DEPARTMENT OF BIOTECHNOLOGY

ANNA UNIVERSITY, CHENNAI

Vision:

The Department of Biotechnology is committed to evolve as a world class science and technology centre by integrating quality and ethics in teaching and research.

Mission:

The mission of the department is

- To provide students a unique and multidisciplinary learning experience that will foster the young minds to develop as a researcher, entrepreneur etc.
- To enhance academic and industrial collaborative research initiatives for the development of biotechnological, food and therapeutic products.
- To emphasise and equip the students towards innovative industrial and research updates.
- To serve the society with utmost commitment, integrity, enthusiasm, and dedication.

ANNA UNIVERSITY, CHENNAI: 600 025

UNIVERSITY DEPARTMENTS

B. TECH. INDUSTRIAL BIOTECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM (CBCS)

1. PROGRAMME OBJECTIVES

Educational objectives of the course bachelor of industrial biotechnology programme can be divided into

1. To ensure that the students have a strong foundation in basic sciences, mathematics, medical sciences, bioinformatics and process engineering.
2. Have knowledge on the theory and practices in the field of biotechnology, especially in the areas of industrial biotechnology and allied areas.
3. Motivate students to continue to pursue lifelong multidisciplinary learning as professional engineers and scientists and effectively communicate technical information, function effectively on teams, to develop and apply biotechnological solutions within a global, societal, and environmental context.
4. Prepare students to critically analyze existing systems in a specific area and develop innovative solutions that cater to the dynamic nature of the biotech industry that may lead to entrepreneurial initiatives.
5. To achieve successful professional and technical career practicing high ethical values and technical standards.

The overall objective of the Programme is to promote education and research in Biotechnology; provide academic and professional excellence for immediate productivity in industrial, governmental, or clinical settings for an ultimate benefit of society and environment.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, the Industrial Biotechnology graduates will have the ability to

	Graduate Attribute	Programme Outcome
PO1	Engineering Knowledge	Apply the knowledge of mathematics, basic science and engineering science
PO 2	Problem Analysis	Identify and analyze problems in a specific area and develop solutions based on biotechnology
PO 3	Design/ development of solutions	Innovate new processes/ modify existing processes for maximum efficiency
PO 4	Conduct investigations of complex problems	Plan, design and perform experiments for a hypothesis and interpret the data
PO 5	Modern tool usage	Apply the various genetic engineering and bioinformatics tools available for better interpretation
PO 6	The Engineer and society	Conduct themselves in a successful career with technical efficiency

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
PO8	Ethics	Interact in industry, business and society with high ethical values
PO9	Individual and team work	Function individually and in a multidisciplinary team.
PO 10	Communication	Proficiency in oral and written communication.
PO 11	Project management and finance	To implement projects in a cost-effective manner
PO 12	Life-long learning	Continue professional development and learning as a life-long activity.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

- Create and develop strategies that reflect the interdisciplinary nature of science, regulation and enterprise in the biotechnology industry.
- Define and solve problems using scientific methods in biotechnology and allied subjects.
- Consider implications of biotechnology in societal, environmental and educational frameworks.
- Demonstrate ability to perform molecular, cellular, and biochemical techniques used in biotechnology.
- Utilize a wide variety of laboratory techniques with accuracy, precision and safety.
- Analyze and report laboratory findings using oral and/or written skills.
- Provide opportunities to acquire the knowledge and skills required to comprehend and commercialize these emerging technologies and/or their products.
- Establish professional responsibilities pertaining to the workforce and Interpret current knowledge and skills to new methods in biotechnology.

4. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1.	✓	✓	✓	✓				✓	✓			
2.			✓	✓	✓		✓					
3.		✓		✓		✓	✓	✓	✓	✓	✓	✓
4.		✓	✓		✓		✓	✓		✓	✓	✓
5.		✓	✓	✓				✓	✓	✓	✓	✓

5. MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

		Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Year 1	Semester 1	Technical English												
		Engineering Mathematics I												
		Engineering Physics												
		Engineering Chemistry												
		Problem solving and Python Programming												
		Basic Sciences Laboratory												
		Problem solving and Python Programming Laboratory												
	Semester 2	Professional Communication												
		Engineering Mathematics II												
		Professional Communication												
		Thermodynamics for	3	3	3	3	3	3	1	1	3	1	2	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

		biotechnologists												
		Microbiology	1	2	2	3	2	2	-	3	3	3	-	3
		Bioorganic Chemistry	3	3	-	2	-	2	-	-	-	-	2	3
		Microbiology Laboratory	3	-	-	2	-	3	2	3	3	3	-	3
		Bioorganic chemistry laboratory	-	-	-	3	-	-	1	-	2	-	2	3
Year 2	Semester 3	Transform techniques and partial differential equations												
		Basic Industrial Biotechnology	3	2	3	3	2	2	2	3	2	2	3	2
		Cell Biology	2	3	2	3	2	1	-	-	-	-	-	3
		Biochemistry	2	3	3	3	2	1	-	-	-	-	-	3
		Material and Energy Balance	3	3	3	3	3	3	1	1	3	1	2	3
		Elective- Humanities I												
		Cell biology laboratory	3	3	2	3	3	2	2	1	-	-	-	-
		Biochemistry laboratory	2	3	3	3	2	1	-	-	-	-	-	3
	Semester 4	Elective- Humanities II												
		Environmental Sciences												
		Audit Course I												
		Mass transfer operations	3	-	3	2	-	1	-	-	-	-	2	-
		Probability and Statistics												
		Analytical methods and instrumentation	3	3	-	2	-	2	-	-	-	-	2	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

		Fluid mechanics and heat transfer operations	2	2	1	2	-	1	1	2	1	1	3	1
		Instrumentation and method of analysis laboratory	-	-	-	3	-	-	1	-	2	-	2	3
		Chemical Engineering Laboratory	2	2	1	2	1	1	1	1	1	1	-	2
Year 3	Semester 5	Total Quality Management												
		Audit Course II												
		Immunology	2	3	2	2	2	2	1	-	-	-	-	3
		Molecular biology	2	3	2	3	2	-	-	-	-	-	-	3
		Bioprocess principles	2	3	3	3	-	1	1	-	-	-	-	3
		Professional elective I												
		Professional elective II												
		Immunology Laboratory	3	3	1	2	2	-	-	1	-	-	-	2
		Bioprocess Laboratory I	3	3	3	3	3	3	3	2	2	1	-	-
	Semester 6	Genetic engineering	3	3	3	2	3	3	3	1	1	-	-	3
		Bioprocess Engineering	2	3	3	2	3	3	2	1	2	-	-	3
		Professional Elective III												
		Professional Elective IV												
		Professional Elective V												
		Open Elective I												
		Molecular Biology and Genetic Engineering Lab	3	3	2	3	3	2	2	1	-	-	-	-

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

		Bioprocess Laboratory II	3	3	3	3	3	3	3	2	2	1	-	-
		Internship / Training (Minimum 4 Weeks)	1	1	2	-	1	-	-	2	2	1	1	2
Year 4	Semester 7	Downstream Processing	3	3	3	3	3	3	3	1	3	1	3	3
		Bioinformatics	3	3	1	3	3	-	-	-	-	-	-	-
		Professional Elective VI												
		Professional Elective VII												
		Open Elective II												
		Project I	2	2	2	1	1	2	-	2	2	2	-	2
		Downstream Processing Lab	3	2	2	3	1	3	1	-	2	1	1	2
		Bioinformatics Lab	3	3	2	3	3	-	-	-	-	-	-	-
	Semester 8	Project II	2	2	3	3	2	1	2	3	3	2	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B. TECH. INDUSTRIAL BIOTECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM CURRICULUM AND

SYLLABI FOR I TO VIII SEMESTERS

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	HS5151	Technical English	HSMC	4	0	0	4	4
2	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3	PH5151	Engineering Physics	BSC	3	0	0	3	3
4	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5	GE5153	Problem solving and Python programming	ESC	3	0	0	3	3
PRACTICALS								
6	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7	GE5161	Problem solving and Python programming Laboratory	ESC	0	0	4	4	2
			TOTAL	**16**	**1**	**8**	**25**	**21**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	HS5251	Professional Communication	HSMC	4	0	0	4	4
2	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
3	IB5201	Thermodynamics for biotechnologists	PCC	2	1	0	3	3
4	EE5251	Basics of Electrical and Electronics engineering	ESC	3	0	0	3	3
5	IB5251	Microbiology	PCC	3	0	0	3	3
6	IB5202	Bioorganic Chemistry	PCC	3	0	0	3	3
PRACTICALS								
7	IB5261	Microbiology Lab	PCC	0	0	4	4	2
8	IB5211	Bioorganic Chemistry Lab	PCC	0	0	4	4	2
			TOTAL	**18**	**2**	**8**	**28**	**24**

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA5355	Transform techniques and partial differential equations	BSC	3	1	0	4	4
2	IB5301	Basic Industrial Biotechnology	PCC	3	0	0	3	3
3	IB5302	Cell Biology	PCC	3	0	0	3	3
4	IB5303	Biochemistry	PCC	3	0	0	3	3
5	IB5304	Material and Energy Balance	ESC	3	1	0	3	4
6		Elective - Humanities I	HSMC	3	0	0	3	3
PRACTICALS								
7	IB5311	Cell biology lab	PCC	0	0	4	4	2
8	IB5361	Biochemistry lab	PCC	0	0	4	4	2
			TOTAL	**18**	**2**	**8**	**27**	**24**

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Elective - Humanities II	HSMC	3	0	0	3	3
2	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3		Audit Course -I*	AC	3	0	0	3	0
4	IB5401	Mass transfer operations	ESC	2	1	0	3	3
5	MA5354	Probability and Statistics	BSC	3	1	0	4	4
6	IB5402	Analytical methods and instrumentation	PCC	3	0	0	3	3
7	IB5452	Fluid mechanics and heat transfer operations	ESC	3	1	0	4	4
PRACTICALS								
8	IB5411	Instrumentation and methods of analysis lab	PCC	0	0	4	4	2
9	IB5451	Chemical Engineering Lab	ESC	0	0	4	4	2
			TOTAL	**20**	**3**	**8**	**31**	**24**

* Audit Course is optional

SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	GE5451	Total quality management	HSMC	3	0	0	3	3
2		Audit Course -II*	AC	3	0	0	3	0
3	IB5551	Immunology	PCC	3	0	0	3	3
4	IB5501	Molecular biology	PCC	3	0	0	3	3
5	IB5502	Bioprocess principles	PCC	2	1	0	3	3
6		Professional elective I	PEC	3	0	0	3	3
7		Professional elective II	PEC	3	0	0	3	3
PRACTICALS								
7	IB5511	Immunology lab	PCC	0	0	4	4	2
8	IB5512	Bioprocess Laboratory I	PCC	0	0	4	4	2
			TOTAL	**20**	**1**	**8**	**29**	**22**

* Audit Course is optional

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	IB5601	Genetic engineering	PCC	3	0	0	3	3
2	IB5602	Bioprocess Engineering	PCC	2	1	0	3	3
3		Professional Elective III	PEC	3	0	0	3	3
4		Professional Elective IV	PEC	3	0	0	3	3
5		Professional Elective V	PEC	3	0	0	3	3
6		Open Elective I	OEC	3	0	0	3	3
PRACTICALS								
7	IB5611	Molecular Biology and Genetic Engineering Lab	PCC	0	0	4	4	2
8	IB5612	Bioprocess Laboratory II	PCC	0	0	4	4	2
9	IB5713	Internship / Training (Minimum 4 Weeks)*	EEC	-	-	-	-	-
			TOTAL	**17**	**1**	**8**	**26**	**22**

***** Students should undergo Internship/Training for which assessment will be done in the seventh semester

SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	IB5751	Downstream Processing	PCC	3	0	0	3	3
2	IB5752	Bioinformatics	PCC	3	0	0	3	3
3		Professional Elective VI	PEC	3	0	0	3	3
4		Professional Elective VII	PEC	3	0	0	3	3
5		Open Elective II	OEC	3	0	0	3	3
PRACTICALS								
6	IB5711	Downstream Processing Lab	PCC	0	0	4	4	2
7	IB5712	Bioinformatics Lab	PCC	0	0	4	4	2
8	IB5713	Internship/ Training (Minimum 4 Weeks)*	EEC	-	-	-	-	2
9	IB5714	Project I	EEC	0	0	6	6	3
			TOTAL	**15**	**0**	**12**	**29**	**24**

SEMESTER VIII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	IB5811	Project II	EEC	0	0	16	16	8
			TOTAL	**0**	**0**	**16**	**16**	**8**

TOTAL CREDITS: 169

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PROFESSIONAL ELECTIVES COURSES (PEC)

Sl. No.	CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IB5001	Advanced Biochemistry	PEC	3	0	0	3	3
2	IB5002	Animal Biotechnology	PEC	3	0	0	3	3
3	IB5071	Bio conjugate Technology and Applications	PEC	3	0	0	3	3
4	IB5003	Bioethics	PEC	3	0	0	3	3
5	IB5004	Bio-industrial Entrepreneurship and IPR	PEC	3	0	0	3	3
6	IB5005	Biopharmaceutical Technology	PEC	2	1	0	3	3
7	IB5006	Biophysics	PEC	3	0	0	3	3
8	IB5072	Biological Spectroscopy	PEC	2	1	0	3	3
9	IB5007	Biosafety	PEC	3	0	0	3	3
10	IB5008	Industrial Biosafety and Hazard Management	PEC	3	0	0	3	3
11	IB5009	Cancer Biology	PEC	3	0	0	3	3
12	IB5010	Developmental biology	PEC	3	0	0	3	3
13	GE5071	Disaster Management	PEC	3	0	0	3	3
14	IB5011	Enzyme technology and Biotransformation	PEC	3	0	0	3	3
15	GE5073	Foundation Skills in Integrated Product Development	PEC	3	0	0	3	3
16	GE5074	Fundamentals of Nano Science	PEC	3	0	0	3	3
17	IB5012	Fundamentals of research methodology	PEC	3	0	0	3	3
18	IB5013	Genetics	PEC	3	0	0	3	3
19	IB5014	Genomics and Proteomics	PEC	3	0	0	3	3

20	GE5072	Human Rights	PEC	3	0	0	3	3
21	CH5072	Instrumentation and Process Control	PEC	3	0	0	3	3
22	IB5015	Marine biotechnology	PEC	3	0	0	3	3
23	IB5075	Metabolic Engineering	PEC	3	0	0	3	3
24	IB5016	Molecular Modelling	PEC	2	1	0	3	3
25	IB5017	Fundamentals of molecular pathology	PEC	3	0	0	3	3
26	IB5018	Neurobiology and Cognitive Sciences	PEC	3	0	0	3	3
27	MA5352	Numerical and statistical methods	PEC	3	0	0	3	3
28	IB5019	Plant Biotechnology	PEC	3	0	0	3	3
29	IB5020	Principles of Food Processing	PEC	3	0	0	3	3
30	IB5021	Process Equipment and Plant design	PEC	3	0	0	3	3
31	IB5022	Symbolic Mathematics	PEC	3	0	0	3	3
32	IB5023	Systems Biology	PEC	3	0	0	3	3
33	IB5024	Tissue Engineering	PEC	3	0	0	3	3
34	CH5751	Transport Phenomena	PEC	2	1	0	2	3
35	IB5073	Chemical Reaction Engineering	PEC	2	1	0	3	3
36	IB5025	Protein Structure and Function	PEC	3	0	0	3	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HUMANITIES AND SOCIAL SCIENCES COURSES (HSMC)

Sl. No.	CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1	HS5151	Technical English	4	0	0	4	4	I
2	HS5251	Professional Communication	4	0	0	4	4	II
5	GE5451	Total Quality Management	3	0	0	3	3	V

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Process	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5271	Gender Culture and Development	3	0	0	3
2.	HU5272	Ethics and Holistic Life	3	0	0	3
3.	HU5273	Law and Engineering	3	0	0	3
4.	HU5274	Film Appreciation	3	0	0	3
5.	HU5275	Fundamentals of Language and Linguistics	3	0	0	3
6.	HU5276	Understanding Society and Culture through Literature	3	0	0	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BASIC SCIENCES COURSES (BSC)

Sl. No.	CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1	MA5158	Engineering Mathematics I	3	1	0	4	4	I
2	PH5151	Engineering Physics	3	0	0	3	3	I
3	CY5151	Engineering Chemistry	3	0	0	3	3	I
4	BS5161	Basic Science Laboratory	0	0	4	2	2	I
5	MA5252	Engineering Mathematics II	3	1	0	4	4	II
6	MA5355	Transform techniques and partial differential equations	3	1	0	4	4	III
7	MA5354	Probability and Statistics	3	1	0	4	4	IV
8	GE5251	Environmental Sciences	3	0	0	3	3	IV

ENGINEERING SCIENCES COURSES (ESC)

Sl. No	CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1	GE5153	Problem solving and Python programming	3	0	0	3	3	I
2	GE5161	Problem solving and Python programming Lab	0	0	4	4	2	I
3	EE5251	Basics of Electrical and Electronics engineering	3	0	0	3	3	II
4	IB5304	Material and Energy Balance	3	1	0	4	4	III
5	IB5452	Fluid mechanics and heat transfer operations	3	1	0	4	4	IV
6	IB5401	Mass transfer operations	2	1	0	3	3	IV
7	IB5451	Chemical Engineering Lab	0	0	4	2	2	IV

PROFESSSIONAL CORE COURSES (PCC)

Sl. No.	Code	Course title	Periods per week			Total contact periods	Credits	Semester
			L	T	P			
1	IB5201	Thermodynamics for biotechnologists	2	1	0	3	3	II
2	IB5251	Microbiology	3	0	0	3	3	II
3	IB5261	Microbiology lab	0	0	4	2	2	II
4	IB5202	Bioorganic Chemistry	3	0	0	3	3	II
5	IB5211	Bioorganic Chemistry Lab	0	0	4	2	2	II
6	IB5301	Basic Industrial Biotechnology	3	0	0	3	3	III
7	IB5302	Cell Biology	3	0	0	3	3	III
8	IB5303	Biochemistry	3	0	0	3	3	III

9	IB5311	Cell biology lab	0	0	4	2	2	III
10	IB5361	Biochemistry lab	0	0	4	2	2	III
11	IB5402	Analytical methods and instrumentation	3	0	0	3	3	IV
12	IB5411	Instrumentation and methods of analysis lab	0	0	4	2	2	IV
13	IB5551	Immunology	3	0	0	3	3	V
14	IB5501	Molecular biology	3	0	0	3	3	V
15	IB5502	Bioprocess principles	2	1	0	3	3	V
16	IB5511	Immunology lab	0	0	4	2	2	V
17	IB5512	Bioprocess Laboratory I	0	0	4	2	2	V
18	IB5601	Genetic engineering	3	0	0	3	3	VI
19	IB5602	Bioprocess Engineering	2	1	0	3	3	VI
20	IB5611	Molecular Biology and Genetic Engineering Lab	0	0	4	2	2	VI
21	IB5612	Bioprocess Laboratory II	0	0	4	2	2	VI
22	IB5751	Downstream Processing	3	0	0	3	3	VII
23	IB5752	Bioinformatics	3	0	0	3	3	VII
24	IB5711	Downstream Processing Lab	0	0	4	2	2	VII
25	IB5712	Bioinformatics Lab	0	0	4	2	2	VII

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Code	Course title	Periods per week			Total contact periods	Credits	Semester
			L	T	P			
1	IB5713	Internship / Training (Minimum 4 Weeks)	0	0	0	2	2	VII
2	IB5714	Project I	0	0	0	2	2	VII
3	IB5811	Project II	0	0	24	12	12	VIII

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	AD5091	Constitution of India	3	0	0	0	2/6
2.	AD5092	Value Education	3	0	0	0	
3.	AD5093	Pedagogy Studies	3	0	0	0	
4.	AD5094	Stress Management by Yoga	3	0	0	0	
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	0	
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	0	
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	0	
8.	AD5098	Sanga Tamil Literature Appreciation	3	0	0	0	

SUMMARY

Category	Semester								Total credits
	I	II	III	IV	V	VI	VII	VIII	
HSMC	4	4	3	3	3				17
BSC	12	4	4	7					27
ESC	5	3	4	9					21
PCC		13	13	5	13	10	10		64
PEC					6	9	6		21
OEC						3	3		6
EEC							5	8	13
Audit Course (Non Credit)				0	0				0
TOTAL	21	24	23	23	22	22	23	8	**169**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER I

HS5151 TECHNICAL ENGLISH

L T P C

4 0 0 4

OBJECTIVES

The first semester English course entitled 'Technical English' aims to,

- Create and develop strategies that reflect the interdisciplinary nature of science, regulation and enterprise in the biotechnology industry.
- Define and solve problems using scientific methods in biotechnology and allied subjects.
- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself – introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution.

UNIT II DIALOGUE WRITING 12

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions -**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions) - **Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic-**Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)- **Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement -**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL: 60 PERIODS

OUTCOMES

At the end of the course the students will have gained

CO1 exposure to basic aspects of technical English.

CO2 the confidence to communicate effectively in various academic situations.

CO3 the use of basic features of Technical English.

TEXTBOOKS

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATICS I	L T P C
	(Common to all branches of B.E. / B.Tech. Programmes in I Semester)	3 1 0 4

OBJECTIVES

The course aims to

- develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL :60 PERIODS

OUTCOMES

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

CO1 use the matrix algebra methods for solving practical problems.

CO2 apply differential calculus tools in solving various application problems.

CO3 able to use differential calculus ideas on several variable functions.

CO4 apply different methods of integration in solving practical problems.

CO5 apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6thEdition, New Delhi,2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7thEdition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5th Edition, New Delhi, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

PH5151	ENGINEERING PHYSICS	L T P C
	(Common to all branches of B.E / B.Tech Programmes)	3 0 0 3

OBJECTIVES

The course aims to

- make the students in understanding the importance of mechanics.
- equip the students on the knowledge of electromagnetic waves.
- introduce the basics of oscillations, optics and lasers.
- enable the students in understanding the importance of quantum physics.
- elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS **9**

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES **9**

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS **9**

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS **9**

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS **9**

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOMES

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

CO1 understand the importance of mechanics.

CO2 express the knowledge of electromagnetic waves.

CO3 know the basics of oscillations, optics and lasers.

CO4 understand the importance of quantum physics.

CO5 apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

REFERENCES

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J. Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K. Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

CY5151	ENGINEERING CHEMISTRY	L T P C
	(COMMON TO ALL BRANCHES)	3 0 0 3

OBJECTIVES

The course aims to

- introduce the basic concepts of polymers, their properties and some of the important applications.
- impart knowledge on the basic principles and preparatory methods of nanomaterials.
- facilitate the understanding of the laws of photochemistry, photo processes and instrumentation & applications of spectroscopic techniques.
- familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY **9**

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY **9**

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY **9**

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photo quenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE **9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY **9**

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

Attested

TOTAL: 45 PERIODS

OUTCOMES

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

CO1 recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.

CO2 identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3 identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.

CO4 recognize different forms of energy resources and apply them for suitable applications in energy sectors.

CO5 demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCES

1. Sachdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B. Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V R Gowariker, N V Viswanathan and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 2009.

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

3 0 0 3

OBJECTIVES

The course aims to

- know the basics of algorithmic problem solving.
- develop Python programs with conditionals and loops.
- define Python functions and use function calls.
- use Python data structures - lists, tuples, dictionaries.
- do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

Suggested Activities

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

Suggested Activities

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods

- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities

- Implementing python program using lists, tuples, sets for the following scenario:

Simple sorting techniques

Student Examination Report

Billing Scheme during shopping.

- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods

- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES **10**

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

Suggested Activities

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

Suggested Evaluation Methods

- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING **7**

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities

- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks -for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods

- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES

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

CO1 develop algorithmic solutions to simple computational problems.
CO2 develop and execute simple Python programs.
CO3 write simple Python programs for solving problems.
CO4 decompose a Python program into functions.
CO5 represent compound data using Python lists, tuples, dictionaries etc.
CO6 read and write data from/to files in Python programs.

TEXT BOOK

1. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff/O'Reilly Publishers, 2016.
3. (http://greenteapress.com/wp/thinkpython/).

REFERENCES

1. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 3.2", Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press, 2013
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2012.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BS5161	BASIC SCIENCES LABORATORY	L T P C
	(Common to all branches of B.E. / B.Tech Programmes)	0 0 4 2

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVES

The course aims to

- inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

LIST OF EXPERIMENTS

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc.
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

OUTCOMES

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

CO1 determine various moduli of elasticity and also various thermal and optical properties of materials.
CO2 determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES

The course aims to

- inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-
10. Phenanthroline / thiocyanate method).
11. Estimation of sodium and potassium present in water using flame photometer.
12. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
13. Pseudo first order kinetics-ester hydrolysis.
14. Corrosion experiment-weight loss method.
15. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES

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

CO1 analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO2 determine the amount of metal ions through volumetric and spectroscopic techniques
CO3 determine the molecular weight of polymers by viscometric method.
CO4 quantitatively analyse the impurities in solution by electroanalytical techniques
CO5 design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel‟s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C

0 0 4 2

OBJECTIVES

The course aims to

- Understand the problem solving approaches.
- learn the basic programming constructs in Python.
- articulate where computing strategies support in providing Python-based solutions to real world problems.
- use Python data structures - lists, tuples, dictionaries.
- do input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES

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

CO1 develop algorithmic solutions to simple computational problems
CO2 develop and execute simple Python programs.
CO3 structure simple Python programs for solving problems.
CO4 decompose a Python program into functions.
CO5 represent compound data using Python data structures.
CO6 apply Python features in developing software applications.

SEMESTER II

HS5251	PROFESSIONAL COMMUNICATION	L	T	P	C
		4	0	0	4

OBJECTIVES

The course aims to

- improve the relevant language skills necessary for professional communication.
- develop linguistic and strategic competence in workplace context.
- enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I TECHNICAL COMMUNICATION **12**

Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)- Speaking: Role play exercises based on workplace contexts, introducing oneself- Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II SUMMARY WRITING **12**

Listening: Listening to talks/lectures both general and technical and summarizing the main points- Speaking: Participating in debates- Reading: Reading technical essays/ articles and answering comprehension questions-Writing: Summary writing-Grammar: Participle forms, relative clauses- Vocabulary Development: Use of compound words, abbreviations and acronyms.

UNIT III PROCESS DESCRIPTION **12**

Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon

UNIT IV REPORT WRITING **12**

Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: reporting words

UNIT V WRITING JOB APPLICATIONS **12**

Listening: Listening to a job interview and completing gap=filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs-Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 read and comprehend technical texts effortlessly.
CO2 write reports of a technical kind.
CO3 speak with confidence in interviews and thereby gain employability

TEXTBOOK:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

ASSESSMENT PATTERN

Assessments will assess all the four skills through both pen and paper and computer based tests.

- Assessments can be pen and paper based, quizzes.

MA5252	ENGINEERING MATHEMATICS – II (Common to all branches of B.E. / B.Tech. Programmes in II Semester)	L	T	P	C
		3	1	0	4

OBJECTIVES

The course aims to

- acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- acquaint the students with Differential Equations which are significantly used in Engineering problems.
- make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION **12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z,\ az,\ 1/z,\ z^2$.

UNIT III COMPLEX INTEGRATION **12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT IV DIFFERENTIAL EQUATIONS **12**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

OUTCOMES

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

CO1 calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.

CO2 construct analytic functions and use their conformal mapping property in application problems.

CO3 evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.

CO4 apply various methods of solving differential equation which arise in many application problems.

CO5 apply Laplace transform methods for solving linear differential equations

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5thEdition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

IB5201 THERMODYNAMICS FOR BIOTECHNOLOGISTS L T P C
2 1 0 3

OBJECTIVES

The course aims to

- learn the laws of thermodynamics and to apply them
- study the PVT behaviour of fluids
- learn the principles of chemical reaction equilibria

UNIT I FIRST LAW OF THERMODYNAMICS 9

Concept of heat work and energy-forms of energy- forms of work- first law of thermodynamics-energy balance equation- batch system energy balance – internal energy and enthalpy changes-application problems – enthalpy changes in chemical and biochemical reactions -application problems- effect of temperature on chemical reactions (Kirchoffs law) Open systems-Simple applied problems

UNIT II THERMODYNAMIC PROPERTIES OF FLUIDS 9

PVT behaviour of pure fluids, Equation of state of ideal gases, Equation of state for Real gases, Second law of thermodynamics, Entropy and entropy changes – Applied problems-Concept of Heat Engine – refrigeration- heat pump -fundamental equations relating first law and second law.

UNIT III FREE ENERGY 9

Helmholtz free energy, Gibbs free energy, Reversible process, Maxwell Relations for fundamental properties, Eqns for ΔG, ΔS, ΔH and Cp-Cv relationship for actual gases. Phase equillibria for single component, VLE and clausius clay petroneqn, Latent heat of phase transformation.

UNIT IV MOLAR PROPERTY OF SOLUTIONS 9

Molar property of ideal solutions & actual solutions, concepts of chemical potential and fugacity, concepts and applications of excess properties of mixtures; activity coefficient; Gibbs Duhem equation, Colligative properties, relationship between equilibrium constant and Gibbs free energy change. Applications of Gibbs free energy on biochemical reactions, Thermodynamic properties of ions in solution, Electrochemical cells, measurement of pH and pK_a.

UNIT V CHEMICAL REACTION EQUILLIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions. Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, thermodynamics and stoichiometry of Product Formation

TOTAL: 45 PERIODS

OUTCOMES

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

CO1 have a comprehensive understanding of the principles of work and energy

CO2 be able to understand principles of entropy and entropy driven processes in biochemical systems

CO3 be able to have comprehensive understanding of the concept of free energy and phase equilibria

CO4 have a thorough understanding of concepts and applications of chemical potential, fugacity and colligative properties

CO5 have complete knowledge of principles of chemical reaction equilibria as applied to biological systems

TEXT BOOKS

1. Smith J.M., Van Ness H.C., And Abbot M.M. “Introduction To Chemical Engineering Thermodynamics”, VII Edition, Tata McGraw-Hill, 2009.
2. Narayanan K.V. “A Text Book of Chemical Engineering Thermodynamics”, II edition, PHI, 2013.
3. Christina Smolke, “The Metabolic Pathway Engineering Handbook Fundamentals”, CRC Press Taylor & Francis Group, 2009.
4. Urs Von Stockar. “Biothermodynamics: The Role of thermodynamics In Biochemical Engineering “ EPFL Press, distributed by CRC Press Taylor & Francis Group, 2013.

REFERENCES

1. Sandler S.I. “Chemical and Biochemical Thermodynamics”, John Wiley,1989.
2. Peter Atkins, Julio de Paula “Physical Chemistry” VII Edition, oxford university press 2002.
3. Donald T.Haynie, “Biological Thermodynamics” II Edition. Cambridge University Press 2013.
4. Sandler S.I. “Chemical, Biochemical, and Engineering Thermodynamics”, V Edition, Wiley, 2017
5. Peter Atkins, Julio de Paula and James Keeler “Atkins' Physical Chemistry: Thermodynamics and kinetics” XI Edition Oxford University Press 2018.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	have a comprehensive understanding of the principles of work and energy	3	3	3	3	3	3	2	1	3	1	1	3	3	3	3	-	-	-	-	3
CO 2	be able to understand principles of entropy and entropy driven processes in biochemical systems	3	3	3	3	3	3	1	1	3	1	1	3	3	3	3	-	-	-	-	3
CO 3	be able to have comprehensive understanding of the concept of free energy and phase equilibria	3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	-	-	-	-	3
CO 4	have a thorough understanding of concepts and applications of chemical potential, fugacity and colligative properties	3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	-	-	-	-	3
CO 5	have complete knowledge of principles of chemical reaction equilibria as applied to biological systems	3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	-	-	-	-	3
Overall CO		3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	-	-	-	-	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EE5251 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LT P C

3 0 0 3

OBJECTIVES

The course aims to

- understand the basic concepts of electric circuits, magnetic circuits and wiring.
- understand the operation of AC and DC machines.
- understand the working principle of electronic devices and circuits.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING 9

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS 9

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads-Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

UNIT III ELECTRICAL MACHINES 9

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

UNIT IV BASICS OF ELECTRONICS 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES 9

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.

TEXT BOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 1989.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5th edition, 2013

REFERENCES

1. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017
3. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill, 2010.
4. Muhammad H.Rashid, "Spice for Circuits and electronics", 4th ed.,Cengage India,2019.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5251 **MICROBIOLOGY** **L T P C**

3 0 0 3

OBJECTIVES

The course aims to

- To provide the students the knowledge of how to identify different microbes
- To make them aware about the requirements for microbial growth and their lifecycle
- To a help them understand the different types of physical and chemical control of microbial growth
- Make them realize the interaction between microbes and their hosts and also how to design antimicrobials
- Make them realize the applications of microbial metabolism in various industries.

UNIT I INTRODUCTION TO MICROBIOLOGY **6**

History (scientists and discoveries), classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

UNIT II MICROBIAL NUTRITION, GROWTH AND METABOLISM **8**

Nutritional classification of microorganisms based on carbon, energy and electron sources Definition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment, different media used for bacterial culture (defined, complex, selective, differential, enriched), Biochemical test for identification (citrate utilization, catalase, coagulase, IMViC), Mathematics of growth-generation time, specific growth rate.

UNIT III CONTROL OF MICROORGANISMS **12**

Sterilization, Physical control of microorganisms dry and moist heat, pasteurization, tyndalization; radiation, ultra sonication, filtration. and chemical control of microorganisms (phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes, sterilizing gases) Disinfection, antiseptics and fumigation. Determination of phenol coefficient of disinfectant. Host-microbe interactions (types of interaction, gnotobiots, host defense and pathogen defense); anti-bacterial (class I, II, III), anti-fungal and anti-viral agents; mode of action and resistance to antibiotics.

UNIT IV MICROBES- STRUCTURE AND REPRODUCTION **10**

Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (Cyanophyta), and fungi (Streptomyces, Saccharomyces), mycoplasma (M. pneumoniae) and bacteriophages (T4 phage, lambda phage)

UNIT V INDUSTRIAL MICROBIOLOGY AND MICROBIAL ECOLOGY **9**

Microbes involved in preservation (*Lactobacillus*,bacteriocins), spoilage of food and food borne pathogens *(E.coli, Clostridium*). Primary and secondary metabolites, Industrial use of microbes (production of penicillin, vitamin B-12); bioremediation (oil spillage); biofertilizers, biopesticides.

TOTAL: 45 PERIODS

OUTCOMES

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

CO1 identify different microorganisms
CO2 design a medium for microbial growth
CO3 learn about various physical and chemical agents control microbial growth
CO4 gain knowledge of how the various drugs interact with the microbial metabolism
CO5 know about the applications of microbial metabolism and their primary and secondary metabolites in various fields.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS

1. Pelczar, M.J. “Microbiology”, 5th Edition, Tata McGraw-Hill, 2001.
2. Prescott. Harley, Klein. “Microbiology “: Authored by Wiley, Sherwood, Woolverton, Prescot 10th edition (2017) McGraw-Hill Higher Education,
3. Ananthanarayanan, R.and Jayaram PanikerC.K., “Textbook of Microbiology”,10th Edition, 2017 Orient Longman
4. Jeremy. W. Dale Understanding Microbes: An Introduction to a Small World”. February 2013 Wiley-Blackwell

REFERENCES

1.. Casida, L.E. “Industrial Microbiology”, New Age International, 1968.

2.. Schlegel, H.G. “General Microbiology”, 7th Edition, Cambridge University Press, 1993.

3. Tortora J, Funke R, Case L, “Microbiology An Introduction” 3rdEdition; Benjamin/Cummings publishing, 1989.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	identify different microorganisms	-	-	2	-	2	3	-	3	3	2	-	3	2	2	-	3	3	2	-	1
CO 2	design a medium for microbial growth	1		3	2	-	-	1	-	2	-	-	2	1	1	-	2	-	-	-	-
CO 3	learn about various physical and chemical agents control microbial growth	-	2	1	-	1	1	1	2	2	-	-	2	1	1	-	2	-	-	-	-
CO 4	gain knowledge of how the various drugs interact with the microbial metabolism	1	1	3	-	-	-	-	-	2	2	-	2	2	3	-	2	3	-	-	2
CO 4	know about the applications of microbial metabolism and their primary and secondary metabolites in various fields	1	2	1	3	-	-	-	2	-	1	2	3	2	-	-	3	2	2	2	3
Overall CO		1	2	2	3	2	2	1	3	3	3	-	3	2	1	1	3	2	2	1	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5202 **BIOORGANIC CHEMISTRY** **L T P C**

3 0 0 3

OBJECTIVES

The course aims to

- enable the students to understand the basics concepts of chemical reactions
- make students understand the kinetics and its reaction mechanism.

UNIT I BONDING AND STEREOCHEMISTRY **9**

Atoms Electrons and orbitals - Covalent Bonds - Octet rule - Polar covalent Bonds - Electronegativity- formal charge - Resonance Acids and Bases - Arrhenius and Bronsted Lowry Theories - Acid Base equilibria - SP3 hybridization - Conformations analysis ethane, butane and cyclohexane - Cis- trans isomerism. Stereochemical activity around the tetrahedral carbon – optical activity - Conformation of the peptide bond.

UNIT II MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS **9**

SN1 and SN2 reactions on tetrahedral carbon- nucleophiles- mechanism steric effects – nucleophilic addition on Acetals and ketals -Aldehyde and ketone groups – reactions of carbonyl group with amines- acid catalyzed ester hydrolysis – Saponification of an ester- hydrolysis of amides. Ester enolates - claisen .condensation – Michael condensation.

UNIT III KINETICS AND MECHANISM **9**

Kinetic method – Rate law and mechanism – Transition states- Intermediates – Trapping of intermediates – Microscopic reversibility – Kinetic and thermodynamic reversibility – Isotopes for detecting intermediates. Primary and secondary isotopes – the Arrhenius equation Eyring equation - ΔG, ΔS, ΔH, Thermodynamics of coupled reactions.

UNIT IV CATALYSIS **9**

Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation

UNIT V BIOORGANIC REACTIONS **9**

Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Merrifield state peptide synthesis – Sanger method for peptide and DNA sequencing **TOTAL: 45 PERIODS**

OUTCOMES:

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

CO1 Bonding and stereochemistry

CO2 Mechanisms of substitution and addition reactions

CO3 Thermodynamics, kinetics and mechanism

CO4 Catalysis

CO5 Bioorganic reactions & mechanisms

TEXT BOOKS:

1. Carey, Francis A.” Organic Chemistry”. VIIth Edition, Tata MCGraw Hill, 2009.
2. Page, M.I. and Andrew Williams “Organic and Bio-organic Mechanisms”. Pearson, 2010.

REFERENCES:

1. Dugas, Hermann “Bioorganic Chemistry: A Chemical Approach to Enzyme Action” 3rd Edition, Springer, 2003.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand the fundamentals, mechanisms and instrumentation involved in spectral analysis	3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-
CO 2	understand the purpose and theories of chromatographic and electrochemical methods	3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-
CO 3	understand the importance of analytical instrumentation for the purification and characterisation of samples	3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-
Overall CO		3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

OBJECTIVES

The course aims to

- make the student aware of the various lab protocols, the safety measures involved while doing experiments
- equip them in handling microbes confidently.

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
6. Staining Techniques Simple, Differential- Gram's Staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria
11. Effect of pH, Temperature, UV radiation on Growth Bacteria
12. Biochemical test for identification of E.coli, Bacillus

Equipment Needed for 20 Students

Autoclave 1

Hot Air Oven 1

Incubators 2

Light Microscopes 4

Incubator Shaker 1

Colorimeter 2

Lamina Flow Chamber 2

Glassware, Chemicals, Media as required

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 identify an organism by microscopic examination, quantification and confirmation by biochemical tests.
CO2 quantify microbes and confirmation of the identity by biochemical tests
CO3 how to use the various equipment in the lab and also the importance of various biosafety measures used in lab

TEXT BOOKS:

1. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.

2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	identify an organism by microscopic examination, quantification and confirmation by biochemical tests.	2	-	-	3	-	3	2	3	3	3	1	3	1	2	-	2	3	3	2	1
CO 2	quantify microbes and confirmation of the identity by biochemical tests.	2	-	-	2	-	2	-	3	3	2	-	3	1	2	1	2	3	3	1	-
CO 3	how to use the various equipments in the lab and also the importance of various biosafety measures used in lab	3	-	-	2	-	3	2	3	3	3	-	3	1	2	1	2	3	3	2	-
Overall CO		3	-	-	2	-	3	2	3	3	3	-	3	1	2	1	2	3	3	1	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5211	BIOORGANIC CHEMISTRY LABORATORY	L T P C
		0 0 4 2

OBJECTIVES

The course aims to

- make the students understand the mechanism of synthesis of different chemical moieties
- familiarise the students with the isolation of biomolecules from natural sources

LIST OF EXPERIMENTS

1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from tartaric acid
5. Preparation of alpha D- glucopyranose pentaacetate
6. Preparation of 1,2,5,6 dicyclohexylnoine alpha d glucofuranose
7. Isolation of lycopene from tomato paste
8. Preparation of L-proline
9. Preparation of L-cysteine from hair
10. Preparationof S-ethylhydroxyl butonate from methylacetoacetate using yeast
11. Resolution of S-ethyl hydroxyl butonate using 3,5 dinitro benzoate.
12. Preparation of 5,10,15,20-tetrakisphenylporphyrin.

Equipment Needed for 20 Students

Colorimeter

Glassware, Chemicals, Media as required

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 comprehend the mechanism of reactions
CO2 be able to synthesise various Bioorganic compounds
CO3 be able to work independently for the experimentation.

REFERENCES:

1. Organic Chemistry, Francis A.Carey, VII Edition, Tata MCGraw Hill, Fourth reprint 2009.
2. Organic and Bio-organic Mechanisms, M.I. Page and Andrew Williams. Pearson, First Impression, 2010.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	comprehend the mechanism of reactions	-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-
CO 2	be able to synthesise various Bioorganic compounds	-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-
CO 3	be able to work independently for the experimentation	-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-
Overall CO		-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

SEMESTER III

MA5355 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES

The course aims to

- introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- introduce Fourier series analysis which is central to many applications in engineering
- develop the analytic solutions for partial differential equations used in engineering by Fourier series;
- acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange's Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 12

Classification of partial differential equations- Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

TOTAL: 60 PERIODS

OUTCOMES

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

CO1 solve partial differential equations which arise in application problems.
CO2 analyze the functions as an infinite series involving sine and cosine functions.
CO3 obtain the solutions of the partial differential equations using Fourier series.
CO4 obtain Fourier transforms for the functions which are needed for solving application problems.
CO5 manipulate discrete data sequences using Z transform techniques.

TEXTBOOKS

1. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
4. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill,

11th Reprint, New Delhi, 2010.

IB5301	BASIC INDUSTRIAL BIOTECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- make the students aware of the overall fermentation technology in general.
- understand the principles and biochemical pathways for the production of commercially important bio-products.

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Types of media, Basic concepts of upstream and downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation. Bioprocess strategies in Plant Cell and Animal Cell culture, monitoring contamination.

UNIT II PRODUCTION OF ORGANIC ACIDS, AMINO ACIDS AND ALCOHOLS 9

Production of commercially important Primary metabolites: Organic Acids – Citric acid, Lactic acid, Acetic acid, Itaconic acid, Kojic acid; Amino Acids – L-Glutamic acid, L-Lysine, L-Tryptophan and **Alcohols – Ethanol, Butanol, Glycerol; Biosynthetic Pathways and Feedback Mechanisms.**

UNIT III PRODUCTION OF ANTIBIOTICS, VITAMINS AND STEROIDS 9

Production processes for various classes of secondary metabolites: Antibiotics – β-Lactam Antibiotics Penicillin, Cephalosporin, Tetracycline; Vitamins – Vitamin B12, Riboflavin, β-Carotene and Alkaloids; Biosynthetic Pathways and Feedback Mechanisms.

UNIT IV PRODUCTION OF ENZYMES, BIOFUELS, DIETARY SUPPLEMENTS 9

Production of Enzymes, Bio pesticides, Bio fertilizers, Bio preservatives, Biopolymers, Biodiesel, Bioethanol, Biogas. Cheese, Beer, Single Cell Proteins – Bacterial, Yeast, Algal & Mushroom culture, Bioremediation, Economic Aspects.

UNIT V PRODUCTION OF RECOMBINANT BIOPRODUCTS 9

Production of recombinant proteins having therapeutic and diagnostic applications, Monoclonal antibodies, vaccines, Human Growth Factor, Insulin, Tumor Suppressor Proteins, Future Aspects.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the steps involved in the production of bio products and methods to improve the productivity.

CO2 apply basic biotechnological principles, methods and models to understand the bioprocess and biochemical engineering.

CO3 identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.

TEXT BOOKS:

1. Casida, L.E. “Industrial Microbiology”, New Age International (P) Ltd, 1968.
2. Cruger,Wulf and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, IInd Edition, Panima Publishing, 2000.
3. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, IInd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
4. James D. Watson, Richard M. Myers, Amy A. Caudy, and Jan A. Witkowski, “Recombinant DNA: Genes and Genomes: A Short Course” - W. H. Freeman, 2007

REFERENCES:

1. Prescott, S.C. and Cecil G. Dunn, “Industrial Microbiology”, Agrobios (India), 2005.
2. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
3. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
4. K.G.Ramawat and Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand the steps involved in the production of bio products and methods to improve the productivity.	3	2	3	2	2	1	2	3	1	2	2	2	3	2	2	3	2	2	2	3
CO 2	apply basic biotechnological principles, methods and models to understand the bioprocessing strategies	3	3	3	3	3	3	2	3	2	2	3	1	3	3	2	3	3	2	2	3
CO 3	identify and debate the ethical, legal, professional, and social issues in the field of biotechnology	2	2	3	3	2	2	2	3	3	2	3	2	3	2	3	3	3	2	2	3
Overall CO		3	2	3	3	2	2	2	3	2	2	3	2	3	2	2	3	3	2	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5302 **CELL BIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- make the students to acquire the basic knowledge of the structural and functional properties of cells
- understand the fundamental and translational research in cell biology.
- know the cellular transport mechanisms and key analytical techniques in cell biology

UNIT I BIOMEMBRANES **10**

Overview of prokaryotic and eukaryotic cells. Lipid bilayer: Composition, structure and properties of membrane lipids. Significance of membrane fluidity and asymmetry. Lipid rafts and its significance. Membrane proteins: Peripheral and various transmembrane proteins with examples – Single pass and multipass transmembrane proteins, Channel proteins and glycosylated proteins. Hydropathy plots. Membrane solubilization and purification: micelle formation. Membrane dynamics: flip-flop, rotational and lateral diffusion. Techniques to assess membrane dynamics: Hybrid cells, FRAP and FLIP techniques. Cell-Cell junctions: Anchoring-, gap- and tight-junctions.

UNIT II CELL ORGANELLES & CYTOSKELETON **7**

Structure and functions of cell organelles: Nucleus and cytoplasm. Mitochondria and Chloroplast – origin and autonomy. Endoplasmic reticulum and its types, Golgi complex, Lysosomes, Vacuoles and peroxisomes. Organelle biomarkers. Cytoskeleton: Structure, Composition, Assembly and functions of microtubules, microfilaments and intermediate filaments.

UNIT III MEMBRANE TRANSPORT **10**

Basics of membrane transport: Size, solubility and electrochemical gradient of solutes across membrane. Kinetics of passive vs. facilitated diffusion. Transport proteins: Uniporters, Symporters, Antiporters, Aquaporins, ATP driven pumps and its types, Ion-channels – voltage and ligand gated. Role of ion-channels and ATP pumps in nerve conduction. Principles of Patch-Clamp experiment to study ion-channels activity.

UNIT IV CELLULAR TRANSPORT SYSTEMS **9**

Protein movement across cellular compartments: Role of signal sequences, organelle receptors/translocators in protein sorting. Vesicular transport: Clathrin coated vesicles, Role of Rab protein in vesicular transport, SNARE proteins and its role in vesicular fusion. Transport vesicles involved in endocytosis and exocytosis.

UNIT V TECHNIQUES IN CELL BIOLOGY **9**

Cell fractionation: Extraction, Homogenization and Centrifugation techniques. Microscopy and cell architecture: Fixation, sectioning and staining techniques for microscopic studies – Light microsope, fluorescent/confocal microscope, Electron microscopes – SEM, TEM and cryo EM. Cell isolation: Fluorescence Activated Cell Sorter (FACS) and Magnetic separation/MACS. Cell viability studies: Using tetrazolium salts, LDH release, Tryphan blue exclusion, etc.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the fundamental composition, structure and characteristics of prokaryotic and eukaryotic cell.
CO2 understand various transport phenomena in cells and their role in cellular homeostasis
CO3 develop knowledge on basic and key techniques involved in cell biology

TEXTBOOKS:

1. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. Molecular Biology of the cell, 6th Edition, 2015
2. Lodish H, Berk A,Matsudaira P,Kaiser CA, Krieger M, Schot MP, Zipursky L, Darnell J. Molecular Cell Biology, 8th Edition, 2016
3. Sadava, D.E. "Cell Biology: Organelle Structure and Function", 11th edition 2016

REFERENCES:

1. Cooper, G.M. and R.E. Hansman "The Cell: A Molecular Approach", IVth Edition, ASM Press, 2007
2. Becker, W.M. etal., "The World of the Cell", Vth Edition, Pearson Education, 2003.
3. Campbell, N.A., J.B. Recee and E.J. Simon "Essential Biology", IIIrd Edition, Pearson International, 2007.
4. Alberts, Bruce et al., "Essential Cell Biology", IInd Edition, Garland Press (Taylor & Francis), 2004.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand the fundamental composition, structure and characteristics of prokaryotic and eukaryotic cells	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO 2	understand various transport phenomena in cells and their role in cellular homeostasis	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO 3	develop knowledge on basic and key techniques involved in cell biology	2	2	3	3	3	3	-	-	-	-	-	2	3	3	-	3	3	2	2	-
Overall CO		2	3	2	3	2	1	-	-	-	-	-	3	2	2	1	3	1	1	1	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5303 **BIOCHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- enable the students to learn the fundamentals of Biochemistry and its significance in Biotechnology and Medicine
- learn about the basic structure and functions of different Biomolecules
- provide the insight about the different metabolic pathway and its regulation

UNIT I PRINCIPLES OF BIOCHEMISTRY: STRUCTURE AND FUNCTION OF CARBOHYDRATES AND LIPIDS **9**

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical nature of water.

Carbohydrates (mono, di, oligo & polysaccharides) mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid.

Lipids**:** Definition and Classification- Fatty acids, glycerol, triacylglycerol. Reactions- saponification, iodination, hydrogenation. Phospholipids, glycolipids, sphingolipids. Inherited metabolic disorders of Lipid-metabolism-Tay- Saach'sdisease, Niemann-Pick's disease and Gaucher's disease. Cholesterol, steroids, Bile acids and salts, Gluco-and Mineralo-corticosteroids. Aldosterone, cortisone and synthetic derivative -prednisolone. Androgens- testosterone, Estrogens- estrone, estradiol and progesterone. Prostaglandins and their functions. LDL, HDL and VLDL. Cardiovascular disease and correlation with circulating lipid and lipoprotein concentration.

UNIT II STRUCTURE AND PROPERTIES OF PROTEINS AND NUCLEIC ACIDS **9**

Proteins-Function Amino Acids, Peptides, and Proteins. Classification based on side-chain properties. Structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins. Determination of primary structure.

Nucleic acids: Proof that DNA is the genetic material- Frederick Griffith, Meselson and Stahl, Hershey and Chase experiment, Purines, pyrimidines, nucleosides, nucleotides, Chargaff's Rules. Base pairing, A-T and G-C base pairing, mRNA, rRNA and tRNA., Watson-Crick structure of DNA. reactions, properties, Tm and hypochromicity, Measurement of DNA and RNA. Nucleoprotein complexes

UNIT III ENZYMES **7**

Enzyme- Introduction to Biocatalysts, Nomenclature, Classification, Mechanism of action, Enzyme and substrate specificity, sensitivity, stereospecificity, Inhibitors, Inhibition- Competitive, Non-competitive. turnover number, Feedback inhibition, allosteric regulation, feedback regulation.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION **15**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids. Interconnection of pathways .

UNIT V CASE STUDIES **5**

Case study on overproduction of primary and secondary metabolites - glutamic acid, threonine, lysine, methionine, isoleucine, propionic acid and ethanol.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 ensure students have a strong foundation in the structure and reactions of Biomolecules.

CO2 introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.

CO3 correlate Biochemical processes with Biotechnology applications.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Lehninger Principles of Biochemistry 7thEdition by David L. Nelson, Michael M. Cox W.H.Freeman and Company 2017
2. Schaum's Outline Of Biochemistry, Third Edition (Schaum's Outline Series) Philip Kuchel,3rd Edition 2009
3. Lippincott Illustrated Reviews: Biochemistry 7th edition Denise R.Ferrier 2017
4. Rastogi, S.C. "Biochemistry" 2nd Edition, Tata McGraw-Hill, 2003.
5. Outlines of biochemistry, 5th Edition: By E E Cohn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 1987.
6. Biochemistry 9th edition by Lubert Stryer. Jeremy Berg, John Tymoczko, Gregory Gatto,2015.WH Freeman Publisher 2019
7. Zubay's Principles of Biochemistry Rastogi, Aneja. Meditech publisher, Fifth edition 1995

REFERENCES:

1. Berg, Jeremy M. et al. "Biochemsitry", 6thEdition, W.H. Freeman & Co., 2006.
2. Voet, D. and Voet, J.G., "Biochemistry", 3rdEdition, John Wiley & Sons Inc.,2004.
3. Murray, R.K., etal "Harper's Illustrated Biochemistry", 27thEdition, McGraw-Hill, 2006.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	ensure students have a strong foundation in the structure and reactions of Biomolecules.	1	3	2	2	2	-	-	-	-	-	-	3	2	2	3	2	-	-	-	1
CO 2	introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions	2	3	3	3	2	-	-	-	-	-	-	3	3	3	3	2	-	-	-	2
CO 3	correlate Biochemical processes with Biotechnology applications.	2	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3	1	1	2	3
Overall CO		2	3	3	3	2	1	-	-	-	-	-	3	3	3	3	2	1	1	1	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5304	MATERIAL AND ENERGY BALANCE	L T P C 3 1 0 4

OBJECTIVES

The course aims to

- learn about various units and dimensions of different physical quantities
- learn about material and energy balance with and without chemical reactions

UNIT I BASIC CHEMICAL CALCULATIONS **12**

Dimension – Systems of units esp. engineering FPS, Engineering MKS & SI systems – Conversion from one system to the other – composition of mixtures and solutions – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, and normality.

UNIT II IDEAL AND ACTUAL GAS EQUATIONS **12**

Ideal and actual gas equations, Application to pure gas & gas mixtures – partial pressures, partial volumes – Air-water vapour systems, Humidity, Molar Humidity, Relative Humidity, % Saturation, humid Volume – Humidity chart – wet, Dry bulb, Dew point temperatures.

UNIT III MATERIAL BALANCE **12**

Material balance concept – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, crystallization, drying, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration

UNIT IV CHEMICAL REACTION **12**

Chemical Reaction-Limiting, excess component, Fractional conversion, Percent conversion, Fractional yield in multiple reactions. Simple problems, Combustion Reactions.

UNIT V ENERGY BALANCE **12**

General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 understand the fundamentals of engineering units and dimensions, unit conversions and stoichiometry

CO2 do engineering calculations based on gas equations and physical properties of gases and vapours

CO3 have comprehensive understanding and be able to perform engineering calculations based on material balances

TEXT BOOKS:

1. Bhatt B.I & SB Thakore, Stoichiometry - V edition Tata McGraw Hill 2017
2. Richard M. Felder, Ronald W. Rousseau “Elementary Principles of Chemical Process” III Ed. John Wiley & Sons Publisher 2008.
3. David M. Himmelblau and James B. Riggs “Basic Principles and Calculations in Chemical Engineering”, VIII Edition PHI 2015.

REFERENCES:

1. McCabe W.L & J.C.Smith & P.Harriot “Unit operations of Chemical Engineering” VII Ed. Mc Graw Hill 2017.
2. Robert W.Fox, Alan T.McDonald & Philip J.Pritchard “Introduction to Fluid Mechanics” VII Ed. John Wiley & Sons 2015.
3. Geankoplis C.J. “Transport process & Separation process Principles IV edition, PHI 2015.

Course Articulation Matrix

Course Outcomes		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
Statement		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
CO 1	understanding of the fundamentals of engineering units and dimensions, unit conversions and stoichiometry	3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	1	-	-	-	3
CO 2	do engineering calculations based on gas equations and physical properties of gases and vapors	3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	1	-	-	-	3
CO 3	have comprehensive understanding and be able to perform engineering calculations based on material balances	3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	1	-	-	-	3
Overall CO		3	3	3	3	3	3	1	1	3	1	2	3	3	3	3	1	-	-	-	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5311	CELL BIOLOGY LABORATORY	L T P C
		0 0 4 2

OBJECTIVES

The course aims to

- make the students learn about the principles of microscopy and sterilisation techniques
- train the students about different cell staining and viability methods

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy , phase contrast and fluorescent microscopy
3. Identification of given plant, animal and bacterial cells & their components by microscopy
4. Staining methods
    a. Haematoxylin & Eosin
    b. Leishman staining
    c. Giemsa staining
5. Cell/tissue lysis and fractionation
    a. Homogenization
    b. Osmosis
    c. Differential centrifugation
6. Cell viability studies
    a. Tryphan blue dye exclusion
    b. Using tetrazolium salts

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 develop the ability to propagate cells under *in vitro* conditions as well as their storage.
CO2 carryout differential staining in order to understand the internal components/complexities of a cell.
CO3 evaluate the integrity and lysis of cells in culture for downstream experiments

Equipment required (for 60 students)

Micropipettes (0.5-2.5 µl) – 30 Nos.

Micropipettes (2-20 µl) – 30 Nos.

Micropipettes (20-200 µl) – 30 Nos.

Micropipettes (100-1000 µl) – 30 Nos.

Refrigerated centrifuge – 2 Nos.

Temperature controlled Incubator shaker – 2 Nos.

Temperature controlled water bath – 2 Nos.

Ice flake machine – 2 Nos.

Phase contrast microscope (Upright) – 8 Nos.

Phase contrast microscope (Inverted) – 2 Nos.

Tissue homogenizer – 2 Nos

Microplate reader – 1 No.

Glass wares/Plastic wares/Chemicals/Media as required

TEXTBOOKS

1. Rickwood, D. and J.R. Harris "Cell Biology : Essential Techniques", John Wiley, 1996.

2. Davis, J.M. "Basic Cell Culture : A Practical Approach", IRL, 1994.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	develop the ability to propagate cells under *in vitro* conditions as well as their storage.	3	3	2	3	3	2	2	-	-	-	-	-	1	-	1	3	1	-	-	-
CO2	carryout differential staining in order to understand the internal components/complexities of a cell	3	3	2	3	3	2	2	-	-	-	-	-	1	-	1	3	1	-	-	-
CO3	evaluate the integrity and lysis of cells in culture for downstream experiments.	2	3	3	2	2	3	3	3	1	-	-	2	2	3	3	3	-	-	2	-
Overall CO		3	3	2	3	3	2	2	1	-	-	-	-	1	1	1	3	-	-	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5361 **BIOCHEMISTRY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES

The course aims to

- learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,).
- make students learn the basic units of measurements and standardisation of various buffer solutions

LIST OF EXPERIMENTS

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates
6. Quantitative method for amino acid estimation using Ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by GOD-POD

Equipment Needed for 20 Students

Autoclave 1

Hot Air Oven 1

Incubators 2

Light Microscopes 4

Incubator Shaker 1

Colorimeter 2

Laminar Flow Chamber 2

Glassware, Chemicals, Media as required

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 know various qualitative and quantitative techniques.
CO2 describe various types of biochemical reaction
CO3 evaluate the novelty of the experiment

TEXT BOOKS:

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.5th edition, 2013.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition),1978.

REFERENCES:

1. Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Conneticut,24th edition,1996
2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers,6th edition,2006.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	know various qualitative and quantitative techniques	1	3	2	2	2	-	-	-	-	-	-	3	2	2	3	2	2	-	-	1
CO 2	describe various types of biochemical reaction	2	3	3	3	2	-	-	-	-	-	-	3	3	3	2	2	2	-	-	2
CO 3	evaluate the novelty of the experiment	2	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3	1	1	2	3
Overall CO		2	3	3	3	2	1	-	-	-	-	-	3	2	2	1	3	2	1	1	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

OBJECTIVES

The course aims to

- introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES

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

CO1 recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2 identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.

CO3 identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.

CO5 demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS

1. Anubha Kaushik and C. P. Kaushik's "*Perspectives in Environmental Studies", 6th Edition,* New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

REFERENCES

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005).
5. ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. (2013).

IB5401	MASS TRANSFER OPERATIONS	L T P C
		2 1 0 3

OBJECTIVES

The course aims to

- introduce the principles of Mass Transfer Operations
- impart knowledge about various mass transfer operations equipment and its design concepts

UNIT I DIFFUSION AND MASS TRANSFER **9**

Eddy Diffusion - Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Mass Transfer Theories & Analogies. Co current and counter current operations.

UNIT II GAS LIQUID OPERATIONS **9**

Principles of gas absorption; Single and Multi-component absorption; Absorption with Chemical Reaction; Industrial absorbers; Design principles of absorbers - HTU, NTU concepts; Solving design problems.

UNIT III VAPOUR LIQUID OPERATIONS **9**

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabe-Thiele &Ponchon-Savarit Principles – design of distillation columns – solving design problems ; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT IV EXTRACTION OPERATIONS **9**

L-L equilibria, Solvent characteristics – Staged and continuous extraction – Spray, packed and mechanically agitated contactors- Pulsed and centrifugal extractors – supercritical extraction – solving problems - Solid-liquid equilibria, Leaching Principles – leaching equipment.

UNIT V SOLID FLUID OPERATIONS **9**

Adsorption equilibria – Nature of adsorbents; Batch and fixed bed adsorption – Adsorbers – steady state moving bed adsorber and unsteady state moving adsorbers – break through curves. Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 demonstrate and classify the use of accurate engineering correlations of diffusion and mass transfer coefficient to model a separation process.
CO2 get a basic knowledge to design and develop different equipment.
CO3 perceive knowledge about gas absorption, humidification, crystallization, adsorption and drying

TEXT BOOKS:

1.Treybal R.E. “Mass Transfer Operations” III edition. Mcgraw Hill, 2017.

2.Geankoplis C.J. “Transport Processes and Unit Operations” IV edition, Prentice Hall of India, 2015.

REFERENCES:

1.J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s chemical engineering. Vol i”, vi edition butterworth-heinemann, 1999.

2.J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol II”, V edition Butterworth-Heinemann, 2013.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	demonstrate and classify the use of accurate engineering correlations of diffusion and mass transfer coefficient to model a separation process	3	3	3	3	1	-	-	-	1	-	3	3	3	3	2	-	2	1	-	-
CO 2	get a basic knowledge to design and develop different equipment	2	3	3	3	1	-	1	-	1	-	2	3	3	3	2	-	1	2	-	-
CO 3	perceive knowledge about gas absorption, humidification, crystallization, adsorption and drying	3	3	3	2	1	-	1	-	1	-	2	3	3	3	2	-	1	1	-	-
Overall CO		3	3	3	3	1	1	1	-	1	-	2	3	3	3	2	-	1	1	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

MA5354 **PROBABILITY AND STATISTICS** **L T P C**
3 1 0 4

OBJECTIVES

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To apply the small/ large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate factorial dependence.
- To monitor a process and detect a situation when the process is out of control.

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables – moments – moment generating functions – binomial, poisson, geometric, uniform, exponential, gamma, weibull and normal distributions – functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – marginal and conditional distributions – covariance – correlation and linear regression – transformation of random variables – central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 12

Type I and Type II errors – tests for single mean, proportion, difference of means (large and small samples) – tests for single variance and equality of variances – chi-square test for goodness of fit – independence of attributes – non-parametric tests: test for randomness and rank – sum test (wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12

Completely randomized design – randomized block design – latin square design – factorial design – taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements ($\bar{X}$ and R charts) – control charts for attributes (p, c and np charts) tolerance limits – acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES

CO1 To analyze the performance in terms of probabilities and distributions achieved by the determined solutions

CO2 To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis

CO3 To apply the basic principles underlying statistical inference(estimation and hypothesis testing)

CO4 To demonstrate the knowledge of applicable large sample theory of estimators and tests To obtain a better understanding of the importance of the methods in modern industrial processes.

TEXT BOOKS:

1. Devore, J.L. "Probability and Statistics for Engineering and the Sciences", Cengage Learning, 9th Edition, Boston, 2017.
2. Johnson, R.A. and Gupta, C.B. "Miller and Freund's Probability and Statistics for Engineers", Pearson India Education, Asia, 9th Edition, New Delhi, 2017.
3. Walpole, R.E., Myers R.H., Myres S.L., and Ye, K. "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, New Delhi, 2011.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Krishnaiah, K. and Shahabudeen, P. “Applied Design of Experiments and Taguchi Methods”, Prentice Hall of India, New Delhi, 2012.
2. Milton, J.S. and Arnold, J.C. “Introduction to Probability and Statistics”, Tata McGraw Hill, 4th Edition, 3rd Reprint, New Delhi, 2008.
3. Ross, S.M. “Introduction to Probability and Statistics for Engineers and Scientists”, Elsevier, 5th Edition, New Delhi, 2014.
4. Spiegel, M.R., Schiller, J., Srinivasan, R.A. and Goswami, D., “Schaum’s Outline of Theory and Problems for Probability and Statistics”, McGraw Hill Education, 3rd Edition, Reprint, New Delhi, 2017.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	know about the different basic statistical tools	2	3	3	3	2	1	1	1	2	-	1	2	3	3	2	2	3	2	2	2
CO 2	know about how to implement statistical tools in biological research	2	2	2	1	2	1	1	1	2	-	-	2	3	2	1	2	3	3	2	2
Overall CO		2	3	3	3	2	1	1	1	2	-	1	2	3	2	1	2	3	1	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5402	ANALYTICAL METHODS AND INSTRUMENTATION	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Enable the students understand the basics of analytical techniques
- Make the students learn the principle and handling of various spectroscopic instruments

UNIT I INTRODUCTION TO SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the fundamentals, mechanisms and instrumentation involved in spectral analysis
CO2 understand the purpose and theories of chromatographic and electrochemical methods
CO3 understand the importance of analytical instrumentation for the purification and characterisation of samples.

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis".. Cengage Learning , 2007.
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". VIIth Edition, CBS, 1986.
3. Braun, Robert D. " Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", Vth Edition, McGraw-Hill, 1985

REFERENCES:

1. Sharma, B.K. "Instrumental Methods of Chemical Analysis : Analytical Chemistry" Goel Publishing House, 1972.
2. Haven, Mary C., et al., "Laboratory Instrumentation ". IVth Edition, John Wiley, 1995.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand the fundamentals, mechanisms and instrumentation involved in spectral analysis	3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-
CO 2	understand the purpose and theories of chromatographic and electrochemical methods	3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-
CO 3	understand the importance of analytical instrumentation for the purification and characterisation of samples	3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-
Overall CO		3	3	-	2	-	2	-	-	-	-	2	3	3	3	1	2	3	3	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5452 FLUID MECHANICS AND HEAT TRANSFER OPERATIONS L T P C
3 1 0 4

OBJECTIVES

The course aims to

- impart knowledge on the fluid statics and dynamics
- incorporate different expressions involved in fluid flow and fluid flowing over immersed solids
- learn the concepts involved in heat transfer by conduction, convection and radiation

UNIT I FLUID PROPERTIES & FLUID MECHANICS 11

Fluid definition- compressible, in compressible fluids – Density, specific gravity, specific weight, surface tension, vapour pressure and viscosity. Newtonian and Non-newtonian fluids. Fluid statics – Barometric equation – application for incompressible and compressible fluids. Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers. Fluid Dynamics – equation of continuity – Bernoulli's equation – pressure loss in straight pipes – in fittings – expansion and contraction losses (applied to Newtonian Fluids only) Fluid flow measurement, Orifice, venture & Rotameter for Newtonian fluids.

UNIT II FLOW OF FLUID THROUGH PACKINGS 12

Fluid transport **for** Industrial application **-** fluid flow through packing- characteristicsof packed bed-Bed surface area-void fraction-Laminar flow through packed bed and turbulent flow-pressure drop experienced by the fluid-equations and application - problems. Fluidization phenomena-Industrial application andminimum fluidization velocity. Fluid moving machinery-pumps**:** centrifugal, Reciprocating-gear, lobe, Peristaltic pumps andgas moving machinery-Fans, blowers and compressors. Principle of ejectors. Mixing & agitation Application**s**, Dimensional analysis, Power requirement in agitation, Liquid agitation, Gas-liquid & solid-liquid systems-agitation scale up.

UNIT III CONDUCTION HEAT TRANSFER 12

Heat transfer phenomena - Heat conduction – Fourier's equation –steady state conduction in radial systems – Resistance concept – series and resistance in conduction – parallel resistance in conduction – unsteady state conduction – extended surfaces (Fins) –combined conduction & convection – 2 dimensional conduction.

UNIT IV CONVECTION HEAT TRANSFER 14

Forced and natural convection – Dimensional analysis, Dimensionless numbers, Convection heat transfer coefficient, Correlations for flow over plate, through tubes, over spheres and cylinders, Agitated systems, Packed columns, condensation phenomena, Film and drop wise condensation over tubes. Boiling of solutions – individual, overall heat transfer coefficients and solving related problems**.**

UNIT V RADIATION HEAT TRANSFER AND HEAT TRANSFER EQUIPMENTS 11

Electromagnetic waves, energy of radiation, Plank's equation-Blackbody Radiation. Kirchhoff's law, Stefan Boltzmann equation of radiant energy – Wien's law, Radiation exchange between surfaces – black and grey bodies - view factors - sample problems. Heat exchangers - types, boilers, Kettles. Heat exchanger Design concept. Correction Factor Charts and Plate Heat Exchangers. NTU concept- Industrial evaporators, Evaporator components. Elevation in boiling point - Duhring's rule-Factors affecting performance of evaporators, Material and energy balance in single effect evaporator – multiple effect evaporators, types of operation, simple application problems.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 learn the rheological behaviour of fluids and its applications

CO2 understand the mass balance in fluid flow operations and also calculation of drag coefficient for fluid flow past solid objects

CO3 understand the basic concepts on conduction convection and radiation involved in heat exchanger equipment and furnace wall.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Mc Cabe, W.L., Smith, J.C. and Harriot, P., 'Unit Operations in Chemical Engineering', VII edition., McGraw-Hill, 2017.
2. Kern, D.Q., 'Process Heat Transfer', McGraw-Hill, 1999.
3. Geankoplis. C.J "Transport Process & separation Process Principles" IV edition Prentice Hall of India 2015.
4. P. K. Nag "Heat & Mass Transfer", Tata McGraw Hill III Edition 2011

REFERENCES:

1. Frank Kreith, Raj M. Manglik and Mark S. Bohn "Principles of Heat Transfer" VII edition Cenage Learning Inc 2018.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	learn the rheological behaviour of fluids and its applications	2	2	1	2	-	2	1	2	2	-	3	2	2	2	1	-	-	-	2	1
CO 2	understand the mass balance in fluid flow operations and also calculation of drag coefficient for fluid flow past solid objects	1	2	2	3	-	-	1	2	-	-	3	1	3	1	1	-	-	1	2	1
CO 3	understand the basic concepts on conduction convection and radiation involved in heat exchanger equipments and furnace wall.	2	1	-	1	-	-	-	2	-	1	3	-	2	1	-	-	-	2	1	1
Overall CO		2	2	1	2	-	1	1	2	1	1	3	1	2	1	1	-	-	1	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5411	INSTRUMENTATION AND METHOD OF ANALYSIS LAB	L T P C
		0 0 4 2

OBJECTIVES

The course aims to

- learn the Precision and validity in an experiment using absorption spectroscopy.
- validate Lambert-Beer's law using KMnO4
- find the molar absorptivity and stoichiometry of the Fe (1,10 phenanthroline)3 using Absorption spectrometry.

LIST OF EXPERIMENTS

1. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
2. UV spectra of nucleic acids.
3. Chemical actinometry using potassium ferrioxolate.
4. Estimation of SO4-- by nephelometry.
5. Estimation of Al3+ by Flourimetry.
6. Limits of detection using aluminium alizarin complex.
7. Chromatography analysis using TLC.
8. Chromatography analysis using column chromatography.

TOTAL: 60 PERIODS

OUTCOMES

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

CO1 have the ability to perform experiments individually using analytical instrument
CO2 have the ability to perform TLC and column chromatographic experiments
CO3 have the ability to trouble shoot problems in the experiment

REFERENCES

1. Skoog, D.A. etal. "Principles of Instrumental Analysis", Vth Edition, Thomson / Brooks – Cole,1998.
2. Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.
3. Willard, H.H. etal. "Instrumental Methods of Analysis", VIth Edition, CBS, 1986.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", Vth Edition, McGraw-Hill, 1985.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	have the ability to perform experiments individually using analytical instrument	-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-
CO 2	have the ability to perform TLC and column chromatographic experiments	-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-
CO 3	have the ability to trouble shoot problems in the experiment	-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-
Overall CO		-	-	-	3	-	-	1	-	2	-	2	3	-	1	-	2	3	3	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5451	CHEMICAL ENGINEERING LAB	L T P C 0 0 4 2

OBJECTIVES

The course aims to

- enhance the understanding of measurement techniques of fluid flows.
- impart practical knowledge on various unit operations.

LIST OF EXPERIMENTS

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Pressure drop flow in pipes
3. Pressure drop in flow through packed column
4. Pressure drop in flow through fluidized beds
1. Characteristics of centrifuge pump
2. Plate and frame filter press
3. Filtration in leaf filter
4. Heat transfer characteristics in heat exchanger
5. Simple and steam distillation
6. HETP in packed distillation
7. Ternary equilibrium in liquid-liquid extraction
8. Adsorption isotherm
9. Drying characteristics in a pan dryer

Equipment Needed for 20 Students

Colorimeter 2

Filter leaf 1Orifice meter 1

Rotameter 1

Venturimeter 1

Glassware, Chemicals, Media as required

TOTAL: 60 PERIODS

OUTCOMES

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

CO1 understand principles in chemical engineering.
CO2 handle various unit operations equipments

CO3 estimate heat and mass transfer coefficients for the corresponding unit operations involved

REFERENCES

1. Mc Cabe, W.L., Smith, J.C. and Harriot, P., 'Unit Operations in Chemical Engineering', VII edition., McGraw-Hill, 2017.

2. Geankopolis. C.J "Transport Process & separation Process Principles" IV edition Prentice Hall of India 2015.

Course Articulation Matrix

Course outcomes statements		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand principles in chemical engineering .	3	2	2	3	-	2	1	-	1	3	1	2	2	2	3	-	2	1	3	3
CO 2	handle various unit operations equipments	1	3	1	3	-	2	1	-	1	3	1	1	1	1	3	-	3	3	2	3
CO 3	estimate heat and mass transfer coefficients for the correspondi ng unit operations involved	3	2	2	3	-	2	1	-	1	3	2	1	2	2	3	--	1	3	2	2
Overall CO		3	2	2	3	-	2	1	-	1	3	1	1	2	2	3	-	3	3	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

SEMESTER V

GE5451	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 apply TQM concepts in a selected enterprise.

CO2 apply TQM principles in a selected enterprise.

CO3 understand Six Sigma and apply Traditional tools, new tools, Benchmarking and FMEA.

CO4 understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5 apply QMS and EMS in any organization.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B. Michna,Glen H. Bester field,Mary B.Sacre,Hemant Urdhware she and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, "Total Quality Management – Text and Cases", Routledge.,2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006

IB5551 IMMUNOLOGY LT P C
3 0 0 3

OBJECTIVES

The course aims to

- discuss the structure, functions and integration of immune system.
- explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I INTRODUCTION TO IMMUNE SYSTEM 12

Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex

UNIT II HUMORAL AND CELLULAR IMMUNITY 12

Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies:structure and functions; antibodies: genes and generation of diversity; antigen-antibodyreactions: precipitation, Agglutination, complement fixation, IFT, RIA, ELISA

UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS 8

Inflammation; protective immune responses to virus, bacteria, fungi and parasites; tumorantigens, tumor immune response, tumor diagnosis, tumor immunotherapy

UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY 7

Immune tolerance, Immuno deficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Auto immune disorders and diagnosis

UNIT V APPLIED IMMUNOLOGY 6

Monoclonal antibodies, engineering of antibodies; Classification of Vaccines, methods ofvaccine development, immunodiagnostic methods (Immuno diffusion ELISA, FACS), immunomodulatory drugs

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand about the immune system structure and functions.
CO2 understand about the immunity to various pathogens

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO3 aware of the principles behind the production of therapeutic/diagnostic molecules.
CO4 learn about the concepts and mechanism behind tumour development, allergy and hypersensivity reactions.

TEXT BOOKS:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., XII edition 2011.
2. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006.

REFERENCES:

1. Coico, Richard "Immunology: A Short Course" VIth Edition. John Wiley, 2008.
2. Khan, Fahim Halim "Elements of Immunology" Pearson Education, 2009.
3. Abbas,Lichtman,Shiv Pillai Cellular and Molecular Immunology 6th edition Elsevier 2017

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand about the immune system structure and functions.	2	3	3	3	2	2	-	-	-	-	-	3	2	1	-	1	-	-	-	1
CO 2	understand about the immunity to various pathogens	1	3	1	2	1	-	-	-	-	-	-	3	2	2	1	2	-	-	-	2
CO 3	aware of the principles behind the production of therapeutic/diagnostic molecules.	2	3	2	2	3	-	1	-	-	-	-	3	2	3	1	3	3	3	2	-
CO 4	learn about the concepts and mechanism behind tumour development, allergy and hypersensivity reactions.	3	2	-	-	-	-	-	-	-	-	-	3	2	2	2	-	-	-	-	-
Overall CO		2	3	2	2	2	2	1	-	-	-	-	3	2	2	1	2	3	3	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5501	MOLECULAR BIOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Understand basic principles of molecular biology such as role of nucleic acids and proteins and how these molecules interact at intracellular level to regulate growth, division and development.
- Apply/relate such principles to manipulate the organisms appropriately for valuable outcome in the area of science and technology.

UNIT I CHEMISTRY OF NUCLEIC ACIDS 9

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling.

UNIT II DNA REPLICATION & REPAIR 9

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III TRANSCRIPTION 9

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

UNIT IV TRANSLATION 9

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications and its importance. Regulation of gene expression: *lac*- and *trp*-operon.

UNIT V CELL DIVISION & CELL CYCLE 9

Cell division: Mitosis, Meiosis and Cytokinesis. Cell cycle: Methods in cell cycle analysis. Regulation of cell cycle – Cell cycle check points, molecules and mechanisms of cell cycle regulation. Cell cycle modulators.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the composition, structure and characteristics of nucleic acids
CO2 understand the central dogma of life and its significance
CO3 comprehend the basic mechanisms of cell division and its status under proliferative and degenerative disorders

TEXTBOOKS:

1. Friefelder, David. "Molecular Biology." Narosa Publications, 1999
2. Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.
3. Karp, Gerald "Cell and Molecular Biology : Concepts and Experiments" IVth Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" IInd Edition, Panima Publishing, 1993.

REFERENCES

1. Cooper GM, Hausman RE. The Cell: A Molecular approach. 7th Edition, 2015.
2. Krebs JE, Goldstein ES, Kilpatrick ST. Lewin's Essential GENES XII,12 th edition 2017
3. Nelson DL, Cox MM. Lehninger Principles of Biochemistry. 6th Edition, 2012.
4. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. Molecular Biology of the cell, 6th Edition, 2014.
5. Lodish H, Berk A, MatsudairaP,Kaiser CA, Krieger M, Schot MP, Zipursky L, Darnell J. Molecular Cell Biology, 6th Edition, 2007.
6. Tropp, Burton E. " Molecular Biology : Genes to Proteins". IIIrd Edition. Jones and Bartlett, 2008.
7. Glick , B.R. and J.J. Pasternak. "Molecular Biotechnology : Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the composition, structure and characteristics of nucleic acids	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO2	understand the central dogma of life and its significance	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO3	comprehend the basic mechanisms of cell division and its status under proliferative and degenerative disorders	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
Overall CO		2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5502 **BIOPROCESS PRINCIPLES** **L T P C**
2 1 0 3

OBJECTIVES

The course aims to

- Develop an understanding of the concepts in different fermentation and sterilisation process
- Study the kinetics involved in growth and sterilisation of micro-organisms.

UNIT I OVERVIEW OF FERMENTATION PROCESSES 6

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 10

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

UNIT III STERILIZATION KINETICS 6

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS 12

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 11

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - Leudeking- Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation – Direct and Indirect methods.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the fundamental configuration of fermenter and to develop knowledge on the design and optimization of fermentation process
CO2 comprehend the metabolic stoichiometry and energetics of the microbial cell
CO3 understand the kinetics of the microbial growth and product formation

TEXT BOOKS:

1. Schuler, Michael L. and Fikret Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
2. Doran, Pauline "of Bioprocess Engineering Principles ". Elsevier, Academic Press 1995

REFERENCES:

1. Lydersen, Bjorn K. "Bioprocess Engineering Systems, Equipment and Facilities" John Wiley, 1994.
2. Bailey, James E. and David F. Ollis, "Biochemical Engineering Fundamentals", IInd Edition. McGraw Hill , 1986.
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the fundamental configuration of fermenter and to develop knowledge on the design and optimization of fermentation process	2	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3	2	2	2	3
CO2	comprehend the metabolic stoichiometry and energetics of the microbial cell	2	3	3	3	-	2	2	-	-	-	-	3	3	2	2	2	2	2	3	2
CO3	understand the kinetics of the microbial growth and product formation	3	2	-	2	-	-	-	-	-	-	-	3	3	-	-	3	3	2	2	2
Overall CO		2	3	3	3	-	1	1	-	-	-	-	3	3	2	1	3	2	2	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5511	IMMUNOLOGY LABORATORY	L T P C 0 0 4 2

OBJECTIVES

The course aims to

- learn the isolation and staining of different blood cells
- learn the different immunological assays

LIST OF EXPERIMENTS

1. Selection of animals and introduction to animal handling (mice/rat/rabbit/ chicken/fish etc)
2. Determination of various routes of immunization
3. Methods of bleeding, serum separation and storage
4. Preparation of antigens/immunization schedule for raising antisera.
5. Identification of leukocytes from blood smear by differential staining (Geimsa stain)
6. Enumeration of RBCs/leukocytes by Neubar chamber for cell culture studies.
7. Separation of Peripheral Blood Mononuclear Cells (PBMC) by Ficoll –Hypaque
8. Determination of agglutination reaction: Blood grouping antigens
9. Determination of immunoprecipitaion reaction: immunodiffusion/immunoelectrophoresis
10. Evaluation of antibody titre by ELISA method
11. Diagnostic determination of agglutination: Widal test
12. Rapid diagnostic tests: Immunochromatographic test strips

*Animal experiments will be conducted by trained faculties in accordance with UGC requirements and CPCSEA guidelines and no dissection of animals will be done

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1 gain experience basic designing of immunological tests.
CO2 gain experience in isolation of different cells
CO3 gain experience in handling of animals and its immunization

LIST OF EQUIPMENTS FOR 30 STUDENTS

Elisa reader 1
Microscopes 8
Microwave oven 1
Hot plate 4
Vortex mixer 4
Table top refrigerated Centrifuge 1
Fluorescent microsope 1

REFERENCES:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman & Co., 7th edition 2013
3. Ashim K. Chakravarthy, Immunology, TataMcGraw-Hill, 1998. 4. Antibodies: A Laboratory Manual, Second edition Edward A. Greenfield, Dana-Farber, Cancer Institute,Cold Spring Harbour Laboratory 2014
5. Current protocols in Immunology Volume I-III John E. Coligan (Editor), Ada M. Kruisbeek (Editor), David H. Margulies (Editor), Ethan M. Shevach (Editor), Warren Strober (Editor) 2004

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	gain experience basic designing of immunological tests.	3	3	1	3	2	-	-	-	-	-	-	2	1	1	1	3	3	2	-	-
CO2	gain experience isolation of different cells	3	3	1	2	1	-	-	-	-	-	-	2	1	1	1	3	3	2	-	-
CO3	gain experience handling of animals and its immunization	3	1	-	1	2	-	-	3	-	-	-	2	1	1	1	3	1	2	1	1
Overall CO		3	3	1	2	2	-	-	1	-	-	-	2	1	1	1	3	3	2	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5512	BIOPROCESS LABORATORY – I	L T P C 0 0 4 2

OBJECTIVES

The course aims to

- design and set up experiments for optimizing process conditions at lab-scale for fermentation and enzymatic biotransformation processes
- understand the kinetics of enzymatic reactions

LIST OF EXPERIMENTS

1. Enzyme kinetics – Determination of Michaelis Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment/ Cross linking
6. Enzymatic conversion in Packed bed Column/Fluidized bed Column
7. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
8. Growth of Algae – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9. Medium optimization – Plackett Burman Design
10. Medium optimization – Response Surface Methodology

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 gain experience in enzyme kinetics and immobilized enzyme studies

CO2 observe the growth kinetics of bacteria and algae

CO3 understand the basic media optimizing strategies

Equipment Needed for 20 Students

Autoclave 1

Hot Air Oven 1

Incubators 2

Light Microscopes 4

Incubator Shaker 1

Colorimeter 2

Laminar Flow Chamber 2

Glassware, Chemicals,

Media as required

REFERENCES:

1. Bailey and Ollis, “Biochemical Engineering Fundamentals”, McGraw Hill (2nd Ed.), 1986.

2. Shuler and Kargi, “Bioprocess Engineering “, Prentice Hall, 1992.

3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications,2012

4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books. 2nd edition 2008

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	gain experience enzyme kinetics and immobilized enzyme studies	3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	1	2	1	2	3
CO2	observe the growth kinetics of bacteria and algae	3	2	3	3	-	2	3	-	-	-	-	3	3	2	1	1	2	1	3	3
CO3	understand the basic media optimizing strategies	2	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3	2	2	2	3
Overall CO		3	3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	2	2	1	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

SEMESTER VI

IB5601	GENETIC ENGINEERING	L T P C 3 0 0 3

OBJECTIVES

The course aims to

- learn the fundamentals of recombinant DNA technology and DNA manipulation techniques.
- apply the fundamentals of r DNA technology on construction of vectors and DNA libraries.
- understand and make the students to aware of the application of genetic engineering in various fields.

UNIT I INTRODUCTION TO RECOMBINANT DNA TECHNOLOGY 9

Overview of recombinant DNA technology and its applications. Recombinant DNA technology tools - Restriction and Modifying systems: Biological importance, Classification, Nomenclature, Applications in recombinant DNA technology - Cohesive ends, blunt ends, Isoschizomers, Neoschizomers, Star activity, Compatible cohesive ends, DNA polymerase, DNA ligase, Alkaline phosphatase – Inter and intra molecular ligation, Polynucleotide kinase, Terminal transferase and Exonuclease, Linkers and adpators.

UNIT II CLONING VECTORS 9

Characteristics and importance: Cloning vector and expression vector, Transformation, Transfection and Transduction – Principle and differences. Plasmid vector: Cloning site, Selection, Screening, Host range – shuttle vectors, Plasmid compatibility, copy number regulation and TA cloning. Bacteriophage vector: λDNA vectors – Insertional and replacement vectors, *in vitro* packaging, Size based selection and Spi¯ selection. Single strand DNA vectors: M13 phage vector and its applications. Combinatorial vectors: Cosmid and Phagemid. Artificial chromosomes: Bacterial and yeast artificial chromosomes.

UNIT III DNA LIBRARIES 9

Construction of genomic and cDNA library: Methods, Chromosomal walking, Limitations in cDNA library construction and full-length cDNA library construction. Screening of DNA libraries: Nucleic acid hybridization and PCR – degenerate probes and primers, Southwestern and Northwestern strategies, Immunochemical, protein-protein/ligand interaction, functional complementation/gain of functionapproaches.

Differential cDNA library: Differential expression analysis and screening, Subtracted cDNA library, PCR based differential display analysis and difference cloning.

UNIT IV AMPLIFICATION OF DNA AND SEQUENCING 9

Polymerase Chain reaction: Principle and Steps in PCR, Types of PCR - Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Colony PCR, Methylation specific PCR and single cell PCR. Real-time PCR/qPCR and its advantages – SYBR green assay, Taqman assay, Molecular beacons. DNA sequencing: Maxam Gilbert's and Sanger's methods of DNA sequencing, Pyrosequencing, Nanopore DNA sequencing,Next generation sequencing .

UNIT V APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY 9

Site directed mutagenesis: Primer extension method, Kunkel's method and PCR based site-directed mutagenesis. Creation of transgenic animals and plants: Zinc finger, TALENS, meganucleases, CRISPR-Cas. DNA microinjection, Viral vectors, Transformation of embryonic stem cells and Ti plasmids. Applications of site specific mutants, transgenic animals and plants.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand strength and limitations of tools and techniques used in recombinant DNA technology

CO2 understand various methods to develop DNA libraries and techniques to identify, screen, sequence and quantify the gene expression

CO3 understand the current techniques involved in gene editing to generate appropriate genetically modified organisms

TEXT BOOKS:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 1993.

2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, Third Edition (Blackwell Publishing),7th edition,2006

REFERENCES:

1. Primrose SB and Twyman RB. "Principles of Gene manipulation and Genomics". 7th Edition, Wiley-Blackwell,2006.
2. Green MR and Sambrook J. "Molecular Cloning: A Laboratory Manual". 4th Edition, CSHL press,2012.
3. Brown TA. "Gene Cloning and DNA analysis: An introduction". 6th Edition, Wiley-Blackwell,2010.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand strength and limitations of tools and techniques used in recombinant DNA technology	3	3	3	2	3	3	3	1	1	-	-	3	3	3	2	3	3	-	2	2
CO2	understand various methods to develop DNA libraries and techniques to identify, screen, sequence and quantify the gene expression	3	3	3	2	3	3	3	1	1	-	-	3	3	3	2	3	3	-	2	2
CO3	understand the current techniques involved in gene editing to generate appropriate genetically modified organisms	2	3	3	2	2	3	3	3	1	-	-	2	2	3	3	3	-	-	2	-
Overall CO		3	3	3	2	3	3	3	1	1	-	-	3	3	3	2	3	2	-	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5602	BIOPROCESS ENGINEERING	L T P C
		2 1 0 3

OBJECTIVES

The course aims to

- Develop an understanding of the concepts involved in the design of different bioreactors and its operation mechanism.
- Learn about the recombinant cell cultivation process and their simulation process

UNIT I OPERATIONAL MODES OF BIOREACTORS 10

Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors

UNIT II BIOREACTOR SCALE – UP 8

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS 8

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors

UNIT IV MODELLING AND SIMULATION OF BIOPROCESSES 12

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V RECOMBINANT CELL CULTIVATION 7

Different host vector system for recombinant cell cultivation strategies and advantages. *E.coli*, yeast *Pichia pastoris/ Saccharomyces cereviseae,* Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the different operational modes of bioreactor and bioreactor scale up

CO2 understand the design of reactors for enzyme immobilization processes

CO3 understand the existing strategies for the cultivation of recombinant cells

REFERENCES:

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, , Springer Verlag.1988, digitalized 2007
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, 2nd edition McGraw Hill. 1986
3. Atkinson, Handbook of Bioreactors Atkinson, B. & Mavituna . F., Biochemical Engineering and Biotechnology Handbook, McGraw Hill (2nd Edition) (1993).
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc. 1997
5. Shuler and Kargi, “Bioprocess Engineering “, Prentice Hall, 1992.
6. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.2009

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the different operational modes of bioreactor and bioreactor scale up	2	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3	2	2	2	3
CO2	understand the design of reactors for enzyme immobilization processes	2	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3	2	2	2	3
CO3	understand the existing strategies for the cultivation of recombinant cells	3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	1	2	1	2	3
Overall CO		2	3	3	2	3	3	2	1	2	-	-	3	2	2	1	3	2	2	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5611 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB L T P C
0 0 4 2

OBJECTIVES

The course aims to

- make the students to learn the basic DNA isolation techniques.
- learn about the identification and characterisation of gene and protein

LIST OF EXPERIMENTS

1. Isolation of total DNA
2. Isolation of Plasmid DNA
3. Agarose gel electrophoresis
4. Restriction enzyme digestion of DNA
5. DNA ligation
6. Competent cell preparation & Transformation
7. Blue-White screening
8. Induction and Analysis of Gene expression
9. PCR
2. SDS-PAGE
3. Western blot

TOTAL: 60 PERIODS

Equipment required (for 60 students)

Micropipettes (0.5-2.5 µl) – 30 Nos.
Micropipettes (2-20 µl) – 30 Nos.
Micropipettes (20-200 µl) – 30 Nos.
Micropipettes (100-1000 µl) – 30 Nos.
Refrigerated centrifuge – 2 Nos.
Chemical fume hoods (for handling toxic solvents) – 2 Nos.
Temperature controlled Incubator shaker – 2 Nos.
Temperature controlled water bath – 2 Nos.
Ice flake machine – 2 Nos.
Agarose gel apparatus with power packs – 30 Nos.
Laminar Air flow (3 or 4 ft length) – 2 Nos.
PCR machine (96/48 Wells) – 2 Nos.
SDS-PAGE apparatus – 30 Nos.
Western transfer apparatus (Semi dry) – 2 Nos.
Western transfer apparatus (wet) – 30 Nos.
Glasswares / Plasticwares/Chemicals/Media as required

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 experience basic techniques of DNA isolation and manipulation

CO2 experience in selecting genetically transformed organisms for downstream analysis.

CO3 experience basic techniques involved in analysis of gene expression at nucleic acids and proteins level

REFERENCES:

1. Green MR and Sambrook J. “Molecular Cloning: A Laboratory Manual”. 4th Edition, CSHL press, 2012.

Course Articulation Matrix

Course outcome statements		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	experience basic techniques of DNA isolation and manipulation	3	3	2	3	3	2	2	-	-	-	-	-	1	-	1	3	1	-	-	-
CO2	experience in selecting genetically transformed organisms for downstream analysis	3	3	2	3	3	2	2	-	-	-	-	-	1	-	1	3	1	-	-	-
CO3	experience basic techniques involved in analysis of gene expression at nucleic acids and proteins level	2	3	3	2	2	3	3	3	1	-	-	2	2	3	3	3	-	-	2	-
Overall CO		3	3	2	3	3	2	2	1	-	-	-	-	1	1	1	3	-	-	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5612	BIOPROCESS LABORATORY II	L T P C 0 0 4 2

OBJECTIVES

The course aims to

- design and evaluate the performance of bioreactors analyzing the mass transfer, heat transfer and mixing capabilities in bioreactors.
- design and set up various recombinant cell cultivation process

LIST OF EXPERIMENTS

1. Batch Sterilization kinetics
2. Batch cultivation with exhaust gas analysis.
3. Fed batch cultivation and Total cell retention cultivation
4. Algal cultivation-Photobioreactor
5. Estimation of KLa – Dynamic Gassing-out method,
6. Estimation of KLa – Sulphite Oxidation Method
7. Estimation of KLa – Power Correlation Method
8. Residence time distribution
9. Estimation of Mixing Time in reactor
10. Estimation of Overall Heat Transfer Coefficient

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1 understand and design the different modes of bioreactor

CO2 estimate the heat transfer and oxygen transfer coefficient

CO3 estimate the residence time and the mixing time in the bioreactor

Equipment Needed for 20 Students

Electrophoresis Kit 1 Reactors 6 Incubators 2 Light Microscopes 1

Incubator Shaker 1 Spectrophotometer 2 Laminar Flow Chamber 1

Glassware, Chemicals, Media as required

REFERENCES:

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, Springer Verlag. 2011
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill 2nd edition 2017.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors, Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc. 1997

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand and design the different modes of bioreactor	3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	1	2	1	2	3
CO2	estimate the heat transfer and oxygen transfer coefficient	3	2	3	3	-	2	3	-	-	-	-	3	3	2	1	1	2	1	3	3
CO3	estimate the residence time and the mixing time in the bioreactor	2	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3	2	2	2	3
Overall CO		3	3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	2	2	1	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

SEMESTER VII

IB5751	DOWNSTREAM PROCESSING	L T P C 3 0 0 3

OBJECTIVES

The course aims to

- understand the fundamentals of biological product recovery , isolation separation purification and formulation
- acquire in depth knowledge and hands on training on design and optimization of Downstream process operations and equipment

UNIT I DOWNSTREAM PROCESSING 10

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre-treatment and stabilisation of bio-products.

UNIT II PHYSICAL METHODS OF SEPARATION 6

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS 12

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 12

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion- exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 5

Crystallization, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 have a comprehensive understanding of the physicochemical properties of biotechnological products and economics of downstream processing

CO2 be capable of equipment selection and design of mechanical separation process for recovery of biotechnological products

CO3 be able to identify and optimize the suitable bio product isolation process at laboratory and pilot scale

CO4 have a thorough understanding of chromatographic separation processes and equipment selection

CO5 have complete knowledge of stability of biotechnology products and should be capable of formulation and stabilization for enhanced shelf-life

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 1988
2. Ghosh, Raja “Principles of Bioseparations Engineering”. World Scientific, 2006.
3. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, and Demetri P. Petrides “Bioseparations Science and Engineering “ Oxford University Press 2006

REFERENCES:

1. Michael C Flickinger “Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology” John Wiley & Sons 2010
2. Michael R Ladisch “Bioseparations Engineering” John Wiley & Sons 2001

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	have a comprehensive understanding of the physicochemical properties of biotechnological products and economics of downstream processing	3	3	3	3	3	3	2	1	3	1	3	3	3	3	3	3	2	-	3	3
CO2	be capable of equipment selection and design of mechanical separation process for recovery of biotechnological products	3	3	3	3	3	3	3	1	3	1	3	3	3	3	3	3	2	-	3	3
CO3	be able to identify and optimize the suitable bio product isolation process at laboratory and pilot scale	3	3	3	3	3	3	2	1	2	1	3	3	3	3	3	3	2	-	3	3
C	have a thorough	3	3	3	3	3	3	3	1	3	1	3	3	3	3	3	3	2	-	3	3

O4	understanding of chromatographic separation processes and equipment selection																				
CO5	have complete knowledge of stability of biotechnology products and should be capable of formulation and stabilization for enhanced shelf-life	2	2	2	2	2	2	3	1	3	1	3	3	2	3	3	3	2	-	3	3
Overall CO		3	3	3	3	3	3	3	1	3	1	3	3	3	3	3	3	2	-	3	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5752 **BIOINFORMATICS** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- Introduce the student to biological data resources, algorithms and alignment tools
- Understand about machine learning techniques and neural networks in the analysis of biological data

UNIT I BIOLOGICAL DATABASES AND SEQUENCE ANALYSIS 9

Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Sequence Analysis,

Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment.

UNIT II ALGORITHMS FOR SEQUENCE ALIGNMENT 9

Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms, Functional annotation.

UNIT III NEXT GENERATION SEQUENCING, DATA ANALYSIS AND APPLICATIONS 9

Genome sequencing, assembling the genome, Next Generation Sequencing, Data formats, Exome sequencing, RNA-seq and its applications.

UNIT IV PHYLOGENETICS,MOLECULAR MODELLING AND DOCKING 9

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Molecular docking principles and applications.

UNIT V MACHINE LEARNING,OTHER BIOINFORMATICS APPLICATIONS 9

Machine learning techniques: Artificial Neural Networks for protein secondary structure prediction, Hidden Markov Models for gene finding, Support Vector Machines. Introduction to Systems Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 get acquainted with various bioinformatics algorithms and tools
CO2 acquire skills to perform phylogenetic studies, molecular docking, analyze next generation sequencing data and interpret results
CO3 acquainted with machine learning techniques

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press. ,4th edition 2014
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press. 1999
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison, Cambridge University Press. 2013
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press. 2nd edition, 2004

REFERENCES:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak, Cambridge University Press 2001
2. RNA-seq Data Analysis: A Practical Approach, by EijaKorpelainen, JarnoTuimala, PanuSomervuo, Mikael Huss and Garry Wong. CRC Press 2014
3. Next Generation Sequencing Data Analysis, by Xinkun Wang CRC Press 2016

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	get acquainted with various bioinformatics algorithms and tools	2	3	1	2	3	-	-	-	-	-	-	-	3	2	-	-	-	-	2	-
CO2	acquire skills to perform phylogenetic studies, molecular docking, analyze next generation sequencing data and interpret results	3	3	1	3	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-
CO3	acquainted with machine learning techniques	3	3	1	3	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-
	Overall CO	3	3	1	3	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5711	DOWNSTREAM PROCESSING LABORATORY	L T P C
		0 0 4 2

OBJECTIVES

The course aims to

- understand the principles behind various separation, concentration and purification processes used in Bioprocess industry
- impart knowledge on various cell disruption techniques
- have a hands-on experience on various downstream processing steps involved in a bioprocess industry.

LIST OF EXPERIMENTS

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, French pressure cell
3. Cell disruption techniques – dynomill – batch and continuous
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biologicals
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography
9. Product polishing – spray drying, freeze drying

TOTAL: 60 PERIODS

List of equipment for 30 students

Centrifuge 1
Cross flow filtration set up 2
FPLC 1
Sonicator 1
French press 1

OUTCOMES:

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

CO1	extract intra and extra cellular proteins from biological samples by performing cell disruption using mechanical and enzymatic methods
CO2	fractionate proteins using precipitation methods
CO3	separate proteins using chromatographic techniques
CO4	analyze the purity of proteins
CO5	design processes for the recovery and subsequent purification of target biological products

REFERENCES:

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 1988

2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann, 2004.

3. J.C. Janson And L. Ryden, (Ed.) – “Protein Purification – Principles, High Resolution Methods And Applications”, VCH Pub. 1989.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	extract intra and extra cellular proteins from biological samples by performing cell disruption using mechanical and enzymatic methods	3	2	2	3	-	3	1	-	2	1	1	2	2	2	3	3	3	3	2	3
CO2	fractionate proteins using precipitation methods	3	1	2	3	-	3	1	-	2	1	1	2	2	2	3	2	3	3	2	3
CO3	separate proteins using chromatographic techniques	3	1	2	3	-	3	1	-	2	1	1	2	2	2	3	3	3	3	2	3
CO4	analyze the purity of proteins	2	1	1	2	3	2	1	-	2	1	1	1	2	2	3	1	3	3	2	3
CO5	design processes for the recovery and subsequent purification of target biological products	3	3	3	3	2	3	1	-	2	1	1	2	2	2	3	3	3	3	2	3
Overall CO		**3**	2	2	3	1	3	1	-	2	1	1	2	2	2	3	3	3	3	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5712	BIOINFORMATICS LABORATORY	L T P C 0 0 4 2

OBJECTIVES

The course aims to

- provide hands on training on data resources and bioinformatics tools
- develop skills in the analysis and interpretation of various in silico techniques such as molecular docking and homology modelling.

LIST OF EXPERIMENTS

1. Basic Linux Commands : Directory commands, File Related commands, cut, paste, commands, sort
2. Advanced Linux commands : Redirection, Pipes, Grep filter
3. Biological Databases : Data formats and Data retrieval
4. Homology search using BLAST family of programs: BLASTp, PSIBLAST, BLASTn, Standalone BLAST
5. Multiple Sequence Alignment
6. Generating Phylogenetic trees and Bootstrapping
7. Understanding PDB structures, Ligand databases, Structure Alignment
8. Visualization tools, PyMol
9. Homology Modeling and Assessing the quality of models: SwissModel, Modeller
10. Molecular docking : Docking of macromolecules with ligands : Autodock
11. NGS data resources
12. Tools for basic analysis of NGS data

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 have knowledge on working in Linux operating system, retrieve biological data and use bioinformatics tools

CO2 perform protein and nucleotide sequence analysis, next generation sequencing data analysis and phylogenetic studies

CO3 perform protein structural studies including modelling and docking and interpret results

REFERENCES:

1. Practical Bioinformatics by Michael Agostino. Garland Science, First Edition, (2012)

2. Bioinformatics and Functional Genomics by Jonathan Pevsner. Wiley Blackwell Publications, 3rd Edition (2015)

3. RNA-seq Data Analysis: A Practical Approach, by EijaKorpelainen, JarnoTuimala, PanuSomervuo, Mikael Huss, Garry Wong. Chapman & Hall/CRC, First Edition (2014)

4. Web based tutorials for Autodock and Next Generation Sequencing Data Analysis.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	have knowledge of working in Linux operating system, retrieve biological data and use bioinformatics tools	2	2	2	2	3	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO2	perform protein and nucleotide sequence analysis, next generation sequencing data analysis and phylogenetic studies	3	3	2	3	3	-	-	-	-	-	-	-	3	3	-	-	2	2	2	-
CO3	perform protein structural studies including modelling and docking and interpret results	3	3	2	3	3	-	-	-	-	-	-	-	3	3	-	-	2	3	3	-
	Overall CO	3	3	2	3	3	-	-	-	-	-	-	-	3	3	-	-	2	2	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5713 **INDUSTRIAL / TRAINING** **L T P C**

(4 WEEKS DURING VI SEMESTER) **0 0 0 2**

OBJECTIVES

- To encourage the students to get connected with any industry/ laboratory/research institute
- To acquire knowledge on solving practical problems, gaining work experience and skills
- Learn to work in an academic/ industrial/research environment.

The students individually undergo training in reputed companies/ research institutes/ organizations for the specified duration.

OUTCOMES:

CO1 learn to work in an industrial/academic/research institute

CO2 gain experience to work as an individual as well as a member of a team

CO3 Acquire practical knowledge and enhance skills

Course Articulation Matrix

	Statement	Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	learn to work in an industrial/academic/research institute	1	1	2	-	1	-	-	1	1	1	-	-	1	1	1	1	1	-	-	1
CO 2	gain experience to work as an individual as well as a member of a team	1	1	2	1	1	-	-	2	2	1	1	2	1	1	1	1	1	-	-	1
CO 3	acquire practical knowledge and enhance skills	1	1	2	1	1	-	-	2	2	1	1	2	1	1	1	1	1	-	-	1
OVERALL CO		1	1	2	-	1	-	-	2	2	1	1	2	1	1	1	1	1	-	-	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5714 **PROJECT I** **L T P C**

0 0 4 2

OBJECTIVES

The course aims to

- to make the students identify any project/ problem relevant to their field of interest that can be carried out
- make them equipped to search databases and journals to collect relevant data and identify a solution
- plan, learn and perform experiments to verify the solution

OUTCOMES:

At the end of the course students will be able to

CO1 identification of field of interest

CO2 equip the students to search and think about logical solutions

Course Articulation Matrix

Course outcome statement		Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
C O1	identification of field of interest	2	2	2	1	1	2	-	2	1	2	-	2	1	1	1	1	1	-	-	1
C O2	equip the students to search and think about logical solutions	2	2	2	1	1	2	-	2	2	2	-	2	1	1	1	1	1	-	-	1
OVERALL CO		2	2	2	1	1	2	-	2	2	2	-	2	1	1	1	1	1	-	-	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER VIII

IB5811	**PROJECT II**	**L T P C**
		0 0 16 8

OBJECTIVES

The course aims to

- to train students to analyze a problem
- to make them understand how to find solutions innovatively
- enable them to acquire technical and experimental skills to validate the solution, analyze the results and communicate .

OUTCOMES:

At the end of the project the student will be able to

CO1 Formulate and analyze a problem

CO2 Plan experiments to find solutions in a logical manner

CO3 Analyze the results, interpret and communicate.

Course Articulation Matrix

	Statement	Programme Outcome (PO)												Program Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	Formulate and analyze a problem	2	2	1	1	1	1	1	2	2	2	1	2	1	-	-	1	1	-	2	1
CO2	Plan experiments to find solutions in a logical manner	2	1	2	2	2	1	2	3	3	2	2	3	2	2	2	3	3	2	2	2
CO3	Analyze the results, interpret and communicate in an effective manner	3	2	3	3	2	2	2	3	3	3	2	3	2	3	1	3	3	3	2	3
OVERALL CO		2	2	3	3	2	1	2	3	3	2	2	3	2	2	2	3	3	3	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5001 **ADVANCED BIOCHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- Gain in depth knowledge about amino acid synthesis, protein biosynthetic pathway and degradation,
- Understand the importance of vitamins and hormones in metabolism

UNIT I METABOLISM OF AMINO ACIDS **10**

Biosynthesis of Gly, Ser and Cys; Biosynthesis of six essential amino acids (Met, Thr, Lys, Ile, Val, Leu) and regulation of branched chain amino acids, synthesis (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feedback) from oxaloacetate and pyruvate, Biosynthesis of aromatic amino acids-Phenylalanine, Tyrosine,Tryptophan. Metabolic disorders associated with branched chain and aromatic amino acid degradation. Important molecules derived from amino acids (Auxins, DOPA, Serotonin, Porphyrins, T3, T4, Adrenaline, Noradrenaline, Histamine, GABA, Polyamines etc)

UNIT II PROTEIN TRANSPORT AND TURNOVER **5**

Protein targeting, signal sequence, SRP pathway, secretion; Folding, Chaperons and targeting of organelle proteins, Protein degradation, ubiquitination, receptor-mediated endocytosis, turnover.

UNIT III METABOLISM OF NUCLEIC ACIDS AND LIPIDS **12**

Biosynthesis of nucleotides, *de novo* and salvage pathways for purines and pyrimidines, regulatory mechanisms: Degradation of nucleic acid by exo and endo nucleases. Triacylglycerol and phospholipid biosynthesis and degradation; Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs,statins.

UNIT IV VITAMINS AND COENZYMES **9**

Fat Soluble Vitamins, provitamins (A, D, E and K). Structure,physiological significance and deficiency symptoms. Water soluble vitamins, structure, coenzyme role and deficiency symptoms. Thiamine,riboflavin, pyridoxine, niacin, folic acid, biotin and Vitamin B12. Recommended dietary intake. Coenzymes: Their role in metabolic pathways.NAD, FAD,TPP, PLP, carboxybiotin

UNIT V HORMONES **9**

Definition. Effects of Hormones. Chemical classification of hormones. Peptide hormone-vasopressin, protein hormone- insulin. Lipid and phospholipid derived hormones- prostaglandin and phospholipids. Steroid hormones-testosterone, estrogen, cortisol. Monoamines: thyroxine, adrenaline. Mechanism of action of steroid and peptide hormones, Hormonal disorders-Diabetes, Thyroid disorders, hypercholesterolemia and its role in cardiovascular disease.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the metabolic pathways which are crucial and relevant in clinical conditions.
CO2 correlate biochemical processes and the importance of vitamins and hormones in metabolic and nutritional disorders.
CO3 gain in depth knowledge and discuss on the current applications and future prospects

TEXT BOOKS:

1. Nelson, D.L et al., “Lehninger’s Principles of Biochemistry” Stryer, Lubert. “Biochemistry”. IV Edition, W.H Freeman & Co., 2000.
2. Voet, D.J and J.G. Voet and C.W. Pratt “Principles of Biochemistry” IIIrd Edition, John Wiley & Sons Inc., 2008.
3. Murray, R.K., et al., “Harper’s Illustrated Biochemistry”. XXVIIth Edition. McGraw-Hill, 2006.

REFERENCES:

1.Creighton. T.E., “Proteins: Structure and Molecular Properties” IInd Edition, W.H. Freeman and Co.,1993.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

2. Salway, J.G., “Metabolism at a Glance”. IInd Edition, Blackwell Science Ltd., 2000.

Course Articulation Matrix

	Statement	Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the metabolic pathways which are crucial and relevant in clinical conditions.	2	3	3	2	2	1	-	-	-	-	-	3	3	2	3	2	-	-	-	-
CO2	correlate biochemical processes and the importance of vitamins and hormones in metabolic and nutritional disorders.	2	3	3	3	1	-	-	-	-	-	-	3	3	3	3	2	-	-	-	2
CO3	gain in depth knowledge and discuss on the current applications and future prospects	2	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3	1	1	2	3
Overall CO		2	3	3	3	2	1	-	-	-	-	-	3	3	2	1	3	1	1	1	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5002 **ANIMAL BIOTECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- discuss the culturing methods of animal cell.
- explain about advanced technologies in therapeutics.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I ANIMAL CELL CULTURE 12

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures- suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

UNIT II ANIMAL DISEASES AND THEIR DIAGNOSIS 10

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP.

UNIT III THERAPY OF ANIMAL DISEASES 12

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

UNIT IV MICROMANIPULATION OF EMBRYO'S 6

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS 5

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 gain the knowledge about animal cell culturing methods and its various applications.
CO2 understand the diagnosis of disease and develop different strategies of treatment
CO3 gain knowledge in the production of transgenic animal technology

TEXT BOOKS:

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997
3. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth Edition R. Ian Freshney 2010

REFERENCES:

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000
2. Animal Cell Biotechnology: Methods and Protocols.Author(s): Ralf Pörtner Series: Methods in Biotechnology, Publisher: Humana Press, Year: 2007
3. Animal cells as bioreactors. Terence Cartwright Series: Cambridge Studies in Biotechnology Publisher: Cambridge University Press, Year: 2008
4. Animal Biotechnology. Models in Discovery and Translation Author(s): Ashish Verma and Anchal Singh (Eds.) Publisher: Academic Press, Year: 2014

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	gain the knowledge about animal cell culturing methods and its various applications.	2	3	2	1	1	2	2	-	-	-	2	2	2	2	1	2	3	-	-	2
CO2	understand the diagnosis of disease and develop different strategies of treatment	2	3	3	3	2	2	1	2	-	-	3	3	3	3	3	2	2	1	2	2
CO3	gain knowledge in the production of transgenic animal technology	2	3	2	2	3	3	2	2	-	-	2	3	3	2	3	1	2	-	2	3
Overall CO		2	3	2	2	1	2	2	1	-	-	2	3	3	2	3	2	1	1	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5071 BIOCONJUGATE TECHNOLOGY AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES

The course aims to

CO1 explain about the principles involved in the different functional targets and its modification

CO2 study about the applications of conjugate technology in Immunology and enzyme technology

UNIT I FUNCTIONAL TARGETS 9

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 9

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APPLICATIONS 9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – modification with synthetic polymers.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 familiarise the students with the various conjugates available in the pharmaceutical and biotechnological industry

CO2 help the students to design and develop efficient conjugates

CO3 help the students apply the knowledge gained about bioconjugates in various fields

TEXTBOOK:

1. Bioconjugate Techniques, G.T. Hermanson, Academic Press, 1999.

REFERENCES:

1. Principles of Biochemistry . Lehninger 7th edition 2017

2. Chemistry of Bioconjugates : synthesis, characterization and biomedical applications 1st edition Ravin Narain 2013

3. Antibody drug conjugates : fundamentals of drug development and clinical outcomes to target cancer 1st edition Kenneth J Oliver, Sara A Hurvitz ,2016.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	familiarize the students with the various conjugates available in the pharmaceutical and biotechnological industry	3	3	2	3	3	3	2	2	3	3	3	2	3	3	3	3	3	3	2	2
CO2	help the students to design and develop efficient conjugates	3	3	2	3	3	3	2	2	3	3	3	2	3	3	3	3	3	3	2	2
CO3	help the students apply the knowledge gained about bioconjugates in various fields	3	3	2	3	3	3	2	2	3	3	3	2	3	3	3	3	3	3	2	2
Overall CO		3	3	2	3	3	3	2	2	3	3	3	2	3	3	3	3	3	3	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5003	BIOETHICS	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- enlighten the students about the ethical issues and the responsibilities
- discuss about the safety and risk assessment in various industrial process

UNIT I ENGINEERING ETHICS 9

Cardinal virtues and their development , concept of morality, ordinal virtues, Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl and Bhopal Case Studies.

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 PERIODS

OUTCOMES:

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

- learn the basics of work ethics
- acquire responsibility of an engineer towards safety
- acquire social responsibility

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, (2000).

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	learn the basics of work ethics	-	-	-	3	-	3	2	3	3	-	2	3	-	-	2	-	-	-	-	3
CO2	acquire responsibiity of an engineer towards safety	-	1	2	2	-	3	3	3	3	-	-	3	-	-	3	-	-	-	-	3
CO3	acquire social responsibility	-	-	-	-	-	3	2	3	3	-	-	3	-	-	3	-	-	-	-	3
Overall CO		-	-	2	-	-	3	3	3	3	-	-	3	-	-	3	-	-	-		3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5004	BIO-INDUSTRIAL ENTREPRENEURSHIP AND IPR	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Discuss about the factors for the development of Entrepreneurship skills
- Explain the process involved in IPR

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

- Should You Become an Entrepreneur? What Skills Do Entrepreneurs Need?
- Entrepreneurship and intrapreurship
- Identify and Meet a Market Need
- Entrepreneurs in a Market Economy
- Select a Type of Ownership

UNITII PREREQUISITES 9

- Choose Your Location and Set Up for Business
- Market Your Business
- Hire and Manage a Staff
- Develop a Business Plan

UNIT-III FINANCIAL MANAGEMENT 9

- Finance, Protect and Insure Your Business
- Record Keeping and Accounting
- Financial Management

UNIT-IV IPR 9

- Types of Intellectual property (IP): Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology
- Indian Patent Act 1970 & recent amendments

UNIT-V PATENTS AND THEIR IMPORTANCE IN BIOTECHNOLOGY 9

- Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition
- Specifications: Provisional and complete Specifications: Provisional and complete; Forms and fees Invention in context of “prior art
- National and PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for. Patent licensing and agreement Patent infringement-meaning, scope, litigation, case studies

TOTAL:45 PERIODS

OUTCOMES:

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

CO1 know the basic requirement for being an entrepreneur
CO2 know how to design and implement a successful commercial venture
CO3 know how to safeguard his innovation /idea via patenting

TEXT BOOKS:

1. Entrepreneurship Ideas in Action—South-Western, 2000.
2. Business Idea The Early Stages of Entrepreneurship Soren Hougaard Publisher: Springer, Year: 2004
3. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
4. Pharmaceutical Substances. Syntheses, Patents, Applications Kleemann Publisher: Thieme, Year 2001

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	know the basic requirement for being an entrepreneur	-	3	2	1	1	2	2	3	-	-	2	3	2	2	3	2	1	-	-	2
CO 2	know how to design and implement a successful commercial venture	2	3	3	3	2	2	1	2	3	-	3	3	3	3	3	2	1	-	2	2
CO 3	know how to safeguard his innovation /idea via patenting	2	3	3	3	3	3	2	2	2	-	2	3	3	2	3	1	1	-	2	3
Overall CO		2	3	3	3	2	2	2	2	2	-	2	3	3	2	3	2	1	1	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5005 **BIOPHARMACEUTICAL TECHNOLOGY** **L T P C**
2 1 0 3

OBJECTIVES

The course aims to

- Explain about the various types of drugs and their mode of action
- Explain about various drug formulations and their applications

UNIT I INTRODUCTION **9**

Pharmaceutical industry & development of drugs ; types of therapeutic agents and their uses; economics and regulatory aspects .

UNIT II DRUG ACTION, METABOLISM AND PHARMACOKINETICS **9**

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics.

UNIT III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS **7**

Types of reaction process and special requirements for bulk drug manufacture.

UNIT IV PRINCIPLES OF DRUG MANUFACTURE **13**

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

UNIT V BIOPHARMACEUTICALS **7**

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn about different dosage forms and their manufacture
CO2 understand pharmacokinetic parameters of drug action
CO3 learn about the principles of drug manufacture

TEXTBOOKS:

1. Lachman/Liebermanns textbook of The theory and practice of Industrial Pharmacy:,CBS Publishers and Distributors,2014.
2. Ansel's Pharmaceutical Dosage forms and Drug delivery systems;Wolter Kluwer publishers,2014.
3. Gilbert S Banker, Modern Pharmaceutics, CRC press,1996
4. D M Brahmanker, S Jaiswal Biopharmaceutics and Pharmacokinetics,Vallabh Publications,2014

REFERENCES

1. Finkel, Richard, etal., "Lippincott's Illustrated Reviews Pharmacology" IV th Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009.
2. N.K .Jain Pharmaceutical product development. 2006. CBS Publishers &Distributors.
3. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
4. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	learn about different dosage forms	3	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	2	1	2	2
CO2	understand pharmacokinetic parameters of drug action	3	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	2	2
CO3	learn about the principles of drug manufacture	3	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	1	2	2
Overall CO			3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5006 **BIOPHYSICS** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- Learn the physical basis of biological processes.
- Understand the complex biological world based on physics and physical chemistry in an analytical, rational and quantitative manner.

UNIT I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 9

Intramolecular bonds – covalent – ionic and hydrogen bonds –Inter-atomic interactions - Molecular dynamic simulation - biological structures –general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

UNIT II CONFORMATION OF NUCLEIC ACIDS 9

Primary structure – the bases – sugars and the phosphodiester bonds- double helical Structure – the a b and z forms – triple helix – G-Quartet - properties of circular DNA – topology – polymorphism and flexibility of DNA – DNA condensation - structure of ribonucleic acids – riboswitches –hydration of nucleic acids - nucleic acid dynamics related to function.

UNIT III CONFORMATION OF PROTEINS 9

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index – protein dynamics – structural motifs – contact map – membrane proteins – protein structure perdiction – Intrinsically Disordered Proteins (IDP) – Protein folding mechanisms – protein aggregation and neurotoxicity.

UNIT IV CELLULAR PERMEABILITY AND ION – TRANSPORT 9

Ionic conductivity – transport across ion channels – mechanism - ion pumps- classification of transport mechanisms – passive and active transport kinetic models - proton transfer – Mitchel's Chemiosmotic Theory of energy transduction - nerve conduction theory and models– techniques of studying ion transport.

UNIT V ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS 9

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows – Electron transfer theories – Electron transfer in mitochondria and chloroplast.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the physicochemical properties of biomolecules
CO2 understand structural dynamics of biomolecules and their role in cellular functions such as transport and DNA organization
CO3 develop basic knowledge on biothermodynamics to assess the strength and limitations of biological systems

TEXTBOOKS:

1. Biophysical Chemistry of Nucleic Acids and Proteins, Thomas E. Creighton 2010
2. Physical Biology of the Cell, R. Phillips et al 2013
3. Biophysics: Molecules In Motion ; R. Duane. Academic Press , 1999

REFERENCE:

1. Cantor, Charles R. and Paul R. Schimmel "Biophysical Chemistry" . 1-3 Vols. W.H.Freeman& Co.,1980.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the physicochemical properties of biomolecules	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO2	understand structural dynamics of biomolecules and their role in cellular functions such as transport and DNA organization	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO3	develop basic knowledge on bio thermodynamics to assess the strength and limitations of biological systems	2	2	3	3	3	3	-	-	-	-	-	2	3	3	-	3	3	2	2	-
Overall CO		2	3	2	3	2	1	-	-	-	-	-	3	2	2	1	3	1	1	1	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5072	BIOLOGICAL SPECTROSCOPY	L T P C
		2 1 0 3

OBJECTIVES

The course aims to

- Instruct the students various spectroscopic and microscopic techniques that are used in research and practice in biotechnology.
- Covers most of the current and novel techniques.

UNIT I CIRCULAR DICHROISM (CD) AND OPTICAL ROTATORY DISPERSION (ORD) 4

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins .

UNIT II FLUORESCENCE AND RAMAN SPECTROSCOPY 11

Molecular energy level diagrams – principles of fluorescence and Raman – parameters for measurement – excited state processes - fluorescence polarization – Forster Resonance Energy Transfer – fluorescence quenching – single molecule spectroscopy - application to proteins and nucleic acids.

UNIT III NUCLEAR MAGNETIC RESONANCE 6

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multidimensional NMR spectroscopy – detemination of macromolecular structure by NMR – magnetic resonance imaging.

UNIT IV MASS SPECTROMETRY and X-RAY DIFFRACTION 12

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications. Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – detemination of crystal structure – electron and neutron diffraction.

UNIT V SPECIAL TOPICS 12

Electron microscopy – transmission and scanning electron microscopy; CryoElectron Microscopy – scanning tunneling and atomic force microscopy (AFM); Fluorescence Correlation Spectroscopy (FCS); FRAP; Two-photon Microscopy; STED and STORM microscopies.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the principle of spectroscopic techniques widely used in many quantitative experiments

CO2 understand the central techniques associated with the elucidation of structure and composition molecules in natural and life sciences

CO3 comprehend the high-resolution imaging techniques to assess surface and intracellular complexity.

TEXTBOOKS:

1. Banwell, Colin N. and E.M. McCash. “Fundamentals of Molecular Spectroscopy” IVthEdition, Tata McGraw-Hill, 1994.
2. Aruldas, G. “Molecular Structure and Spectroscopy”. IIndEdition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. “ Introduction to Spectroscopy:” IIIrdEdition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. ”Spectroscopic Methods in Organic Chemistry”. VthEdition, Tata McGraw-Hill, 1995.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Siuzdak, Gary. “Mass Spectrometry for Biotechnology ”. Academic Press / Elsevier,1996.
2. Hammes, Gordon G. “Spectroscopy for the Biological Sciences”. John Wiley, 2005.
3. Campbell I.D and Dwek R.A., “ Biological Spectroscopy “, Benjamin Cummins and Company, 1986.
4. Atkins P.W., “Physical Chemistry “, Oxford IV Edition, 1990.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the principle of spectroscopic techniques widely used in many quantitative experiments	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	2
CO2	understand the central techniques associated with the elucidation of structure and composition molecules in natural and life sciences	2	2	2	3	2	-	-	-	-	-	-	2	2	2	2	3	-	-	-	2
CO3	comprehend the high-resolution imaging techniques to assess surface and intracellular complexity.	2	2	2	3	2	-	-	-	-	-	-	2	2	2	2	3	-	-	-	2
Overall CO		2	2	2	3	2	-	-	-	-	-	-	2	2	2	2	3	-	-	-	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5007 **BIOSAFETY** **LT PC**
3 0 0 3

OBJECTIVES

The course aims to

- Create awareness about biosafety and containment guidelines
- Assess the risk analysis and the stringency requirements

UNIT I NEED FOR BIOSAFETY **9**

Introduction; the history and incidence of laboratory-acquired infections (LAI) ,incidents of secondary transmission from the laboratory, Outline the types of laboratory accidents leading to LAIs, Explain the role of aerosols in LAIs, Illustrate the importance of biosafety and biocontainment in minimizing the risk of LAIs

UNIT II BIOLOGICAL SAFETY CABINETS **9**

Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; recommended Biosafety Levels for Infectious Agents and Infected Animals, The classes and types of biological safety cabinets (BSC), Understand the principles of HEPA filtration, Explain the practices for safely working in a BSC , Identify other laminar flow devices and their limitations for use with microorganisms . Outline the certification process for BSCs

UNITIII BIOSAFETYGUIDELINES **9**

Biosafety guidelines - Government of India; Definition of GMOs and LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMO

UNIT IV GENETICALLY MODIFIED ORGANISMS AND REGULATIONS **9**

Biosafety for human health and environment. - Global scenario of transgenic micro organisms and plants. Ecological risk of engineered microorganisms/plants and remedial measure .Components of a risk assessment for microorganisms Outline factors affecting risk assessment (agent, host, environment, behavioural) . Risk Assessment; Risk Analysis; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartageena Protocol

UNIT V BIOCONTAINMENT AND CERTIFICATION **9**

Describe the progression of building a new biocontainment laboratory from conceptualization through to certification. Outline the concepts to be addressed during the laboratory programming phase, architectural and engineering biocontainment features, key security features and control systems, commissioning and certification process and understand the difference between them.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 familiarize the students with the concept of biosafety
CO2 enable them to work in a GLP accredited laboratory and their standards
CO3 enable students to familiarize themselves with the concept of GMO

TEXTBOOKS AND REFERENCES:

1. Biosafety in Microbiological and Biomedical Laboratories, 5th ed. 2009
2. Biological Safety, Principles and Practices, 4th ed. (Fleming & Hunt) ASM Press 2006
3. Guide for the care and use of laboratory animals 8t ed . (National Research Council) National Academies Press 2011
4. Control of communicable diseases manual 20th ed. (Heymann) 2014
5. NIH guidelines for research involving recombinant or synthetic nucleic acid molecules (2013)
6. Collins, C.H., and Kennedy, D.A. Laboratory-acquired infections. In: Laboratory acquired infections: history, incidence, causes and preventions. Oxford, UK: Butterworth-Heinemann, 1999;1-37.
7. Harding, A.L., and Brandt Byers, K. Epidemiology of laboratory-associated infections. In: Fleming, D.O., and Hunt, D.L. Biological safety: principles and practices. Washington, DC: ASM Press, 2000;35-54.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

	Statement	Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	familiarize the students with the concept of biosafety	3	2	3	2	3	3	3	3	3	2	-	2	3	1	3	1	2	2	1	3
CO2	enable them to work in a GLP accredited laboratory and their standards	3	3	3	2	3	3	3	3	3	2	-	2	3	2	3	1	2	2	2	3
CO3	enable students to familiarize themselves with the concept of GMO	3	3	3	2	3	3	3	3	3	2-	-	-	2	2	3	1	2	3	2	3
Overall CO		3	2	3	2	3	3	3	3	3	2	-	2	3	2	3	1	2	2	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5008	INDUSTRIAL BIOSAFETY AND HAZARD MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- make the students aware of safety guidelines in industry
- learn about risk analysis and implementation procedures
- learn about concepts in hazard analysis and its applications

UNIT I SAFETY REQUIREMENTS **9**

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II IMPLEMENTATION AND ASSESSMENT OF SAFETY **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety

UNIT III RISK ANALYSIS **9**

Overall risk analysis--emergency planning-on site &off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV GUIDELINES **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras- VizagBopal analysis.

UNIT V REGULATIONS AND CASE STUDY ANALYSIS **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 familiarize the students with the concept of biosafety

CO2 enable them to work in a GLP accredited laboratory and their standards

CO3 enable students to familiarize themselves with the concept of GMO

TEXT BOOKS:

1. Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.
2. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
3. Skeleton, B., Process Safety Analysis : An introduction, Institution of chemical Engineers, U.K., 1997. . Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis,Dyadem Press, 2004.

REFERENCES:

1. Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company,1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGraw-Hill Book Co., 1980.
3. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prentice Hall, NJ, 1990.
4. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall,London, 1994

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	familiarize the students with the concept of biosafety	3	2	3	2	3	3	3	3	3	2	-	2	3	1	3	1	2	2	1	3
CO2	enable them to work in a GLP accredited laboratory and their standards	3	3	3	2	3	3	3	3	3	2	-	2	3	2	3	1	2	2	2	3
CO3	enable students to familiarize themselves with the concept of GMO	3	3	3	2	3	3	3	3	3	2-	-	-	2	2	3	1	2	3	2	3
Overall CO		3	2	3	2	3	3	3	3	3	2	-	2	3	2	3	1	2	2	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5009	CANCER BIOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Understand the basic principles of cancer development and pathology
- Familiar with basic facets of carcinogenesis and methods to study the process
- Familiar with basic principles and applications of cancer therapies

UNIT I FUNDAMENTALS OF CANCER BIOLOGY 9

Cancer Epidemiology, different forms of cancers, Regulation of cell cycle, modulation of cell cycle in cancer ,mutations that cause cancer, Hallmarks of cancer, Tumor Viruses, Apoptosis ,tumour suppressor genes,diet and cancer,Infection and Inflammation, Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT II MOLECULAR MECHANISMS OF CANCER 9

Signal targets and cancer, Activation of kinases; Oncogenes, Identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors and oncogenes,Growth factors related to transformation. Telomerases.Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT III SIGNALLING AND METABOLIC PATHWAYS IN CANCER 9

Pathways that contribute to the altered cancer cell metabolism, Warburg effect.Cell signaling pathways. Tumor Angiogenesis, Cancer Stem Cells. GPCR signaling, Jak-STAT signaling, Integrin Sigalling, Wnt Signalling. TGF-B signaling, NF-Kb signaling, Notch signaling, Hedgehog and RasSignalling pathways in cancer.

UNIT IV DETECTION OF CANCER 9

Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer. Prediction of aggressiveness of cancer,Tumor staging, Applications of new technologies in prevention, assessing risk and diagnostics, Use of cancer antigens in cancer detection/classification, Monoclonal antibodies in cancer diagnosis, Cancer imaging Technologies.

UNIT V MECHANISMS OF CANCER THERAPY 9

Different forms of therapy, chemotherapy, radiation therapy, Immunotherapy, CAR-T therapy , advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.Cancer antigen based vaccines ,cell based therapy against cancer,Targeted therapy, Hormone Therapy

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 be familiar with basic facts of carcinogenesis and understand the molecular mechanisms and signaling pathways in cancer
CO2 be familiar with fundamental principles and applications of cancer therapies
CO3 understand the principles and applications of cancer detection and diagnosis

TEXTBOOKS:

1. Weinberg, R.A. “The Biology of Cancer” Garland Science, 2007
2. McDonald, F *et al*., “Molecular Biology of Cancer” 2nd Edition. Taylor & Francis, 2004.

REFERENCES:

1. King, Roger J.B. “Cancer Biology” Addison Wesley Longman, 1996.
2. Ruddon, Raymond W. “Cancer Biology” 3rd Edition. Oxford University Press, 1995.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	be familiar with basic facts of carcinogenesis and understand the molecular mechanisms and signaling pathways in cancer	3	2	2	2	2	-	-	-	1	-	-	1	2	2	2	3	3	2	1	2
CO2	be familiar with fundamental principles and applications of cancer therapies	3	3	2	2	2	-	-	-	1	-	-	1	2	2	2	3	3	2	3	2
CO3	understand the principles and applications of cancer detection and diagnosis	3	3	3	2	2	-	-	-	1	-	-	1	2	2	2	3	3	2	3	1
Overall CO		3	3	2	2	2	-	-	-	1	-	-	1	2	2	2	3	3	2	3	22

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5010	DEVELOPMENTAL BIOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Make the students understand the basics of development
- Differences in the developmental pathways of different organisms.
- Make them aware how the basic developmental pathways are regulated by biotic and abiotic factors

UNIT 1 HISTORY & BASIC CONCEPTS OF DEVELOPMENT 9

Overview of how the modern era of developmental biology emerged through multidisciplinary approaches, stages of development- zygote, blastula, gastrula ,neurula. Cell fate& commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation,l ineages of three germ layers, fate map. Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, mosaic and regulative development. Pattern formation-- axis specification, positional identification (regional specification). Morphogenetic movements Model organisms in Developmental biology

UNIT II EARLY DEVELOPMENT IN INVERTEBRATE /VERTEBRATE MODELS 9

Drosophila, *C.elegans*, Xenopus,Mouse/ human. Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates

UNIT III LATE DEVELOPMENT IN INVERTEBRATE /VERTEBRATE MODELS 9

Organogenesis- development of central nervous system in vertebrates, vulval formation in C.elegans

UNIT IV GERM CELL SPECIFICATION& MIGRATION 9

Germplasm and determination of primordial germ cells, germ cell migration (Drosophila, vertebrates), Gamete maturation (amphibians, mammal) Medical aspects in developmental biology (genetic errors in human development, teratogenesis) developmental therapies

UNIT V APPLICATIONS 9

Overview of plant development, Medical implications of developmental biology - genetic errors/ teratogenesis/ stem cell therapy etc

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn the basics of developmental biology

CO2 understand the differences in the developmental pathways of different organisms.

CO3 understand the influence of the biotic and abiotic factors on developmental pathways

REFERENCES:

1. Developmental Biology, 10th edition by Scott F. Gilbert (Sinauer Associates, Inc.) 2013
2. Essential Developmental Biology by Jonathan Slack, 3rd edition, Wiley Blackwell 2012
3. Developmental Biology, Werner A Muller: 1997 edition (6 December 2012)
4. Principles of Development - Lewis Wolpert 4th edition, Oxford University Press 2011

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	learn the basics of development	3	1	-	-	2	-	-	-	-	-	-	3	2	1	1	-	-	-	-	-
CO2	understand the differences in the developmental pathways of different organisms.	3	1	-	-	2	-	-	-	-	-	-	3	2	1	1	-	-	-	-	-
CO3	understand the influence of the biotic and abiotic factors that regulate developmental pathways are	3	2	1	-	2	-	-	-	-	-	-	3	2	1	1	-	-	-	-	-
Overall CO		3	1	1	-	2	-	-	-	-	-	-	3	2	1	1	-	-	-	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

OBJECTIVES

The course aims to

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OUTCOMES:

On Completion of the course, the students should be able to

CO1 Differentiate the types of disasters, causes and their impact on environment and society

CO2 Assess vulnerability and various methods of risk reduction measures as well as mitigation.

CO3 Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

IB5011 ENZYME TECHNOLOGY AND BIOTRANSFORMATIONS L T P C
3 0 0 3

OBJECTIVES

The course aims to

- Make the students understand the basic mechanism of enzyme action,
- Make the students learn the characterization and purification of enzymes and its applications

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 9

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Koshland, Némethy,Filmer and Monod Changeux W yman models, pH and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS 9

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, Introduction to Biosensors- design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

UNIT IV ENZYMES FROM NATURALSOURCES 9

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays

UNIT V BIOTRANSFORMATION APPLICATIONS OF ENZYMES 9

Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions –aldehydes, Ketones,C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis– esters, amide, peptide, Modified and Artificial Enzymes , Catalytic antibodies

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 know about the intricacies of enzyme action for biotechnological applications
CO2 acquire knowledge of the kinetics of enzyme action
CO3 design strategies for the isolation and purification of enzymes from Natural sources
CO4 comprehend the Biotransformation applications of enzymes

TEXT BOOKS:

1. Trevor Palmer, Enzymes IInd Horwood Publishing Ltd 2007

2. Faber K ,Biotransformations in Organic Chemistry, IV edition , Springer 2000

REFERENCES:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.1997
2. James M. Lee, Biochemical Engineering .Prentice Hall Inc 1992
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals 2nd edition , McGraw Hill. 1986
4. W iseman, Enzyme Biotechnology, Ellis Horwood Pub.1995

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	know about the intricacies of enzyme action for biotechnological applications	3	3	-	1	-	3	3	3	-	-	-	3	3	3	3	3	-	3	3	3
CO2	acquire knowledge of the kinetics of enzyme action	3	3	-	3	-	3	-	-	-	-	-	3	-	3	-	3	3	-	3	-
CO3	design strategies for the isolation and purificationof enzymes from Naturalsources	3	3	3	2	-	3	3	3	-	-	3	3	3	3	3	3	3	3	3	3
CO 4	comprehend the Biotransformation applications of enzymes	3	3	3	1	1	3	1	-	-	-			2	1	1	2	2	-	3	1
Overall CO		3	3	3	2	1	3	3	3	-	-	3	3	3	3	3	3	3	3	3	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

GE5073 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT L T P C

3 0 0 3

OBJECTIVES

The course aims to

- understand the global trends and development methodologies of various types of products and services
- conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends-Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies**-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering -traceability Matrix and Analysis - Requirement Management - **System Design &Modeling -**Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** – Concept Screening& Evaluation - **Detailed Design -** Component Design and Verification –**Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation- **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL –**Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Define, formulate and analyze a problem

CO2 Solve specific problems independently or as part of a team

CO3 Gain knowledge of the Innovation & Product Development process in the Business Context

CO4 Work independently as well as in teams

CO5 Manage a project from start to finish

TEXTBOOKS:

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGrawHill, Fifth Edition, 2011.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.

2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford,2004.

3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning –Concepts”, Second Edition, Prentice Hall, 2003.

4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

GE5074 FUNDAMENTALS OF NANOSCIENCE L T P C

3 0 0 3

OBJECTIVES

The course aims to

- learn about basis of nanomaterial and its preparation
- learn about characterisation and applications in other fields

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth,

laser ablation, CVD routes, Plasma CVD), structure-property Relationships

applications- Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course the students will be able to CO1
familiarize about the science of nanomaterials CO2
demonstrate the preparation of nanomaterials CO3
develop knowledge in characteristic nanomaterial

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale characterization of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES:

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.
2. AkhleshLakhtakia (Editor),“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	familiarize about the science of nanomaterials	3	2	2	2	3	2	2	1	2	1	2	2	3	2	-	2	3	-	2	-
CO2	demonstrate the preparation of nanomaterials	2	2	2	2	3	2	2	1	2	1	2	2	2	3	2	3	2	2	2	-
CO3	develop knowledge in characteristic nanomaterial	2	2	2	2	3	2	2	1	2	1	2	2	3	2	3	2	2	-	3	-
Overall CO		2	2	2	2	3	2	2	1	2	1	2	2	2	2	2	2	2	1	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5012	FUNDAMENTALS OF RESEARCH METHODOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- understand the relevance, basic concepts, theories and approach towards research project planning, execution, report submission and publish manuscripts
- understand and apply the concepts in all areas of research
- execute the concepts in real time research /case studies

UNITI INTRODUCTION TO RESEARCH METHODOLOGY 9

Objectives of research, types of research, Basic, Applied, Evaluation and Action Research, Process of research and its criteria Elements of Research,Concepts, Constructs, Definitions – Theoretical and Operational, Theory, Literature Review and its importance, Models, research questions and objectives, research design and methodology.

UNITII RESEARCH DESIGN 9

Selection of the problem, defining the problem, techniques for selection: different research designs, Basics of experimental design, proposing a research plan. Features of Good Design, Concepts, Types. Basic principles of Experimental Design, various methods of Research.Survey, Philosophical, Historical, Experimental, Causal Comparative, Genetic, Case Studies.

UNITIII LITERATURE SURVEY 9

Literature survey, reporting. Library organization: indexing, cataloguing, INSDOC,MEDLINE, Internet facilities- Bibliography and references. Source of literature (reviews, shortnotes, abstracts, journal articles, periodicals, magazines)

Preparation of index cards, request for reprints. Techniques of a scientific paper: citing reference, foot notes, tables, figures, proof reading. Preparation of scientific report. Llibrary cataloguing, Dewey, ISBS, ISSN, Bar coding and accession number)Internet resources: world wide web, electronic publication and online journals.

UNIT IV DATA COLLECTION AND ANALYSIS 9

Quantitative Research Methods,Variables, Conjecture, Hypothesis, Measurement, Types of data and scales, Sample, Sampling techniques, Probability, Probability Distributions, Hypothesis Testing, Level of Significance and Confidence Interval, t-test, ANOVA, Correlation, Regression Analysis Method validation, observation and collection of data, methods of data collection, data processing and analysis strategies and tools,data analysis with statistics package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), Qualitative Approaches,Types of approaches – Narrative, phenomenological, grounded theory, ethnographic, case study, Data Sources: Interviews, Focus groups, observations, approaches to analysis of qualitative data –coding, content analysis

UNIT V RESEARCH ETHICS, IPR, PUBLICATIONS 9

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 gain knowledge in fundamentals of research planning

CO2 get exposure to the different research fields in Biotechnology

CO3 acquire skill development in knowledge transfer from laboratory to industry approach

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers. 2. Kothari, C.R., 1990.
2. Research Methodology: Methods and Techniques. New Age International. 418p. New Age International Publishers; Fourth edition 2019
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing..
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing
6. www. Social research methods. Net
7. www. processreserachmethods.org

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (POs)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	Gain Knowledge in fundamentals of research planning	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-
CO2	get exposure to the different fields of research in biotechnology	3	2	2	2	2	3	2	2	2	2	2	2	2	2	2	3	2	-	-	-
CO3	acquire skills development to transfer knowledge from laborartory to industry approach	2	2	2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	3	3	3
Overall CO		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5013	GENETICS	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Understand the fundamentals of inheritance
- Understand the role of inheritance in evolution and disease

UNIT I BACTERIAL GENETICS 7

Transformation, Transduction, Conjugation – mapping, fine structure mapping in merozygotes-plasmids and episomes

UNIT II CLASSICAL GENETICS 8

Mendel's principles and experiments, segregation, multiple alleles – Independent Assortments, Genotypic interactions, epistasis and Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis

UNIT III APPLIED GENETICS 9

Chromosome organization, structure and variation in prokaryotes and eukaryotes, Giant chromosomes – polytene and lampbrush, deletion, inversion, translocation, duplication. variation in chromosomal numbers – aneuploidy, euploidy, polyploidy, Ames test, karyotyping, Linkage, Crossing over – cytological basis of crossing over, chromosome mapping – two and three factor cross – interference, somatic cell hybridization

UNIT IV POPULATION GENETICS 9

Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium, non random mating, population analysis, Models for population genetics. Mutation and Migration size, Genetic variation and Sociobiology

UNIT V GENETIC DISEASES 12

Inborn errors of metabolism, Sickle cell, hemochromatosis, cystic fibrosis, hypogonadotropic hypogonadism, Gaucher's disease, achondroplasia, phenylketonuria, Huntington's Disease, Cystic fibrosis, hemoglobinopathies, Age-related macular degeneration, Obesity, Type 2 diabetes, Psychiatric disease, including missing heritability, autism

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the basics of inheritance of genes

CO2 apply the knowledge in different systems

CO3 know how to apply the knowledge in the treatment of human diseases

TEXT BOOKS:

1. Tamarin, R.H., "Principles of Genetics", Tata McGraw Hill, New Delhi, 2002
2. De Robertis, E. D. P. and De Robertis, E. M. F., "Cell and Molecular Biology", 8th Edition, Lippincott Williams & Wilkins, New York, USA, 2001.

REFERENCES:

1. Gardner, E.J, Simmons, M.J, and Snustad, D.P., "Principles of Genetics",8th Edition, John Wiley & Sons, Singapore, 2003.
2. Strickberger, M.W., "Genetics", 3rd Edition, Prentice Hall of India, New Delhi, 2008.
3. Klug, W.S. and Cummings, M.R., "Concepts of Genetics", Pearson Education, New Delhi, 2003.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the basics of inheritance of genes	3	1	1	1	1	-	-	-	-	-	-	3	2	2	1	1	-	-	-	2
CO2	apply the knowledge in different systems	3	1	1	1	1	-	-	-	-	-	-	3	2	2	2	1	-	-	-	2
CO3	know how to apply the knowledge in the treatment of human diseases	3	2	1	1	2	-	-	-	-	-	-	3	2	2	2	1	-	-	-	2
Overall CO		3	1	1	1	1	-	-	-	-	-	-	3	2	2	2	1	-	-	-	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5014	GENOMICS AND PROTEOMICS	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Provide the students a broader knowledge on the structure and function of genomes.
- Understand and learn about different protein characterisation and profiling techniques.

UNIT I INTRODUCTION **8**

Introduction to genome, transcriptome, and proteome; Overview of genomes of bacteria, archae, and eukaryote; Genomes of organelles.

UNIT II GENOME MAPPING AND SEQUENCING **10**

Genetic and physical mapping, Linkage analysis, RFLP, SNP, SSLP, Restriction mapping, STS mapping, FISH, Top-down and bottom-up sequencing strategies, Whole genome sequencing, Gap closure, Pooling strategies.

UNITI II FUNCTIONAL GENOMICS **9**

Genome annotation, ORF and functional prediction,Genefinding,Substractive DNA library screening, Differential display and Representational difference analysis, SAGE,TOGA, Introduction to DNA microarray.

UNIT IV TECHNIQUES IN PROTEOMICS **9**

In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of proteins on SDS gels,Protein cleavage,Edman protein microsequencing, Mass spectrometry-principles of MALDI-TOF, Peptide mass fingerprinting.

UNIT V PROTEIN PROFILING **9**

Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the existence of various levels of protein structures

CO2 learn about the building blocks of proteins and other factors contributing to protein structures

CO3 correlate protein structures with their functions

CO4 learn the methods of characterization of proteins

TEXTBOOKS:

1. Suhai, Sandor “Genomics and Proteomics: Functional and Computational Aspects”. Springer, 2000
2. Pennington, S.R. and M.J. Dunn “Proteomics: From Protein Sequence to Function”. VivaBooksPvt. Ltd., 2002.
3. O’Connor, C.D. and B.D.Hames. “ Proteomics”. Scion Publishing, 2008.
4. Primrose, S.B. and Twyman. “Principles of Genome Analysis and Genomics”. 7th Edition,Blakwell Publishing, 2006

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Cantor, Charles R. and Cassandra L. Smith. “Genomics : The Science and Technology Behind the Human Genome Project”. John Wiley & Sons, 1999.
2. Liebler, R.C. “Introduction to Proteomics”. Humana Press, 2002.
3. Hunt, Stephen P. and Frederick J. Livesey. “Functional Genomics”. Oxford University Press,2000.
4. Conard, Edward. “Genomics”. Apple Academics, 2010

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the existence of various levels of protein structures	-	-	-	-	-	-	1	-	-	1	-	3	1	-	-	-	-	-	2	-
CO2	learn about the building blocks of proteins and other factors contributing to protein structures	-	1	-	1	1	-	1	-	-	1	-	3	1		2	-	-	1	2	1
CO3	correlate protein structures relate to protein functions	2	-	2	3	2	2	2	1	2	1	2	2	3	2		3	2	1	1	3
CO4	learn the methods of characterization of proteins	2	-	-	3	3	3	2	2	2	1	2	2	2	3	-	3	3	2	2	2
Overall CO		2	1	-	3	2	2	2	1	2	1	2	3	2	2	1	3	2	1	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

GE5072	HUMAN RIGHTS	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- make students learn about the concept and regulation of human rights
- make students aware about the constitutional human rights

UNIT I INTRODUCTION TO HUMAN RIGHTS **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II REGULATIONS IN HUMAN RIGHTS **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III MONITORING AGENCIES **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV HUMAN RIGHTS-INDIAN PERSPECTIVE **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V IMPLEMENTATION OF HUMAN RIGHTS IN VARIOUS SCENARIO **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 acquire the basic knowledge of human rights.

CO2 acquire knowledge about the regulatory bodies involved in human rights

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.

2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.

3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

CH5072	INSTRUMENTATION AND PROCESS CONTROL	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Introduce dynamic response of open and closed loop systems
- Make the students learn about the control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION 6

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, Volumetric Flow Rate and mass flow rate (for liquids and solids), viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 11

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 10

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE 9

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS 9

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn about the construction and working principles of instruments in bio-process industries.
CO2 control the process parameters in optimized conditions at bio process industries.
CO3 understand and design the modern hardware and instrumentation needed to implement in process control.

TEXT BOOKS:

1. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003.
2. Coughnowr, D., “ Process Systems Analysis and Control “, IIndEdn., McGraw Hill, New York, 1991.

REFERENCES:

1. Marlin, T. E., “ Process Control “, IInd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., “Principles and Practice of Automatic Process Control”, IInd Edn., John Wiley, New York, 1997.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	learn about the construction and working principles of instruments in bioprocess industries	3	2	2	1	-	-	1	-	-	-	1	1	2	1	-	-	-	-	1	-
CO2	control the process parameters in optimized conditions at bio process industries	3	2	1	2	-	-	1	-	-	-	2	1	3	1	-	-	-	-	1	-
CO3	understand and design the modern hardware and instrumentation needed to implement in process control	2	3	2	1	-	-	2	-	-	-	1	1	2	1	-	-	-	-	2	-
Overall CO		2	2	2	1	-	-	1	-	-	-	1	1	2	1	-	-	-	-	1	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5015	MARINE BIOTECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Discuss about the abiotic and biotic components of the marine ecosystem.
- Discuss about the active compounds obtained from the marine environment and their applications.
- Explain the various techniques used in aquaculture.

UNIT I INTRODUCTION TO MARINE ENVIRONMENT 9

World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisons of the sea – history of marine biology – bioecochemical cycles – food chain and food web.

UNIT II IMPORTANT MARINE ORGANISMS 9

Phytoplanktons – zoo planktons – nektons – benthos – marine mammals – marine algae – mangroves – coral reefs – deep sea animals and adaptation – intertidal zone – fauna and flora.

UNIT III MARINE ENVIRONMENTAL BIOTECHNOLOGY 9

Marine pollution – biology indicators (marine micro , algae) – biodegradation and bioremediation – marine fouling and corrosion.

UNIT IV MARINE PHARMACOLOGY 9

Medicinal compound from marine flora and fauna – marine toxins , antiviral and antimicrobial agents.

UNIT V AQUACULTURE TECHNOLOGY 9

Important of coastal aquaculture – marine fishery resources – common fishing crafts and gears – aquafarm design and construction.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the physical and biological nature of the marine environment.
CO2 know about the active ingredients present in the marine system and their application.
CO3 know about the marine fishery resources and aquaculture techniques utilized for its mass cultivation

TEXT BOOKS:

1. Recent advances in marine biotechnology volume 3 – M.Fingerman , R . Nagabhushanam Mary – Frances Thomson. Science Publishers Inc, USA 1999

2. Recent advances marine biotechnology volume 7 – M.Fingerman , R .Nagabhushanam Mary – Frances Thomson Science Publishers Inc, USA 2002

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the physical and biological nature of the marine environment.	2	2	1	1	2	-	-	-	-	-	-	3	2	1	1	2	-	-	-	-
CO2	know about the active ingredients present in the marine system and their application.	1	2	3	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	3
CO3	know about the marine fishery resources and aquaculture techniques utilized for its mass cultivation	1	2	3	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	3
Overall CO		1	2	3	3	2	-	-	-	-	-	-	3	2	2	2	3	-	-	-	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5075	METABOLIC ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- Impart knowledge about basics of metabolic design and pathway analysis.
- Understand about quantification of metabolism with focus of pathways leading to industrially relevant products.

UNIT I BASICS OF METABOLIC DESIGN AND PATHWAY ANALYSIS 9

Basic principles of metabolic design, thermodynamics of pathway, redox balancing, , transport of substrates, enzyme candidates, substrate and product transport and choice of appropriate genetic strategies.

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY 9

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, lumping of reaction rates, analysis of over determined systems using black box model- identification of gross measurement errors. Introduction to MATLAB®

UNIT II METABOLIC FLUX ANALYSIS 9

Theory of determined ,over-determined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling.

UNIT IV METABOLIC CONTROL ANALYSIS 9

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Experimental determination of flux control coefficients and other coefficients. Theory of large deviations

UNIT-V ANALYSIS OF METABOLIC NETWORKS 9

Stoichiometric Network Analysis. Elementary mode analysis, extreme pathways. Control of flux distribution at a single branch point, Grouping of reactions, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn pathway analysis by understanding material balances and stichometry
CO2 understand the basics of metabolic flux and control analysis
CO3 perform theoretical analysis of metabolic networks and experimental validation

TEXT BOOKS:

1. Gregory N. Stephanopoulos, Aristos A. Aristidou, Jens Nielsen, Metabolic Engineering: Principles and Methodologies, Academic Press 1998.
2. Sang Yup Lee E. Terry Papoutsakis Marcel Dekker, Metabolic Engineering.inc 1998
3. Nielsen J and Villadsen J. (1994) Bioreaction Engineering Principles. New york:Plenum Press

REFERENCES:

1. Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists by Eberhard O. Voit Cambridge University Press 2000
2. Applications of Plant Metabolic Engineering. R. Verpoorte, A. W. Alfermann and T. S. Johnson (eds). Springer, P.O. Box 17, 3300 AA Dordrecht, The Netherlands. 2007.
3. Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts Edited by Zoltan Szallasi, JorgStelling and VipulPeriwal MIT Press Cambridge 2006

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	learn pathway analysis by understanding material balances and stichometry	3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	1	2	1	2	3
CO2	understand the basics of metabolic flux and control analysis	3	2	3	3	-	2	3	-	-	-	-	3	3	2	1	1	2	1	3	3
CO3	perform Theoretical analysis of metabolic networks and experimental validation	2	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3	2	2	2	3
Overall CO		3	3	3	3	3	3	2	2	1	-	-	3	2	2	1	2	2	1	2	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5016 **MOLECULAR MODELING** **L T P C**
2 1 0 3

OBJECTIVES

The course aims to

- Understand the molecular behaviour of proteins, nucleic acids and small molecules in the biological system.
- Explain the principles involved in molecular modelling.

UNIT I INTRODUCTION TO CLASSICAL MECHANICS 9

Newtons laws of motion – time intervals- algorithms

UNIT II INTRODUCTION TO STATISTICAL MECHANICS 9

Boltzman's Equation – Ensembles – Distribution law for non interacting molecules – Statistical mechanics of fluids.

UNIT III QUANTUM MECHANICS 9

Photoelectric effect – De Broglies hypothesis – Uncertainity principle – Schrodingers time independent equation – particle in a one -dimensional box.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV GROMOS , GROMACS, AMBER & DOCK 9

Various forcefields for proteins and nucleic acids – Molecular mechanics – Molecular dynamics– Molecular dynamics simulations in water and organic solvents.

UNIT V GAUSSIAN 9

Preparing input files – job types – model chemistries – basis sets – molecule specifications running Gaussian – examples.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the behaviour of Small and macro molecules in biological system.

CO2 simulate the biomolecules using molecular modelling softwares.

CO3 assess and utilize various softwares and tools which utilizes quantum and molecular mechanics principles.

TEXTBOOKS:

1. Leach, Andrew R. " Molecular Modelling : Principles and Applications" IInd Edition, Pearson, 2010.
2. Cohen, N.C. " Guide Book on Molecular Modeling in Drug Design" Academic Press/ Elsevier, 1996.

REFERENCES:

1. Statistical Mechanics ; D. McQuarrie, Narosa, University Science Books; 1st edition 2000
2. Quantum Mechanics; D. McQuarrie, Narosa, 1999.
3. GROMOS Handbook www.gromacs.org

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand the behaviour of Small and macro molecules in biological system.	2	2	-	-	3	-	3	-	2	-	-	-	2	2	-	2	2	-	-	1
CO2	simulate the biomolecules using molecular modelling softwares.	2	2	2	-	3	-	-	-	-	-	-		2	2	-	2	-	-	-	-
CO3	assess and utilize various softwares and tools which utilizes quantum and molecular mechanics principles	2	2	3	2	3	-	-	-	-	-	-	-	2	2	-	2	-	1	-	-
Overall CO		2	2	3	2	3	-	-	-	-	-	-	-	2	2	-	2	-	1	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5017 FUNDAMENTALS OF MOLECULAR PATHOLOGY L T P C
3 0 0 3

OBJECTIVES

The course aims to

- Make the students learn about host defense against pathogens and virulence factors.
- Study about the virulence factors and life cycle in different pathogens.
- Provide basic information on molecular pathogenesis of infectious diseases

UNIT I INTRODUCTION 7

Molecular Koch's postulates, Concepts of disease, Virulence, Optimal virulence**,** Horizontal and vertical transfer of virulent gene, Virulent factors, Evolution of bacterial pathogens, Biofilms, Quorum sensing molecules, Multidrug resistance mechanisms, Plasmid-mediated resistance.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES 8

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) 15

Virulence, virulence factors, virulence- associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, **Vibrio Cholerae**: Cholera toxin, co-regulated pili, filamentous phage, survival **E.coli pathogens**: Enterotoxigenic E.coli (ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemerrohogic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative E.coli (EAEC). **Shigella**: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage **Plasmodium**:Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. **Influenza virus**: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 7

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS 8

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno& DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 obtain the knowledge on the interaction of host and the pathogens.

CO2 help the students to know evasion strategies of pathogen against host defence

CO3 help the students to understand, how to develop the preventive measures and develop the probable treatment strategies for infectious diseases.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Iglewski B.H and Clark V.L “Molecular basis of Bacterial Pathogenesis “, Academic Press, 1990.
2. Peter Williams, Julian Ketley& George Salmond, “Methods in Microbiology: Bacterial Pathogenesis, Vol. 27”, Academic Press, 1998.
3. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
4. Nester, Anderson, Roberts, Pearsall, Nester, “Microbiology: A Human Perspective”, McGraw Hill, 3rd Edition, 2001.
5. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	obtain the knowledge on the interaction of host and the pathogens.	-	3	2	2	2	-	-	-	2	-	-	2	3	2	2	3	2	3	2	1
CO2	help the students to know evasion strategies of pathogen against host defence	-	3	2	2	2	-	-	-	2	-	-	2	3	2	2	3	2	3	2	1
CO3	help the students to understand, how to develop the preventive measures and develop the probable treatment strategies for infectious diseases.	-	3	2	2	2	-	-	-	2	-	-	2	3	2	2	3	2	3	2	1
Overall CO		-	3	2	2	2	-	-	-	2	-	-	2	3	2	2	3	2	3	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

OBJECTIVES

The course aims to

- Understand the fundamentals on neuronal systems, neuronal drugs and on how the brain responds and adapts to changing environments and outline of their mechanism of action.
- Identify the fundamental relationships among neural activity, drug therapy, cognition and behaviour.

UNIT I NEUROANATOMY 9

Classification of central and peripheral nervous systems; Structure and function of neurons; types of neurons; cranial nerves, spinal nerves, glial cells; myelination; Brief anatomy of Brain and Spinal cord Blood Brain barrier; Meninges and Cerebrospinal fluid; Spinal Cord.

UNIT II NEUROPHYSIOLOGY 8

Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons, classification of neurotransmitters; neuropeptides; adrenergic and cholinergic transmission; hormones and their effect on neuronal function.

UNIT III NEUROPHARMACOLOGY 12

Overview of drug mechanism of action and classification – parasympathetic and sympathetic drugs, neuroleptics, thymoleptics, analeptics, drugs used in Alzheimer's and Parkinson disease, drug addiction

UNIT IV APPLIED NEUROBIOLOGY 7

Basic neurologic mechanism of sense organs; research models for study and investigation in neurosciences and neuropharmacologic drug development

UNIT V BEHAVIOUR AND COGNITIVE SCIENCE 9

Basic mechanisms associated with motivation; behavioural studies – interpersonal interaction models, Transactional Analysis, neurology of memory; disorders associated with the nervous system.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 gain knowledge about the principles and implications of neuroscience

CO2 learn to apply this knowledge and explore the possibility of neuroengineering applications.

CO3 analyze various facts about brain function and experimental approaches, theories, and models to integrate neuroscience information cross their biotech discipline

TEXT BOOKS:

1. Ross and Wilson Anatomy and Physiology in Health and Illness:, 11th edition, Anne Waugh 2010
2. Principles of Neural Science, Fifth Edition by Eric R. Kandel (Editor), James H. Schwartz (Editor), Thomas M. Jessell (Editor), Steven A. Siegelbaum (Editor), A. J. Hudspeth 2012
3. Neuroscience by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel LaMantia, Leonard E. White 6 edition (October 12, 2017)
4. Lippincott Illustrated Reviews: Pharmacology 6th edition, Karen Whalen 2014

REFERENCES:

1. Neuroscience: Exploring the Brain 4th Edition, by Mark F. Bear, Barry W. Connors, Michael A. Paradiso Wolters Kluwer Health; 4 edition 2015
2. Mathews G.G. Neurobiology:molecules, cells and systems/Gary G. Mathews 2nd edition, Blackwell Science, UK, 2000.
3. The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science, Norman Doidge Penguin USA 2007

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	gain knowledge about the principles and implications of neuroscience	2	-	-	2	2	-	-	-	-	-	-	2	1	2	-	-	-	-	-	1
CO2	learn to apply this knowledge and explore the possibility of neuroengineering applications	2	2	-	-	-	-	-	-	-	-	-	3	1	2	-	-	-	-	2	2
CO3	analyze various facts about brain function and experimental approaches,	2	-	-	3	2	-	-	-	-	-	-	3	3	2	-	-	-	-	-	2
Overall CO		2	2	-	2	2	-	-	-	-	-	-	3	1	2	-	-	-	-	2	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

MA5352 NUMERICAL AND STATISTICAL METHODS L T P C

3 0 0 3

OBJECTIVES

The course aims to

- train the students to address the mathematical problems involved in biological sciences
- understand various sampling, quantitative and statistical problems pertaining to biotechnology.

UNIT I ROOT FINDING METHOD, SYSTEM OF LINEAR EQUATIONS AND INTERPOLATION 9

Root finding – Newton Raphson method – Simultaneous linear equations – Direct method – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods – Jacobi and Gauss Seidal methods – Difference table – Newton's forward and backward interpolation – Newton's divided differences – Lagrangian interpolation.

UNIT II NUMERICAL INTEGRATION AND INITIAL VALUE PROBLEM FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Trapezoidal and Simpson's 1/3 rules – Taylor series and Euler methods – Fourth order Runge- Kutta method for first order differential equations – Predictor-corrector method – Adam-Bashforth method

UNIT III EMPIRICAL STATISTICS 9

Types of sampling – Description of discrete and continuous data – Measures of Central tendency and dispersion for grouped and ungrouped data – Measures of position – Box and Whisker plot.

UNIT IV ESTIMATION THEORY 9

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation – Curve fitting by Principle of least squares – Regression Lines.

UNIT V TESTING OF HYPOTHESIS 9

Sampling distributions – Type I and Type II errors – Tests based on Normal, t, *chi*χ^2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand basic knowledge in underpinning experimental predictions in modern biological science
CO2 explore complex biological systems mathematical models are used algebraically
CO3 understand the different statistical methods which can be used for comparing experimental results with the hypothesis

TEXT BOOKS:

1. Grewal, B.S., "Numerical methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, 2014.
2. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", Sultan Chand & Sons, Eleventh Edition (Reprint), 2019.
3. Iyengar, S. R. K., Jain, R. K. and Mahinder Kumar Jain, "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International Publishers, New Delhi, 2012.
4. Miller, I. and Miller, M., "John E. Freund's Mathematical Statistics", Pearson, Eighth Edition, 2013.

REFERENCES:

1. Mann, P.S., "Introductory Statistics", John Wiley and Sons. Inc 5th Edition, 2004.
2. Miller, I. and Freund, J. E., "Probability and Statistics for Engineers", Pearson, Ninth Edition, 2017.
3. Montgomery, D.C. and Runger, G.C., "Applied Statistics and Probability for Engineers", Wiley Student Edition, 2007.
4. Walpole, R.E., Myers R.H., Myres S.L., and Ye, K., "Probability ad Statistics for Engineers and Scientists", Pearson Education, Asia, 8thEdiiton, 2007.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	The basic knowledge in underpinning experimental predictions in modern biological science	1	2	2	1	2	1	1	-	2	-	1	2	1	2	1	2	1	1	-	1
CO2	To explore complex biological systems mathematical models are used algebraically	1	2	1	2	1	2	1	-	2	-	1	1	1	2	1	2	2	-	1	1
CO3	Statistical methods can be used for comparing experimental results with the hypothesis	1	2	1	2	2	1	2	1	2	1	1	1	2	1	2	1	1	1	-	-
Overall CO		1	2	1	2	2	1	1	-	2	-	1	1	1	2	1	2	1	1	-	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5019	PLANT BIOTECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- provide an understanding of the different physiological and developmental processes in plants
- provide knowledge on plant tissue culture methods
- provide knowledge on different biotechnology tools that help to study as well as modify plants suited to industrial exploitation

UNIT I PLANT PHYSIOLOGY AND BASIC ORGANIZATION OF GENETIC MATERIAL 9

Photosynthesis, respiration, phyto-hormones, photoperiodism and flowering, plant signaling and behavior [plant communication] Nuclear, chloroplast and mitochondrial genome. Gene structure and regulation of gene expression.

UNIT II PLANT TISSUE CULTURE 9

Introduction to cell and tissue culture , media, aseptic techniques, initiation and maintenance of callus and suspension cultures protoplast isolation and fusion, section and regeneration of hybrid plants(somatic embryogenesis and organogenesis), Embryo culture, Anther, pollen and ovary culture for production of haploid plants. Cryopreservation, slow growth for germplasm conservation and encapsidation. Applications of tissue culture

UNIT III PLANT TRANSFORMATION 9

Direct (particle bombardment, PEG mediated transformation, electroporation, silicon carbide fibre) and indirect gene transformation (Agrobacterium and viral mediated transformation,), Vectors , Promoters ,Markers and reporters used for plant transformation. Chloroplast transformation -

UNIT IV APPLICATIONS OF TRANSGENIC PLANT TECHNOLOGY 9

Production of genetically modified plants for herbicide resistant (phosphoinothricin, glyphosate) insect resistance (Bt genes) biotic and abiotic stress tolerance and improvement of quality traits[Golden Rice, Fortified rice], technology protection system [Terminator gene technology),), viral resistant (coat protein or replicase or movement protein mediated) . Biopharming-Therapeutic proteins in transgenic plants

UNIT V MARKER ASSISTED BREEDING AND BIOSAFETY 9

Phenotypic, enzyme and molecular markers (single locus and multi-locus markers), co-dominant and dominant markers. Global status and bio-safety concerns for production and release of transgenic plants.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand about the physiology and metabolism in plants

CO2 acquire knowledge on plant tissue culture methods

CO3 use different biotechnology tools to study as well as modify plants suited to industrial exploitation

TEXT BOOKS:

1. Adrian Slater, N W Scott, M Fowler, Plant Biotechnology: The Genetic Manipulation ofPlants, second Edition 2014, Oxford University Press.
2. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
3. H.S. Chawla. 2015. Plant biotechnology: A practical approach. Oxford and IBH PublishingCo. Pvt. Ltd., India.
4.Bhojwani, Sant Saran, Dantu, Prem Kumar, Plant Tissue Culture: An Introductory Text 2013; Springer India;

REFERENCES:

1. M.K. Razdan. 2014. Introduction to Plant Tissue Culture. 2nd Edition, Oxford and IBHPublishing Company, India
2. Wang, Aiming and Ma, Shengwu. 2014. Molecular Farming in Plants: Recent Advances andFuture Prospects. Springer, New York, USA.
3. Edwin F. George, Michael A. Hall and Geert-Jan De Klerk 2014. Plant propagation by tissueculture. 3rd Edition. Springer, The Netherlands.
4. Hammond PM and Yusibov V. Plant Biotechnology New Products and Applications.Springer International Edition. 1999
5. Roberta Smith. 2013. Plant tissue culture: Techniques and experiments. Third edition.Academic Press, Elsevier Inc., USA.
6. Gerard J. Tortora, Sandra. R. Grabowski, Principles of Anatomy and Physiology, TenthEdition, 2002, Wiley Publishers.

Course Articulation Matrix

	Statement	Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand about the physiology and metabolism in plants	2	-	-	1	-	-	-	-	1	-	-	2	-	-	-	-	-	-	2	-
CO2	acquire knowledge on plant tissue culture methods	2	-	-	2	1	-	2	1	1	1	-	3	1	2	-	3	1	1	2	-
CO3	use different biotechnology tools to study as well as modify plants suited to industrial exploitation	2	2	1	2	2	2	1	-	1	1	-	2	1	2	2	2	1	2	1	1
Overall CO		2	2	1	2	1	1	1	1	1	1	-	2	1	2	2	2	1	1	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB 5020	PRINCIPLES OF FOOD PROCESSING	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- learn about the various food constituents and its additives.
- learn about various microbes associated with food
- learn about different food processing and preservation techniques.

UNIT I FOOD AND ENERGY 9

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.

UNIT II FOOD ADDITIVES 9

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III MICROORGANISMS ASSOCIATED WITH FOOD 9

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV FOOD BORNE DISEASES 9

Classification – food infections – bacterial and other types; food intoxications and poisonings– bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V FOOD PRESERVATION 9

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 learn different constituents present in food and microorganism involved in processing of food.

CO2 learn principles and different preservations techniques of food can also be known.

CO3 learn techniques involved in modern food processing and impact of the process on food quality

REFERENCES:

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.
3. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co., New York 1988.
4. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	learn constituents present in food and microorganism involved in processing of food.	3	3	2	2	1	1	-	1	3	-	1	2	1	2	-	2	2	2	3	2
CO2	learn principles and different preservations techniques of food can also be known.	2	3	2	2	1	2	-	2	3	-	1	2	2	2	-	1	2	2	3	2
CO3	learn techniques involved in modern food processing and impact of the process on food quality	2	3	2	2	1	2	-	3	3	-	1	2	2	2	-	1	2	2	3	3
Overall CO		2	2	2	2	1	1	-	2	3	-	1	2	2	2	-	1	2	2	3	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5021 PROCESS EQUIPMENTS AND PLANT DESIGN L T P C
3 0 0 3

OBJECTIVES

The course aims to

- explain about the designing aspects of various equipments used in biotech industry.
- discuss about the process involved in the construction of an Industrial Plant.

UNIT I HEAT EXCHANGERS, CONDENSERS, EVAPORATORS 12

Single and multi process exchangers, double pipe, U tube heat exchangers, combustion details supporting structure. Single and vertical tube evaporation, Single and multi effect evaporators, forced circulation evaporators.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II STORAGE VESSEL FOR VOLATILE AND NON VOLATILE FLUIDS PRESSURE VESSEL STRUCTURE 6

Design of the following equipments as per ASME, ISI codes, drawing according to scale; monoblock and multiplayer vessels, combustion details and supporting structure.

UNIT III EXTRACTOR, DISTILLATION AND ABSORPTION TOWER 10

Construction details and assembly drawing; Plate and Packed Extraction Towers; Plate and Packed absorption Towers; Plate and Packed Distillation Towers.

UNIT IV PUMPS, MECHANICAL SEALS, VALVES AND SWITCHES 8

Various types of pumps, Principle of working, construction, usages, advantages and disadvantages; Various types of seals, effectiveness, usages; Pneumatic Seals; Gate, Globe and Butterfly Valves, their material of construction; Pneumatically Controlled Valves.

UNIT V PIPING, PLANT LAY OUT AND DESIGN 9

Various types of Piping, material of construction, their usage; Pipe lay out; Modern Plant Design and case Studies.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 design the heat exchangers and evaporators.

CO2 design the pressure and storage vessels.

CO3 design the distillation column, absorption column, and extractors.

CO4 understand the usage of different pumps, mechanical seals, valves and switches.

CO5 design layout of industrial plants

REFERENCES:

1. Brownell, L.E. and Young, E.H., “Process Equipment Design”, Wiley Eastern India Limited 2009.
2. Kern, D.Q., ‘Process Heat Transfer’, McGraw-Hill, 1999.
3. McCabe, W.L., J.C. Smith and P. Harriott “Unit Operations of Chemical Engineering”, VIth Edition, McGraw-Hill, 2001.
4. Ray Sinnott & Gavin Towler “Chemical engineering design” V edition, Butterworth-Heinemann, 2015.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	design the heat exchangers and evaporators.	3	3	3	-	-	3	1	1	3	1	2	2	3	3	1	-	-	-	2	1
CO2	design the pressure and storage vessels.	3	3	3	-	-	3	1	1	3	1	2	2	3	3	1	-	-	-	2	1
CO3	design the distillation column, absorption column, and extractors.	3	3	3	-	-	3	1	1	3	1	2	2	3	3	1	-	-	-	2	1
CO4	understand the usage of different pumps, mechanical seals, valves and switches.	3	1	1	-	-	3	1	1	3	1	2	2	1	1	1	-	-	-	2	1
CO5	design layout of industrial plants	3	3	3	-	-	3	1	1	3	1	2	2	3	3	1	-	-	-	2	1
Overall CO		3	3	3	-	-	3	1	1	3	1	2	2	3	3	1	-	-	-	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5022	SYMBOLIC MATHEMATICS	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- familiarize the students with MATLAB environment, Programming techniques in MATLAB
- learn about Data File handling and Plotting Functions in MATLAB and LABVIEW environment

UNIT I INTRODUCTION TO MATLAB 9

Introduction - Operations with variables – Arrays - Multidimensional Arrays - Element by Element operations - Polynomial operations using arrays - Cell Arrays - Structure arrays - Writing script files - Logical variables and operators- Flow control- Loop operators- Writing functions- Input/ output arguments- Function visibility, path.- Simple graphics- 2D plots- Figures and subplots

UNIT II DATA AND DATA FLOW IN MATLAB 9

Data types- Matrix, string -cell and structure- Creating, accessing elements and manipulating of data of different types - File Input-Output- Matlab files- Text files- Binary files - Mixed text- binary files- Communication with external devices- Serial port- Parallel port- Sound card-Video input

UNIT III FUNCTIONS & FILES 9

Elementary Mathematical Functions - User Defined Functions - Advanced Function Programming - Working with Data Files, Introduction to Numerical Methods -Linear algebra- numerical integration and differentiation- solving systems of ODE's and interpolation of data.

UNIT IV PROGRAMMING TECHNIQUES & DATA VISUALIZATION AND STATISTICS 9

Program Design and Development - Relational Operators and Logical Variables Logical Operators and Functions - Conditional Statements -Loops - Basic statistical tools in Matlab,XY-plotting functions - Subplots and Overlay plots - Special Plot types - Interactive plotting - Designing GUI interfaces using Matlab's GUIDE interface.

UNIT V FUNDAMENTALS OF VIRTUAL INSTRUMENTATION & DATA ACQUISITION 9

Concept of virtual instrumentation (VI)– LabVIEW software- basics- Creating, Editing and debugging a VI in LabVIEW- Creating a sub VI- Loops and charts- data acquisition with LabVIEW- plug-in DAQ boards- Organization of the DAQ VI System- Performing analog input and analog output- Scanning multiple analog channels- Driving the digital I/Os- Buffered data acquisition

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 Carry out simple computations and analyses using MATLAB
CO2 Write simple programs in MATLAB to solve scientific and mathematical problems
CO3 Use LABVIEW for Data Acquisition.

TEXT BOOKS:

1. Essential Matlab for Engineers and Scientists (Fourth Edition). Elsevier Ltd. Author(s): Brian H. Hahn and Daniel T. Valentine,4th edition 2010.
2. Rahman, and Herbert Pichlik,, 'LabVIEW – Applications and Solutions', National Instruments Release,. National Instruments LabVIEW Manual ,1998

ONLINE MATLAB TUTORIALS AND REFERENCES

1. Tutorials offered by The Mathworks .The creators of Matlab.
2. Introductory Matlab material from Indiana University
3. A practical introduction to Matlab from Michigan Tec
4. Links to Matlab tutorials, references, books, packages, etc. - The Math Department at UIC

MATLAB guides Provided with the Matlab installation

1. Getting Started with Matlab
2. Using Matlab
3. Using Graphs in Matlab
4. Using GUIs in Matlab

For links to these documents visit Dr. Randy Jost's web page (USU ECE Department). For other links related to Matlab,

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	Carry out simple computations and analyses using MATLAB	3	3	1	2	1	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-
CO2	Write simple programs in MATLAB to solve scientific and mathematical problems	3	3	1	2	1	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-
CO3	Use LABVIEW for Data Acquisition.	3	3	1	2	1	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-
	Overall CO	3	3	1	3	1	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5023 **SYSTEMS BIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to

- Familiarize the students with the concepts of system biology.
- Make them aware of the kinetic modelling and flux balance analysis.
- Make them familiarize tools and databases for modelling.

UNIT I INTRODUCTION **9**

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modeling : Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state. Merits of computational modeling.

UNIT II KINETIC MODELLING **9**

Kinetic modeling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modeling.

UNIT III FLUX BALANCE ANALYSIS **9**

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.

UNIT IV NETWORK MOTIFS **9**

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT V TOOLS AND DATABASES FOR MODELING **9**

Tools and databases for modeling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of this course students will be able to

CO1 understand System Biology Concepts
CO2 develop simple kinetic and flux balance models
CO3 learn basics of SBML

TEXT BOOKS:

1. Edda Klipp, Wolfram Liebermeister, Christoph Wierling ,Systems Biology a Textbook by Wiley-BlackWell Publications (2009 Edition).
2. Uri Alon , An introduction to Systems Biology: Design Principles of Biological Circuits, (Chapman and Hall / CRC 2007 Edition)
3. Edda Klipp, Ralf Herwig, Axel kowald, Christoph Wierling, Hans Lehrach ,Systems Biology in practice : concepts, implementation and application. (Wiley – VCH 2005)

REFERENCES:

1. Foundations of Systems Biology Edited by Hiroaki Kitano (MIT Press) 2001
2. Systems Biology: Definitions and perspectives by Lilia Albhergina (Springer Publications 2008)
3. GROMACS .. www.gromacs.org
4. AUTODOCK autodock.scripps.edu
5. NEXT generation sequencing https:// usegalaxy.org

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	understand System Biology Concepts	3	3	2	2	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-
CO2	develop simple kinetic and flux balance models	3	3	2	2	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-
CO3	learn basics of SBML	3	3	2	2	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-
	Overall CO	3	3	2	2	3	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

IB5024	TISSUE ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- learn principles of tissue engineering and tissue repair.
- learn the major components of tissue engineered scaffolds, including polymeric constructs and cellular populations.
- understand design considerations for tissue engineering focusing on the stem cells,biomaterials and its applications
- appreciate regulatory, ethical , and commercial considerations for tissue engineering
- understand mechanisms by which tissue engineered scaffolds can modify disease processes.
- appreciate the application of tissue engineering to worldwide diseases.

UNIT I INTRODUCTION 9

Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics ,appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE 9

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix& Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering. Cells micro-mechanisms for regeneration and repair

UNIT III BIOMATERIALS 9

Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology. 3DPrinting, controlled bioactive factor release mechanisms.

UNIT IV BASIC BIOLOGY OF STEM CELLS 9

Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, Stem Cell markers, FACS analysis, Types & sources of stem cell with characteristics: embryonic, adult, haematopoetic, Mesenchymal stem cells, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells, Induced pluripotent stem cells.

UNIT V CLINICAL APPLICATIONS 9

Stem cell therapy, Molecular therapy,Stem cell therapy for Neurodegenrative diseases, spinalcord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, Orthopedicapplications, Stem cells and Gene therapy Tissue engineering for skin transplantion, cartilage, bone,Neural tissue engineering, Tissue engineered product characterization, safety, efficacy. Cryobiology, Vitrification technology, Preservation –freezing and drying. Patent protection and regulation of of tissue-engineered products, ethical issues.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn principles of tissue engineering and tissue repair.

CO2 learn the major components of tissue engineered scaffolds, including polymeric constructs and cellular populations.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO3 understand design considerations for tissue engineering focusing on the stemcells, biomaterials and its applications.
CO4 appreciate regulatory, ethical and commercial considerations for tissue engineering.
CO5 understand mechanisms by which tissue engineered scaffolds can modify disease processes and its applications to diseases worldwide

TEXT BOOKS:

1. Clemens Van Blitterswijk ,Tissue Engineeering.Elseiver,2nd edition,2014.
2. Bernhard O.Palsson, SangeetaN.Bhatia, "Tissue Engineering" Pearson Publishers 2009.
3. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.
4. The molecular and cellular biology of wound repair. Clark, Plenum Press.1988
5. Biomaterials Science. Ratner, Hoffman, Schoen, Academic Press.3rd edition 2012
6. Cell and Molecular Biology, Gerald Karp, John Wiley & Sons, Inc.2015

REFERENCES:

1. Bernard N. Kennedy (editor). Stem cell transplantation, tissue engineering, and cancerapplications, Nova Science Publishers, 2008.
2. Raphael Gorodetsky, Richard Schäfer..Stem cell-based tissue repair. RSC Publishing,2011.
3. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult &Fetal Stem Cells,Academic Press, 2004.
4. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, Elsevier Academicpress,2006.
5. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches InTissueEngineering&Regenrative Medicine" Artech House, INC Publications, 2008.
6. Naggy N. Habib, M.Y. Levicar, , L. G. Jiao,.and N. Fisk, Stem Cell Repair and Regeneration, volume-2, Imperial College Press,2007.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	learn principles of tissue engineering and tissue repair	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3	1	-	1	2
CO 2	learn the major components of tissue engineered scaffolds, including polymeric constructs and cellular populations	2	3	2	3	2	-	-	1	1	-	-	3	2	2	2	3	2	-	2	3
CO 3	understand design considerations for tissue engineering focusing on the stemcells,biomaterials and its applications.	2	3	2	3	2	1	-	3	1	-	-	3	2	2	2	3	3	-	3	3
CO 4	appreciate regulatory, ethical , and commercial considerations for tissue engineering	2	3	2	3	2	-	-	3	1	-	-	3	2	2	2	3	2	-	3	3
CO 5	understand mechanisms by which tissue engineered scaffolds can modify disease processes and its applications to diseases worldwide	2	3	2	3	2	-	-	2	1	-	-	3	2	2	2	3	3	-	3	3
Overall CO		2	3	2	3	2	-	-	3	1	-	-	3	2	2	2	3	3	-	3	3

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

CH5751	TRANSPORT PHENOMENA	L T P C
		2 1 0 3

OBJECTIVES

The course aims to

- introduce the concept of simultaneous mass, momentum and energy transport
- develop velocity, temperature and concentration profiles for various systems involving turbulent flow

UNIT I MOMENTUM TRANSPORT 7

Viscosity, temperature effect on viscosity of gases and liquids, Newton's law, mechanism of momentum transport, shell balance method, pressure and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW 8

Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT 10

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow, with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV EQUATIONS OF CHANGE FOR NON ISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS 10

Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS 10

Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow : stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes
CO2 learn the mechanism of fluids in motion under different conditions
CO3 study the non isothermal system and temperature distribution in turbulent flows

TEXT BOOKS:

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. N., "Transport Phenomena", II edition, John Wiley, 2006
2. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1987.
3. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena: A unified approach", Volume I & II Brodkey publishing, 2003.

REFERENCES:

1. Welty, J. R., Wilson, R. E., Wicks, C. E., and Rorer,G. L., “Fundamentals of Momentum, Heat and Mass Transfer ”, V edition, John Wiley & sons Inc., 2010.
2. Slattery , J. S., “Advanced Transport Phenomena”, Cambridge University Press, London, 1999.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO 1	understand the fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes.	3	2	3	2	-	1	-	-	-	-	1	-	3	2	-	-	-	1	-	-
CO 2	learn the mechanism of fluids in motion under different conditions	2	3	2	1	-	2	-	-	-	-	2	-	2	3	-	-	-	2	-	-
CO 3	study the non isothermal system and temperature distribution in turbulent flows	3	2	1	2	-	1	-	-	-	-	1	-	1	2	-	-	-	1	-	-
Overall CO		3	2	2	2	-	1	-	-	-	-	1	-	2	3	-	-	-	1	-	-

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5073	CHEMICAL REACTION ENGINEERING	L T P C
		2 1 0 3

OBJECTIVES

The course aims to

- To provide the basics of reaction types, variable affecting the reaction rate and evaluation of rate equations for different types of reactions.
- To provide the information about different reactor systems and deriving the performance equations of various reaction system.

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 8

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II IDEAL REACTORS 10

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III IDEAL FLOW AND NON IDEAL FLOW 10

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS 8

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 write the rate equation for any type of reaction.

CO2 design reactors for heterogeneous reactions and optimize operating conditions.

CO3 relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

TEXT BOOKS:

1.Levenspiel O. “Chemical Reaction Engineering”, III Edition, John Wiley, 1999.

2.Fogler H.S. “Elements Of Chemical Reaction Engineering”,IV edition, Pearson Education India, 2015

REFERENCES:

1. Missen R.W., Mims C.A., and Saville B.A. “Introduction to Chemical Reaction Engineering and Kinetics”, John Wiley & sons, 1999.

2. Dawande, S.D., “Principles of Reaction Engineering”, I edition, Central Techno Publications, 2001.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	write the rate equation for any type of reaction	2	1	2	2	1	2	2	3	2	1	2	2	2	2	2	2	1	2	2	1
CO2	design reactors for heterogeneous reactions and optimize operating conditions	1	2	2	2	2	2	2	2	3	2	2	1	2	2	2	2	2	1	1	2
CO3	relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Overall CO		1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IB5025	PROTEIN STRUCTURE AND FUNCTION	L T P C
		3 0 0 3

OBJECTIVES

The course aims to

- To provide fundamental knowledge on the existence of various structures of proteins and how these structures relate to their functions.
- They would also understand the building blocks and other factors contributing to the structures.
- Additionally, they will also learn about the methods for characterization of proteins

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 10

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE 10

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn- beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites.

UNIT III TERTIARY STRUCTURE 5

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 10

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans- membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications.

UNIT V PROTEOMICS 10

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.

Computer exercise on the above aspects

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 the existence of various levels of protein structure

CO2 the building blocks of proteins and other factors contributing to protein structures

CO3 how these protein structures relate to protein functions

CO4 the methods of characterization of proteins

TEXT BOOKS:

1. Branden C. and Tooze J., “Introduction to Protein Structured” 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. “Proteins” 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, “Proteomics : Protein Sequence to Function”. Viva Books, 2002
4. Liebler, “Introduction to Proteomics” Humana Press, 2002.

REFERENCES :

1. Voet D. and Voet G., “Biochemistry”. 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M.“Protein Structure : Protein Science and Engineering”.Nova Science Publications, 2011.
3. Williamson, Mike “How Proteins Work”. Garland Science, 2012.

Course Articulation Matrix

Course Outcomes Statement		Programme Outcome (PO)												Programme Specific Outcomes (PSO)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	the existence of various levels of protein structures	-	-	-	-	-	-	1	-	-	1	-	3	1	-	-	-	-	-	2	-
CO2	the building blocks of proteins and other factors contributing to protein structures	-	1	-	1	1	-	1	-	-	1	-	3	1	-	2	-	-	1	2	1
CO3	protein structures relate to protein functions	2	-	2	3	2	2	2	1	2	1	2	2	3	2	-	3	2	1	1	3
CO4	the methods of characterization of proteins	2	-	-	3	3	3	2	2	2	1	2	2	2	3	-	3	3	2	2	2
Overall CO		2	1	2	3	2	2	2	1	2	1	2	2	2	2	1	3	2	1	2	1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AUDIT COURSES (AC)

AD5091 **CONSTITUTION OF INDIA** **L T P C**
3 0 0 0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I INTRODUCTION **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

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

UNIT III ORGANS OF GOVERNANCE **9**

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

UNIT IV EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

TEXTBOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AD5092 **VALUE EDUCATION** **L T P C**
3 0 0 0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION 9

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

UNIT II IMPORTANCE OF VALUES 9

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

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour 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.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓	✓			✓
CO3							✓	✓	✓			✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 **PEDAGOGY STUDIES** **L T P C**
3 0 0 0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY: 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

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.

UNIT IV PROFESSIONAL DEVELOPMENT 9

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

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												✓
CO2												✓
CO3												✓
CO4												✓
CO5												✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AD5094 **STRESS MANAGEMENT BY YOGA**

L T P C
3 0 0 0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog.(Ashtanga)

UNIT II YAM **9**

Do`s and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM **9**

Do`s and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓				✓
CO3							✓	✓				✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS L T P C
3 0 0 0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities

CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AD5097 **ESSENCE OF INDIAN KNOWLEDGE TRADITION** **L T P C**
3 0 0 0

COURSE OBJECTIVES

The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I INTRODUCTION TO CULTURE **9**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE **9**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY **9**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) **9**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA **9**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45PERIODS

COURSE OUTCOMES

After successful completion of the course the students will be able to

- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AD5098 **SANGA TAMIL LITERATURE APPRECIATION** **L T P C**

3 0 0 0

Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
3. ‘Attruppadai’ in SangaTamil Literature.
4. ‘Puranaanuru’ in SangaTamil Literature.
5. ‘Pathitrupaththu’ in SangaTamil Literature.

UNIT I SANGA TAMIL LITERATUREANINTRODUCTION **9**

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s Grammar- Tamil Sangam Literature’s parables.

UNIT II ‘AGATHINAI’AND‘PURATHINAI’ **9**

Tholkappiyar’s Meaningful Verses–Three literature materials–Agathinai’s message- History of Culturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.

UNIT III ‘ATTRUPPADAI’. **9**

AttruppadaiLiterature–Attruppadaiin‘Puranaanuru’-Attruppadaiin‘Pathitrupaththu’-Attruppadai in ‘Paththupaattu’.

UNIT IV ‘PURANAANURU’ **9**

Puranaanuru onGood Administration,Rulerand Subjects–Emotion&itsEffectin Puranaanuru.

UNIT V ‘PATHITRUPATHTHU’ **9**

Pathitrupaththuin‘Ettuthogai’–Pathitrupaththu’sParables–Tamildynasty:Valor,Administration, Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES: Upon completionofthiscourse, the studentswillbeable to:

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.

2. Differentiate‘Agathinai’ and‘Purathinai’in their personal andsocietallife.
3. Appreciate and apply the messages in‘ Attruppadai’ in their personal and societalife.
4. Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societallife.
5. Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societallife.

REFERENCES:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1									0.9						0.6
2									0.9						0.6
3									0.9						0.6
4									0.9						0.6
5									0.9						0.6

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171 LANGUAGE AND COMMUNICATION LT P C

3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives

- ✓ To familiarize students with the concept of communication using linguistic and non linguistic resources.
- ✓ To help students ask critical questions regarding facts and opinions.
- ✓ To provide students with the material to discuss issues such as language and power structures.
- ✓ To help students think critically about false propaganda and fake news.

Learning Outcomes

- ➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- ➢ Students will be able to analyse communication in terms of facts and opinions.
- ➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

a) Writing and Speech

b) Distinction between language structure and language use, form and function, acceptability and grammaticality

c) Gestures and Body language, pictures and symbols, cultural appropriacy

d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II STRUCTURE OF WRITING/CONVERSATION: 9

a) Language skills and the communication cycle; speaking and listening, writing and reading

b) Initiating and closing conversations, intervention, turn taking

c) Writing for target reader, rhetorical devices and strategies

d) Coherence and Cohesion in speech and writing

UNIT III POWER STRUCTURE AND LANGUAGE USE: 9

a) Gender and language use

b) Politeness expressions and their use

c) Ethical dimensions of language use

d) Language rights as part of human rights

UNIT IV MEDIA COMMUNICATION: 9

a) Print media, electronic media, social media

b) Power of media

c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9

a) Fundamentals of persuasive communication

b) Persuasive strategies

c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

HU5172 VALUES AND ETHICS L T P C

3 0 0 3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE 9

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES 9

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand definition and classification of values.

CO2: Able to understand purusartha.

CO3: Able to understand sarvodaya idea.

CO4: Able to understand sustenance of life.

CO5: Able to understand views of hierarchy of values.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓	✓			✓
CO2								✓	✓			✓
CO3								✓	✓			✓
CO4								✓	✓			✓
CO5								✓	✓			✓

TEXTBOOKS:

1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

HU5173 HUMAN RELATIONS AT WORK L T P C

3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.

- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1: Understand the importance of self-management.

CO2: Know how to deal with people to develop teamwork.

CO3: Know the importance of staying healthy.

CO4: Know how to manage stress and personal problems.

CO5: Develop the personal qualities essential for career growth.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓		✓	✓			✓
CO2									✓	✓		✓
CO3						✓		✓	✓			✓
CO4								✓				✓
CO5								✓	✓	✓		✓

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

HU5174 PSYCHOLOGICAL PROCESSES L T P C
3 0 0 3

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitve and Perceptual – Industrial and Organizational.

UNIT 2: SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

Attested

UNIT 3: COGNITION & AFFECT

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

UNIT 5: PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References

1. Morgan, C.T.and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W.Passer, Ronald E.smith (2007), Psychology: The science of mind and Behavior,3rd Edition Tata McGraw-Hill Edition.
4. Robert S.Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence. personality. psychopathology. and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality and intelligence (pp. 249-284). New York: Plenum Press.
6. Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg. & P. Ruzgis (Eds.). Personality and intelligence (pp. 188-21 7). New York: Cambridge University Press.

- De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

HU5175 EDUCATION, TECHNOLOGY AND SOCIETY L T P C

3 0 0 3

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES

Learning Theories – Behaviorism – Cognitivism – Social Constuctivism – Humanism Learning Styles – Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

UNIT III TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

Attested

INTERNAL (100 % WEIGHTAGE)

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

(a) Written Test (40 marks)

(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)

(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)

(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)

(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

HU5176 PHILOSOPHY L T P C

3 0 0 3

OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

UNIT I KNOWLEDGE 9

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

UNIT II ORIGIN 9

Origin of Universe And Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittriya Upanishad.

UNIT III WORD **9**

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

UNIT IV KNOWLEDGE AS POWER/OPPRESSION **9**

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

UNIT V SELF KNOWLEDGE/BRAHMAN **9**

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE **L T P C**
3 0 0 3

UNIT I INTRODUCTION **7**

Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS 9

Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH 11

Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING 7

Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR 11

Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall
2. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson
3. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
4. Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271	GENDER, CULTURE AND DEVELOPMENT	L T P C
		3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender-based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

Objectives

- ✓ To familiarize students with the concepts of sex and gender through literary and media texts.
- ✓ To help students ask critical questions regarding gender roles in society.
- ✓ To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- ✓ To help students think critically about gender based problems and solutions.

Learning Outcomes

- ➢ Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- ➢ Students will be able to analyse current social events in the light of gender perspectives.
- ➢ Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I: Introduction to Gender

- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

Texts:

1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations

- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

Texts:

1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)
2. Video: Witness: Freeing Women From Cleaning Human Waste (2014, HRW, Manual Scavenging, India)

UNIT III: Gender Development Issues

- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

Texts:

1. The Many Faces of Gender Inequality (Essay, Amartya Sen, Frontline, Volume 18 - Issue 22, Oct. 27 - Nov. 09, 2001)

2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

UNIT IV: Gender-based Violence

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

Texts:

1. Lights Out (Play, Manjula Padmanabhan)

2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture

- Gender and Film
- Gender, Media and Advertisement

Texts:

1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:

Discussion & Classroom Participation: 20%

Project/Assignment: 30%

End Term Exam: 50%

HU5272	**ETHICS AND HOLISTIC LIFE**	**L T P C**
		3 0 0 3

OBJECTIVES:

- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.

- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE

The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT

Intellectual, Emotional, Creative, Ethico- spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:

Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE

Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

Science, Technology, Consumerism, Relation with Nature and Environment, New dimension of Global Harmony: Democracy, Equality, Social Justice

TOTAL:45 PERIODS

OUTCOMES:

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

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

HU5273 **LAW AND ENGINEERING** **L T P C**

3 0 0 3

UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9

Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II LAWS 9

Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III BUSINESS ORGANISATIONS 9

Sole traders (Business has no separate identity from you, all business property belongs to you).

Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

UNIT IV LAW AND SOCIETY 9

Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence.

UNIT V CASE STUDIES 9

Important legal disputes and judicial litigations

TOTAL: 45 PERIODS

HU5274 **FILM APPRECIATION** **L T P C**

3 0 0 3

COURSE DESCRIPTION

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This

course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

OBJECTIVES:

- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I THE COMPONENTS OF FILMS 9

Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

UNIT II EVOLUTION OF FILM 9

History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurists, Feminist, Psychonalyic, Idealogical Theories.

UNIT III FILMS ACROSS THE WORLD 9

European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.

UNIT IV INDIAN FILMS 9

The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.

UNIT V INTERPRETING FILMS 9

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

OUTCOMES

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

- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.

Teaching Methods

- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Evaluation

- As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate

its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)

- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983
5. The Encyclopedia of Indian Cinema Edited by Ashish Rajadhyaksha and Paul Willemen, BFI, 1994.

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS L T P C

3 0 0 3

OBJECTIVES

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

CONTENTS : -

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW 9

Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive,universal-Human Language – Animal Language – Sign Language- Computers and Language.

UNIT II MORPHOLOGY - WORDS OF LANGUAGE 9

Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems – inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE 9

Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE 9

Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE 9

Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

Teaching Methods :

Lectures, discussion.

Evaluation Internal and External :

Internal: 2 written tests + assignments, seminars, project (50+15+15+20).

External: A 3 hour written exam (50 marks)

REFERENCES :

1.Victoria Fromkin, Robert Rodman, Nina Hyams.2019.An Introduction to Language.USA.CENGAGE.11th edition

2. Cook. G,2003. Applied linguistics.UK: Oxford University Press.

HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE L T P C

3 0 0 3

OBJECTIVES

- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.
- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

Unit 1 Introduction

Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

Unit 2. Reading Culture

Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel's ' The night of the Scorpion' . 'Nothing's Changed'- Tatamkhulu Afrika- Apartheid. Ruskin Bond- 'Night train at Deoli'- How real life is different from movies.

Unit 3. Identifying Meaning

Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar's 'Jagat Mithya'- the world as an illusion. The Indian version as 'meaninglesss meaning'.

Unit 4. Post Modernism

'If on a winter's night a traveler'- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

Unit 5. Returning to Pictures

Literature of the present- Emphasis on the visual world. Twitterature. SMS. Whatsapp language. Consumer culture. Change in fixed gender notions. Interactive sessions. Introspection.

Reading list

1. Bond, Ruskin: 'Night train at Deoli'
2. Ezekiel, Nissim: ' The Night of the Scorpion'
3. Afrika,Tatamkhulu: 'Nothing's Changed'
4. Barthes, Roland: *Mythologies*
5. Shankaracharya: *Viveka Chudamani*
6. Camus, Albert- *The Myth of Sisyphus*
7. Calvino, Italo: *If on a winter's night a traveler*
8. Farrell, Edmund J: 'Listen, my children, and you shall read'

Outcome

- Can identify the connections among language, literature and culture.
- Is able to relate between seemingly different aspects of life.
- Understands the fractions in modern life and can assimilate meanings.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025