Stress and Their Management by Yoga: A Study of Neurohumoral Response",Banaras Hindu University, 1978.

Course Contents and Lecture Schedule

S.No.	Topics	No. of hours
1	**Introduction of Yoga**	
1.1	Meaning and Definition of Stress.	1
1.2	Types: Eutress, Distress, Anticipatory Anxiety.	1
1.3	Intense Anxiety and Depression. Meaning of Management	1
1.4	Stress Management	1
2.0	**Concept of Stress**.	
2.1	Concept of Stress according to Yoga: Patanjali aphorism (PYS II – 3)	1
2.2	Avidya Asmita. Bhagavad – Gita (Gita II 62-63)	1
2.3	Dhayato Visayam Punsah	1
2.4	Yoga Vasistha	1
2.5	Yoga Upanishad	1
3.0	**Physiology of Stress Management**	
3.1	Physiology of Stress on: Autonomic Nervous System (ANS),	1
3.2	Physiology of Stress on: Endocrine System, Hypothalamus,	1

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3.3	Physiology of Stress on: Cerebral Cortex and Neurohumours.	1
3.4	Physiology of Stress on: Neurohumours.	1
4	**Mechanism of Stress related diseases:**	
4.1	Psychic, Psychosomatic, Somatic and Organic phase.	1
4.2	Role of Meditation & Pranayama on stress.	1
4.3	Physiological aspect of Meditation.	2
4.4	Constant stress & strain, anxiety, conflicts resulting in fatigue among Executive.	1
4.5	Contribution of Yoga to solve the stress related problems of Executive.	1
5	**Yoga for health**	
5.1	Meaning and definition of Health	1
5.2	Various dimensions of health (Physical, Mental, Social and Spiritual)	1
5.3	Yoga and health – Yoga as therapy. Physical fitness. Stress control exercise	1
5.4	Physical fitness. Stress control exercise	2
5.5	Sitting meditation, Walking meditation.	1
5.6	Progressive muscular relaxation, Gentle stretches and Massage.	1
	Total	30

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70 PAC 007	Personality Development Through Life Enlightenment Skills	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- To learn to achieve the highest goal happily.
- To become a person with stable mind, pleasing personality and determination.
- To awaken wisdom in students.
- To inculcate the habit of personality development
- To gain knowledge on life skills

Pre-requisites

- NIL

Course Outcomes

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

CO1	Develop versatile personality.	Apply
CO2	Achieve the highest goal in life by developing personality.	Apply
CO3	Lead the nation and mankind to peace and prosperity.	Apply
CO4	Ability to improve life skills	Apply
CO5	Ensure the good quality of paper at very first-time submission	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	50	50
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Passed in BoS Meeting held on 20/06/2025
Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech - Biotechnology								
70 PAC 007 - Personality Development Through Life Enlightenment Skills								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
	2	**0**	**0**	**30**	**0**	**100**	**-**	**100**

Introduction to Personality Development: The concept of personality - Dimensions of personality – Theories of Freud & Erickson- Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles.	[06]
Attitude & Motivation Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation	[06]
Self-esteem Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self-esteem - Symptoms - Personality having low self-esteem - Positive and negative self-esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviors - Lateral thinking	[06]
Other Aspects of Personality Development Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics –Good manners and etiquette.	[06]
Employability Quotient Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.	[06]
Total Hours:	30

Text Book(s):	
1.	Swami Swarupananda "Srimad Bhagavad Gita" Advaita Ashram Publication Department), Kolkata, 2016
2.	Gopinath P., Rashtriya, Bhartrihari's Three Satakam (Niti-sringar-vairagya) Sanskrit Sansthanam, NewDelhi. 2015
Reference(s):	
1.	Sagir Ahmed, "Enlightenment: Personality Development & Management", Mind & Body PhilosophyeBooks, 2015
2.	Chakroborty S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press,New Delhi, 2018
3.	Prashant Kumar Nayak, "Personality Development Through Life Enlightenment Skills", Springer, 2010
4.	Saroj Hiremath, "Life skills and Personality Development", Sage Publisher 2016

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Course Contents and Lecture Schedule		
S.No.	**Topics**	**No. of hours**
1.0	**Introduction to Personality Development:**	
1.1	The concept of personality - Dimensions of personality	1
1.2	Theories of Freud & Erickson-Significance of personality development.	2
1.3	The concept of success and failure: What is success?	1
1.4	Hurdles in achieving success - Overcoming hurdles.	2
2.0	**Attitude & Motivation**	
2.1	Attitude - Concept - Significance	1
2.2	Factors affecting attitudes and Positive attitude	1
2.3	Advantages, Negative attitude and Disadvantages	1
2.4	Ways to develop positive attitude, Differences between personalities having positive	
2.5	Negative attitude, Concept of motivation – Significance.	1
2.6	Internal and external motives Importance of self- motivation- Factors leading to de-motivation.	1
3.0	**Self-esteem**	
3.1	Term self-esteem - Symptoms – Advantages.	1
3.2	Do's and Don'ts to develop positive self-esteem.	1
3.3	Low self-esteem - Symptoms - Personality having low self-esteem	1
3.4	Positive and negative self-esteem. Interpersonal Relationships.	
3.5	Defining the difference between aggressive, submissive and assertive behaviors -	1
3.6	Lateral thinking	1
4	**Other Aspects of Personality Development**	
4.1	Body language - Problem-solving	1
4.2	Conflict and Stress Management - Decision-making skills	1
4.3	Leadership and qualities of a successful leader	1
4.4	Character building -Team-work – Time management -	1
4.5	Character building -Team-work – Time management - Work ethics	1
4.6	Good manners and etiquette.	
5	**Employability Quotient**	
5.1	Resume building- The art of participating in Group Discussion	1
5.2	Facing the Personal (HR & Technical) Interview.	1
5.3	Frequently Asked Questions -	2
5.4	Psychometric Analysis	2
	Total	30

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Approved in Academic Council Meeting held on 19/07/2025

BoS Chairman Signature

70 PAC 008	Sanskrit for Technical Knowledge	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- To improve brain functioning
- To develop the logic in mathematics, science & other subjects enhancing the memorypower
- To explore the huge knowledge from ancient literature
- To inculcate technical knowledge on Sanskrit

Pre-requisites

- -NIL-

Course Outcomes

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

CO1	Know the basic Sanskrit language	Apply
CO2	Explain an ancient Sanskrit literature about science & technology.	Apply
CO3	Develop logical skill among the group.	Apply
CO4	Speak and write Sanskrit language	Apply
CO5	Describe the technical concepts of engineering	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	50	50
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Passed in BoS Meeting held on 20/06/2025
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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025								
M. Tech- Biotechnology								
70 PAC 008 - Sanskrit for Technical Knowledge								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
	2	0	0	30	0	100	-	100

Basics of Sanskrit Alphabets in Sanskrit.	[06]
Sentences of Sanskrit Past/Present/Future Tense, Simple Sentences	[06]
Sanskrit Literature Order, Introduction of roots	[06]
Information of Sanskrit Literature Technical information about Sanskrit Literature	[06]
Technical Concepts in Engineering Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.	[06]
Total Hours:	**30**

Text Book(s):	
1.	Vishwas, Abhyaspustakam" – Samskrita-Bharti Publication, New Delhi. 2014
2.	Prathama Deeksha-Vempat iKutumbshastri, "Teach Yourself Sanskrit" Rashtriya SanskritSansthanam, NewDelhi Publication.2016
Reference(s):	
1.	Suresh Soni, "India's Glorious Scientific Tradition" Ocean books (P) Ltd., New Delhi.2007
2.	Venkitasubramonia Iyer S., "Technical Literature in Sanskrit, Volume 10", University of Kerala, 1997
3.	Kaviraj Gopinath, "The Sandilya Sanhita Bhaktikhanda", Publisher: Nabu Press, 2016
4.	Khmer Bible, "Sanskrit textbook rewrites the script on modern science", Cambodia Press, 2019.

Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
S.No.	**Topics**	
1.0	**Basics of Sanskrit**	
1.1	Alphabets in Sanskrit	6
2	**Sentences of Sanskrit**	
2.1	Past Tense	1
2.2	Future Tense,	1
2.3	Present	2
2.4	Simple Sentences.	2
3.0	**Sanskrit Literature**	
3.1	Order	2
3.2	Introduction of roots	2
3.3	Technical information about Sanskrit Literature	2
4.0	**Information of Sanskrit Literature**	
4.1	Technical information about Sanskrit Literature	6
5	**Technical Concepts in Engineering**	
5.1	Technical concepts of Engineering-Electrical, Mechanical.	2
5.2	Technical concepts of Engineering- Architecture.	2
5.3	Technical concepts of Engineering-, Mathematics.	2
	Total	30

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BoS Chairman Signature

70 PAC 009	Research Ethics	Category	L	T	P	Credit
		AC	2	0	0	0

Objectives

- Analyze the ethical practices in research
- To know the Unethical practices in research
- Familiarize about research and documentation
- Enlighten about collaborative research
- Aware about publication ethics

Pre-requisites

- NIL

Course Outcomes

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

CO1	Comprehend the importance of ethical practices in research.	Apply
CO2	Distinguish ethical practices from unethical practices in Research	Apply
CO3	Understand ethical practices in conducting research and its dissemination.	Apply
CO4	Understand the collaborated research and IPR	Apply
CO5	Understand of the right journal selection.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	50	50
Apply	20	20
Analyze	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2025							
M. Tech – Biotechnology							
70 PAC 009 - Research Ethics							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	T	P		C	CA	ES	Total
	2	0	0	30	0	100	-	100

Introduction to Ethical Practice in Research Values Underlying Research Integrity; Framework for Good Academic Research Practices	[6]
Ethics in Research Design & Conducting Research Planning; Research Questions and Documentation ; Literature Review; Data Precision, Accuracy & errors, Research Execution, Documentation & Manuscript writing; Checks for Plagiarism, Falsification, Fabrication, and m Misrepresentation.	[6]
Best Practice Guide for Research Integrity and Ethics: Important basic principles, Principles of research integrity, Principles of research ethics, Guidelines for research ethics during the research process, Responsibility and duty of care of research institutions.	[6]
Collaborative Research & IPR Collaboration and Authorship; Sharing of Credits; Intellectual Property	[6]
Dissemination Selection of the Right Medium for Publication; Choosing the Right Journal for Publication; Translation of Research	[6]
Total Hours:	**30**

Text Book(s):	
1.	Guidance Document: Good Academic Research Practices. New Delhi: University Grants Commission,Sep 2020 (https://www.ugc.ac.in/e-book/grap_29092020/mobile/index.html)
2.	UGC Regulation: Promotion of Academic Integrity and Prevention of Plagiarism in HEI's, Regulation 2018 (https://www.ugc.ac.in/pdfnews/7771545_academic-integrity-Regulation2018.pdf)
Reference(s):	
1.	Muralidhar, K., Ghosh, A., &Singhvi, A. K. (2019). Ethics in Science Education, Research and Governance. ISBN: 978-81-939482-1-7 (https://www.insaindia.res.in/pdf/Ethics_Book.pdf)
2.	Griffiths, P. A., McCormick Adams, R., Albertis, B. M., Blout, E. R., Browder, F. E., Challoner, M. D., &Stine, D. D. (1995). On being a scientist: responsible conduct in research. Washington (DC): NationalAcademy
3.	Steven D. Krause (2007) Process of Research writing (Open Textbook Library, University of Michigan)
4.	Chery Lowry (2016) Choosing & Using sources: A guide to academic research (Open Textbook Library,University of Michigan)

Course Contents and Lecture Schedule

S.No.	Topics	No.of hours
1.0	**Introduction to Ethical Practice in Research**	
1.1	Framework for Good Academic Research Practices	1
1.2	Values Underlying Research Integrity	1
1.3	Values Underlying Research Integrity value and important	1
1.4	Framework for Good Academic Research Practices.	2
	Framework for Good Academic Research Practices important	1
2.0	**Ethics in Research Design & Conducting Research**	
2.1	Planning; Research Questions and Documentation.	2
2.2	Literature Review; Data Precision, Accuracy & errors.	1

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2.3	Research Execution, Documentation & Manuscript writing.	
2.4	Checks for Plagiarism, Falsification.	1
2.5	Fabrication, and m Misrepresentation	1
3.0	**Best Practice Guide for Research Integrity and Ethics:**	
3.1	Important basic principles, Principles of research integrity.	1
3.2	Principles of research ethics	2
3.3	Guidelines for research ethics during the research process	2
3.4	Responsibility and duty of care of research institutions.	
4.0	**Collaborative Research & IPR**	
4.1	Collaboration and Authorship	2
4.2	Sharing of Credits;	2
4.3	Intellectual Property	2
5.0	**Dissemination**	
5.1	Selection of the Right Medium for Publication;	2
5.2	Choosing the Right Journal for Publication;	2
5.3	Translation of Research	2
	Total	30

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