DEPARTMENT OF

BIOTECHNOLOGY

PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

PMIST

PERIYAR MANIAMMAI

INSTITUTE OF SCIENCE & TECHNOLOGY

(Deemed to be University)

Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited

think • innovate • transform

Minutes of

7th Board of studies

FOR

B.Tech – BIOTECHNOLOGY

(Based on Outcome Based Education)

(III- VIII Semester)

REGULATION– 2018

Revision -1

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CONTROL COPY / PMIST

Head
Department of Biotechnology

Dean Academics
Periyar Maniammai Institute of Science & Technology
(Deemed to be University)
Periyar Nagar, Vallam,
Thanjavur - 613 403. Tamilnadu.

DEAN
Faculty of Engineering and Technology

TABLE OF CONTENTS

PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

Institute is committed to the following Vision, Mission and core values, which guide Department of Biotechnology to fulfil the mission and vision:

INSTITUTION VISION	
To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society.	
INSTITUTION MISSION	
UM1	Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge.
UM2	Providing student - centered education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work.
UM3	Involving progressive and meaningful research with concern for sustainable development.
UM4	Enabling the students to acquire the skills for global competencies.
UM5	Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics.

INSTITUTION CORE VALUES

- Student – centric vocation
- Academic excellence
- Social Justice, equity, equality, diversity, empowerment, sustainability
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs
- Learning, a life – long process
- Team work
- Entrepreneurship for men and women
- Rural development
- Basic, Societal, and applied research on Energy, Environment, and Empowerment.

DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT VISION	
To become state of art department fostering biotechnology education and research to produce technologist, scientist and entrepreneurs for the benefit of society and environment.	
DEPARTMENT MISSION	
DM1	To offer programs with state of art infrastructure, learning and impart training in biotechnology.
DM2	To develop graduates of highly skilled, with entrepreneurial, professional, ethical and socially responsibility to work in or create various biotechnology industries.
DM3	To pursue research as well as collaborate with biotechnology, food and pharmaceutical industries, academic and R&D institutions whenever necessity arises.
DM4	To contribute socio-economic developments through sustainable Bio technological intervention utilizing rural knowledge in health, food processing and agriculture practices.

Table: 1 Mapping of Institution Mission (IM) with Department Mission (DM)

	IM 1	**IM 2**	**IM 3**	**IM 4**	**IM 5**
DM 1	3	1	0	2	0
DM 2	1	3	1	3	3
DM 3	2	2	3	2	1
DM 4	0	1	2	1	2
	6	**7**	**6**	**8**	**6**

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

Based on the mission of the department, the programme educational objectives is formulated as

PEO1	To have a strong foundation in basic and applied science along with basic engineering fundamentals for their successful career in Biotechnology and related fields.
PEO2	To work at technically adequate level in formulating experiments and find solutions, to ever demanding problems in Biotechnology.
PEO3	To make them skillful professional biotechnologist who can apply principles of the subject to develop excellent research tools and capabilities through project works.
PEO4	To emphasize on interdisciplinary research emerging science and technology so that students can address important national and global needs, and work in the direction of technology transfer and their commercialization.
PEO5	To develop the qualities like creativity, leadership, teamwork, skill, and professional ethics, thus contributing towards the growth and development of society.

Table 2: Mapping of Program Educational Objectives (PEOs) with Department Mission (DM)

	DM 1	DM 2	DM3	DM 4
PEO 1	2	2	2	1
PEO 2	2	3	2	1
PEO 3	2	2	1	1
PEO 4	1	1	3	2
PEO 5	1	2	2	3
	8	**10**	**10**	**8**

1- Low 2 – Medium 3-High

The development of vision, mission and programme educational objectives is tuned in line with the global and national standards and it is assured that the department vision and mission will facilitate in meeting the vision and mission of the University.

The Program Educational Objectives shall cover both technical and professional aspects of the expected achievement in terms of technical skills required in the profession for which the program prepares students

- Achievements in terms of professional, ethical, and Communicational aspects required by the profession for which the program prepares students (team work, ethical behavior, effective communication, etc.)
- Achievements in terms of management and leadership skills (project managers, directors, CTOs, CEOs, etc.)

- Achievements in terms of life-long learning and continuous education (certifications, conferences and workshops attendance, etc.)
- Achievements in terms of advanced and graduate studies pursuing (graduate studies, research careers, etc.)
- Other aspects could be considered when defining educational objectives such as the ability to engage in entrepreneurship activities

PROGRAMME OUTCOME (PO)

At the time of graduation, competency of the student is measured through the attainment of programme outcomes. The quantification of programme outcomes attainment is measured through the assessment of established course outcomes for each subject.

PROGRAM OUTCOMES	
PO 1	The fundamental concepts of both engineering and life sciences and apply it to a wide range of interdisciplinary work.
PO 2	An ability to analyze complex engineering problems, conduct experiments in biotechnology and apply in the field by generating innovative, economical and feasible solutions.
PO 3	An experience to develop a process that meets the specific needs of societal and environmental problems to draw meaningful conclusions.
PO 4	To draw conclusion in research based methods for value addition to existing products.
PO 5	Soft-skills through classroom seminars, institutional and industry interactions, use of modern technique and ICT tools.
PO 6	An ability to apply contextual knowledge to assess the issues in public health, society and environment.
PO 7	An ability to update the modern techniques in biotechnological essential for protecting the environment and sustainable development.
PO 8	An ability to demonstrate themselves as morally responsible citizens by being aware of his/her roles, duties, professional and ethical responsibilities and rights.
PO 9	A Positive attitude and interpersonal skills to function in multidisciplinary teams and setups.
PO 10	An ability to communicate, comprehend and write effective reports.
PO 11	An enthusiasm for life-long learning and urge to contribute to technology and society by working in a need-based and problem solving projects.
PO 12	An ability to use the techniques, skills, and modern engineering tools necessary for Engineering practice
PROGRAM SPECIFIC OUTCOME	
PSO1	Knowledge and skills to become an herbal biotechnology entrepreneur for product commercialization.
PSO2	An ability to extend the research initiatives in bioenergy fields.

GRADUATE ATTRIBUTES

1. **Knowledge base for Engineering:** Demonstrate competence in mathematics, natural sciences, engineering fundamentals and specialized engineering knowledge appropriate to the programme.
2. **Analytical Skills:** Identify, formulate, analyse and solve diverse engineering problems.
3. **Design:** Solution for complicated open–ended engineering problems and design the components with appropriate standards to meet specified needs with proper attention to public health, safety, environment and society.
4. **Experimental Investigation:** Technical skills to conduct investigation, interpretation of observed data and provide solution for multifaceted problems.
5. **Modern Engineering tools usage**: Acquire, select, manipulate relevant techniques, resources and advanced engineering ICT tools to operate simple to complex engineering activities.
6. **Impact of engineering on society:** Provide a product / project for use by the public towards their health, welfare, safety and legal issues to serve the society effectively.
7. **Environment and Sustainability:** Design eco-friendly and sustainable products in demonstrating the technology development to meet present and future needs.
8. **High Ethical Standards:** Practice ethical codes and standards endorsed by professional engineers.
9. **Leadership and team work:** Perform as an individual and as a leader in diverse teams and in multi-disciplinary scenarios.
10. **Communication Skills:** Professional communication with the society to comprehend and formulate reports, documentation, effective delivery of presentation and responsible to clear instructions.
11. P**roject management and Finance:** Appropriate in incorporating finance and business practices including project, risk and change management in the practice of engineering by understanding their limitations.
12. **Life-long learners:** Update the technical needs in a challenging world in equipping themselves to maintain their competence.

Table : 3 Mapping of Program Educational Objectives (PEOs) with Program Outcomes (POs)

PO → / PEO ↓	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO 2
1	2	0	2	1	0	0	0	0	0	0	1	1	0	2
2	0	2	2	2	1	0	0	0	0	1	1	2	1	2
3	1	0	0	0	2	0	0	0	1	1	1	1	1	1
4	1	1	0	0	1	0	0	1	1	2	1	1	0	1
5	0	0	0	0	0	2	2	1	1	1	1	1	1	1
	4	3	4	3	4	2	2	2	3	5	5	6	3	7

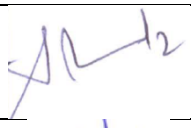
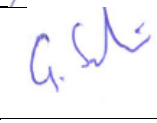
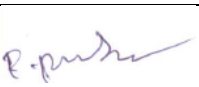
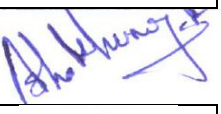
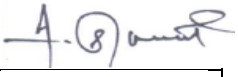
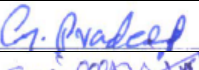
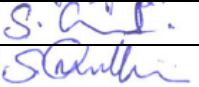
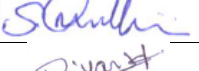
1 - Low 2 – Medium 3 - High

Table :4 Mapping of Program Outcomes (POs) & Program Specific Outcomes (PSOs)with Graduate Attributes (GAs)

GA → / PO/PSO ↓	1	2	3	4	5	6	7	8	9	10	11	12
PO1	3	1	0	1	1	1	0	1	0	0	1	2
PO2	1	3	1	1	1	0	1	0	1	0	1	3
PO3	1	1	3	1	1	0	0	0	1	0	0	2
PO4	0	0	2	3	0	0	0	0	0	0	0	1
PO5	0	0	0	1	3	0	0	0	0	2	0	3
PO6	1	0	0	0	0	3	0	1	0	1	0	3
PO7	0	0	0	0	0	0	3	1	1	0	0	1
PO8	0	0	0	0	0	1	1	3	0	0	1	1
PO 9	0	0	0	0	0	1	1	1	3	1	0	1
PO10	0	0	0	0	1	0	0	0	1	3	0	1
PO11	0	0	0	0	1	1	1	1	1	2	3	1
PO12	0	0	0	0	1	1	1	1	1	2	2	1
PSO1	0	0	0	1	1	1	1	1	1	1	1	1
PSO2	0	0	2	0	0	0	0	0	1	1	1	1

1- Slightly 2 – Supportive 3 - Highly related

MEMBERS OF THE BOARD OF STUDIES **Venue: Dean Research office**

Sl.No.	Name	Designation	Membership	
1.	Dr. S. Kumaran	Associate Professor & Head, Dept. of Biotechnology, PMIST	Chairperson	
2.	Dr. P.Suresh Kumar	Director, Protein Technology Professor & Dean, Anna University, Regional Campus, Tirunelveli	External Member (Academic Expert)	
3.	Mr. S. Sundarajan	National Head Pharma and Foods (Labmate Asia Pvt. Ltd)	External Member Representing industry	
4.	Dr. Sathyanarayana. N. Gumadi	Professor, Department of Biotechnology, IIT-M, Chennai	Special invitee from Academic	
5.	Ms. R.Prasanna Srinivasan	Research Assistant, TAN Bio (R& D) solutions, Periyar Technology Business Incubator, PMIST Campus	External Member (Alumni)	
6.	Ms.R. Umkantham	2, Jagadesan Nagar, Sugathidal road, opp kodiamman kovil, thanjavur	Parent invite	
7.	Dr.A.Ashok Kumar	Assistant Professor, Dept. of Chemical Engineering, PMIST	Member	
8.	Ms. A. V. Snehya	Assistant Professor, Dept. of Biotechnology, PMIST	Member	
9.	Ms. A. Sangeetha	Assistant Professor, Dept. of Chemical Engineering, PMIST	Member	
10.	Dr.K.Anbarasu	Assistant Professor, Dept. of Biotechnology, PMIST	Member	
11.	Dr. Nitinkumar	Assistant Professor, Dept. of Biotechnology, PMIST	Member	
12.	Ms. R. Harivardhinie	Final year student, Dept. of Biotechnology, PMIST	Student Members	
13.	Ms. R. Bhuvaneswari			
14.	Mr. G. Pradeep	Third year student, Dept. of Biotechnology, PMIST		
15.	Mr. S. Kilurudeen			
16.	Ms. S. Gayathri	Second year student, Dept. of Biotechnology, PMIST		
17.	Ms. S. Nandhini			
18.	Ms. K. Priyanka	First year student, Dept. of Biotechnology, PMIST		

Faculty members assigned for course development

S.No	Sub. Code	Category	Course Name	Staff In-charge
1.	**Professional Core Subjects**			
2.	XBT302	PCC	Material and Energy Balance	Dr. A. Ashok Kumar
3.	XBT303	PCC	Biochemistry	Dr. S. Kumaran
4.	XBT304	PCC	Microbiology	Dr. K. Anbarasu
5.	XBT305	PCC	Unit operations	Dr. A. Ashok Kumar
6.	XBT402	PCC	Genetics	Dr. Nitinkumar
7.	XBT403	PCC	Cell Biology	Dr. K. Anbarasu
8.	XBT404	PCC	Bioenergetics and Metabolism	Dr. S. Kumaran
9.	XBT405	PCC	Chemical Engineering Thermodynamics	Ms. A. Sangeetha
10.	XBT501	PCC	Bioinstrumentation	Ms. Snehya.A. V
11.	XBT502	PCC	Molecular Biology	Dr. Nitinkumar
12.	XBT503	PCC	Bioprocess Engineering	Ms. Snehya.A. V
13.	XBT602	PCC	Bioreactor Design	Ms. Snehya.A. V
14.	XBT603	PCC	Recombinant DNA Technology	Dr. Nitinkumar
15.	XBT604	PCC	Immunology	Dr. Nitinkumar
16.	XBT702	PCC	Bioinformatics and Computational Biology	Ms. Snehya.A. V
17.	XBT703	PCC	Downstream processing	Ms. Snehya.A. V
	Professional Elective Subjects			
18.	XBT504 A	PEC	Plant biotechnology	Dr. S. Kumaran
19.	XBT504 B	PEC	Nanobiotechnology	Dr. Nitinkumar
20.	XBT504 C	PEC	Chemical Reaction Engineering	Ms. A. Sangeetha
21.	XBT605 A	PEC	Animal biotechnology	Dr. Nitinkumar
22.	XBT605 B	PEC	Pharmaceutical Biotechnology	Dr. K. Anbarasu
23.	XBT605 C	PEC	Heat Transfer	Dr. A. Ashok Kumar
24.	XBT701 A	PEC	Protein Engineering	Dr. S. Kumaran
25.	XBT701 B	PEC	Food Technology	Dr. K. Anbarasu
26.	XBT701 C	PEC	Mass Transfer Fundamentals	Ms. A. Sangeetha
27.	XBT704 A	PEC	Cancer Biology	Dr. Nitinkumar
28.	XBT704 B	PEC	Stem cell biotechnology	Dr. Nitinkumar
29.	XBT704 C	PEC	Metabolic Engineering	Dr. Nitinkumar
	Minor Courses			
30.	XBTM01	MIC	Plant Tissue Culture Training	Dr. S. Kumaran
31.	XBTM02	MIC	Embryo Technology	Dr. S. Kumaran
32.	XBTM03	MIC	Training on Instrumentation (GC-MS, HPLC, AFM, SEM, TEM, XRD)	Dr. S. Kumaran
33.	XBTM04	MIC	MAT-lab for biological applications	Dr. A. Ashok Kumar

34.	XBTM05	MIC	Animal Handling Training	Dr. K. Anbarasu
35.	XBTM06	MIC	Biosimilars	Dr. Nitinkumar
36.	XBTM07	MIC	Clone Development	Dr. Nitinkumar
37.	XBTM08	MIC	Marine Biotechnology	Dr. S. Kumaran
38.	XBTM09	MIC	Beverage Technology	Dr. K. Anbarasu
39.	XBTM10	MIC	Membrane Separation Technology	Ms. A. Sangeetha
40.	XBTM11	MIC	Food Processing Technology	Dr. K. Anbarasu
41.	XBTM12	MIC	Solid/Liquid waste management	Ms.Snehya. A. V
	Subjects offered by other Departments			
42.	XPS301	BS	Probability and Statistics	Dr. A.Sasikala
43.	XUM306	UGCMC	Human Ethics	Dr. S. Kumaran
44.	XES401	ESC	Material Science	Dr. A. Ashok Kumar
45.	XUM406	HSMC	Entrepreneurship Development	Dr. S. Kumaran
46.	XUM407	UGC MC	Constitution of India	Dr. Selva Kumar
47.	XUM506	HSMC	Employability Skills and report writing	Dr. Nitinkumar
48.	XUM507	MC	Essence of Indian Traditional Knowledge	Dr. K. Anbarasu
49.	XMC605	HSMC	Process Engineering Economics and Industrial Management	Dr. A. Ashok Kumar
	Subjects offered to other Departments			
50.	XBTOE 1	OE	Intellectual property Rights	Dr. S. Kumaran
51.	XBTOE 2	OE	Industrial safety and Risk assessment	Dr. A. Ashok Kumar
52.	XBTOE 3	OE	Food and Nutrition	Dr. K. Anbarasu
53.	XBTOE 4	OE	Introduction to MATLAB – For Engineering Applications	Dr. A. Ashok Kumar
54.	XBTOE 5	OE	Project Management	Dr. A. Ashok Kumar

SUMMARY OF THE FEED BACK OBTAINED

Feedback of Parents/ Employers/ Industry Expert, Students, Teachers were collected.

(1) Parents/Employers Feedback on Curricular Aspects

In that, the following suggestions are made,

1. Eighty percentage of the parents appreciated the breadth and depth of elective courses offered from the department.
2. The stake holders expressed the happiness over the fulfillment of requirements in career through designed curriculum and syllabus.
3. The research components are incorporated with curriculum is also appreciated.
4. The suggestion is received that to enclose real life applications in the lab components.

(2) Student Feedback on Curricular Aspects

In that, the following important observations were made,

1. Text book and reference book availability in the library for the students was found to be excellent.
2. The timeline completion of syllabus was rated above 71%, and found to be very good.

(3) Teacher' s Feedback on Curricular Aspects

In that, the following important observations were made,

1.The syllabus is in line with Indian statutory bodies/ councils.

2.The curriculum and syllabus scrupulously follow the Outcome Based Education.

3.All the teachers were able to complete the syllabus in the stipulated time.

4.The timeline completion of syllabus was found to be very good and rated above 71%.

5.It was suggested to include industrial experiments in the lab component for improving the problem-solving skills of the students.

The above inputs have taken care while framing curriculum and syllabus 2018, Revision-1.

CURRICULUM DEVELOPMENT

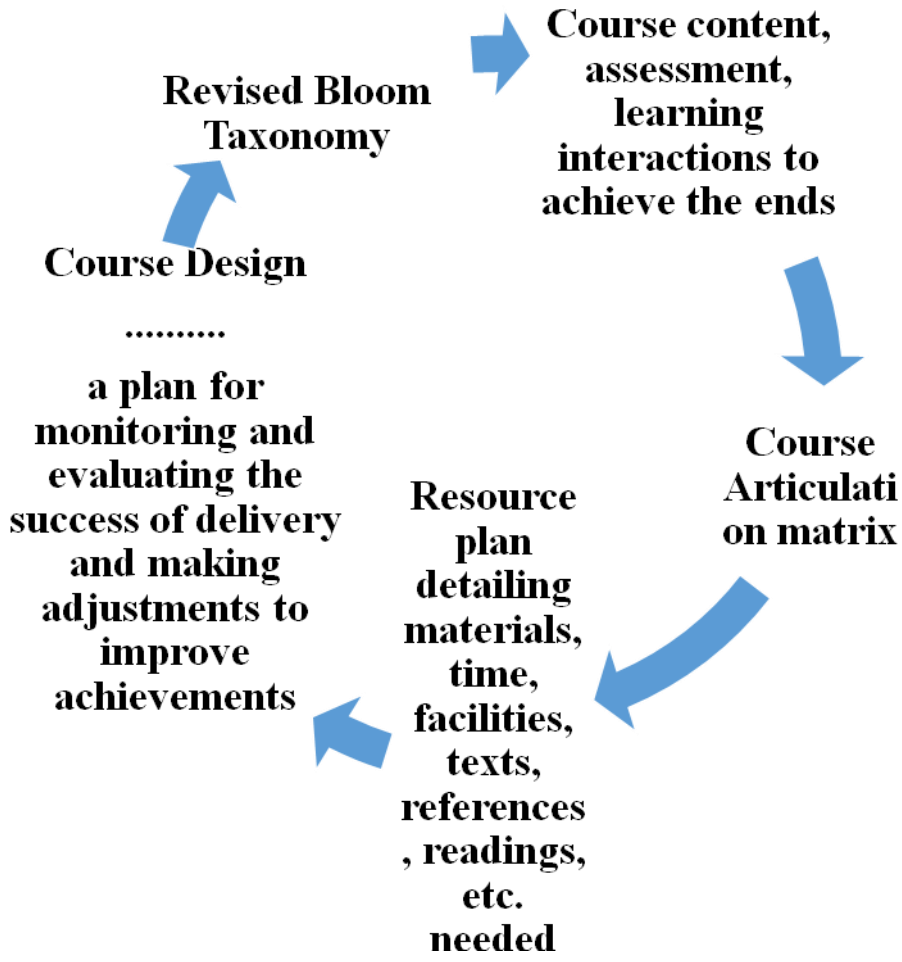
The curriculum design for biotechnology has been developed appropriately with vision and mission focused towards students PEOs. Depending on the course objectives, especially B.Tech in biotechnology taken special consideration to vary from science graduation, which is specific curriculum, is drawn from foundation of Mathematics, Science, Biological science, Engineering science, Engineering and Technology. The developed specific curriculum define the role of B. Tech biotechnologist to meet global challenges through well-equipped minimum implemented proven techniques for real time practical problems of society. In

added to that developed curriculum is also enriched with technical competencies, engagement skill, sustainable learning, adapting, leadership, teamwork, and communication skill.

After the frequent discussions happen between faculties, students, and technocrats, the course curriculum is allowed to develop and drafted the final course content. The developed curriculum is also ensure the integration of students, coherent learning experience which is contribute on their personal, academic as well as professional development. Design and develop of courses and topics were done with in a comprised framework of specified curriculum along with specified assessment and arrangements. They are clearly identified the aims and learning outcomes of education.

COURSE DEVELOPMENT

The following elements were developed by the faculty involved after interaction and discussions.



In aligning programme outcome and graduate attributes, course offered to the degree programme are finalized based on the standard template finalized by the university.

In aligning programme outcome and graduate attributes, course offered to the degree programme are finalized based on the standard template finalized by the university.

Distribution of Subjects to be included as per UGC and NAAC

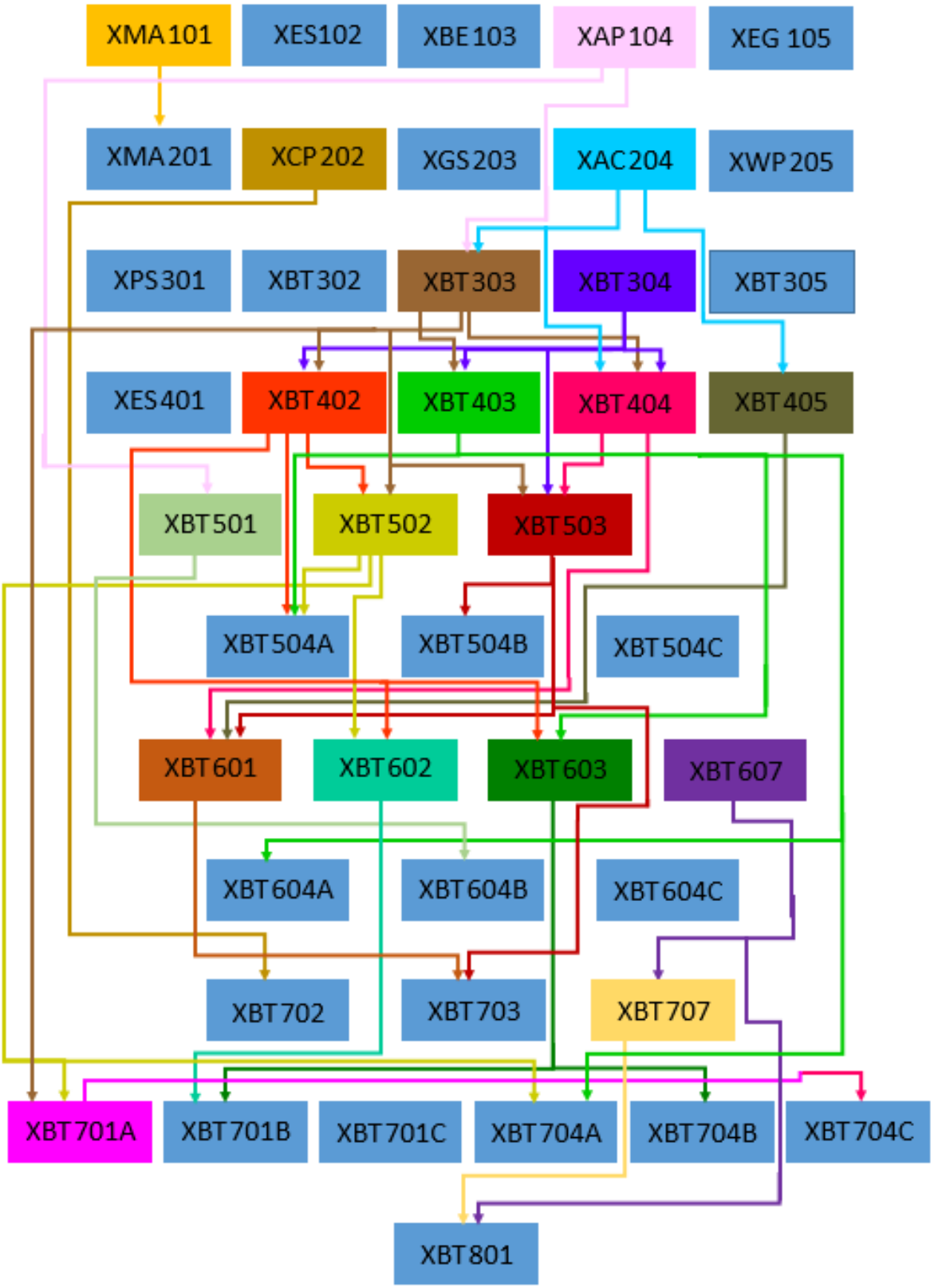
S.No	Category	Symbol
1.	Humanities and Social Sciences (HS), including Management;	HS
2.	Basic Sciences(BS) including Mathematics, Physics, Chemistry, Biology;	BS
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	ES
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch;	PC
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	PE
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	OE
7.	Project Work, Seminar and/or Internship in Industry or elsewhere	PW/PI
8.	Mandatory Courses (UGC Mandatory)	MC
9.	Non-credit Course	ELS
10.	NCC/NSS/YRC/RRC/Sports	

SUMMARY OF CREDITS

Category	I	II	III	IV	V	VI	VII	VIII	Total	As suggested By AICTE * Model curriculum
HS		**3**		**3**	**3**	**3**			**12**	12
BS	**10**	**9**	**4**						**23**	26
ES	**8**	**8**		**3**					**19**	29
PC			**16**	**18**	**12**	**13**	**8**		**67**	47
PE					**3**	**3**	**6**		**12**	23
OE					**3**	**3**	**6**		**12**	11
PW/PI							**1**	**12**	**13**	12
Skill oriented						**1**	**1**		**02**	**-**
MC			**0**	**0**	**0**				**0**	**0**
Total	**18**	**20**	**20**	**24**	**21**	**23**	**22**	**12**	**160**	**160**

*** flexibility of +/- 20%**

PRE REQUISITE MAPPING



XMA 101 - Calculus and Linear Algebra
XES 102 - Environmental Sciences
XBE 103 - Electrical and Electronics Engineering Systems
XAP 104 - Applied Physics for Engineers
XEG 105 - Engineering Graphics
XMA 201 - Calculus, Ordinary Differential Equations and Complex variables
XCP 202 - Programming for Problem Solving
XGS 203 - English
XAC 204 - Applied Chemistry for Engineers
XWP 205 - Workshop Practices
XPS 301 - Probability and Statistics
XBT 302 - Material and Energy Balance
XBT 303 - Biochemistry
XBT 304 - Microbiology
XBT 305 - Unit operations
XPS 401 - Material Science
XBT 402 - Genetics
XBT 403 - Cell Biology
XBT 404 - Bioenergetics and Metabolism
XBT 405 - Chemical Engineering Thermodynamics
XBT 501 - Bioinstrumentation
XBT 502 - Molecular Biology
XBT 503 - Bioprocess Engineering
XBT 504A - Plant biotechnology
XBT 504B - Food Biotechnology
XBT 504C - Chemical Reaction Engineering
XBT 601 - Bioreactor Design
XBT 602 - Recombinant DNA Technology
XBT 603 - Immunology
XBT 604A - Animal biotechnology
XBT 604B - Nanobiotechnology
XBT 604C - Heat Transfer
XBT 607 - Skill oriented Minor course I
XBT 701A - Protein Engineering
XBT 701B - Pharmaceutical Biotechnology
XBT 701C - Mass Transfer Fundamentals
XBT 702 - Bioinformatics and Computational Biology
XBT 703 - Downstream processing
XBT 704A - Cancer Biology
XBT 704B - Stem cell biotechnology
XBT 704C - Metabolic Engineering
XBT 707 - Skill oriented Minor course II
XBT 801 - Project work

SEMESTER-WISE STRUCTURE OF CURRICULUM

REGULATIONS – 2018, Revision- 1

(Applicable to the students admitted from the Academic year 2018-19)

SEMESTER I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XMA101	BS	Calculus and Linear Algebra	3	1	0	4
XES102	BS	Environmental Sciences	3*	0	0	0
XBE103	ES	Electrical and Electronics Engineering Systems	2	1	2	5
XAP104	BS	Applied Physics for Engineers	3	1	2	6
XEG105	ES	Engineering Graphics	0	0	3	3
		TOTAL	**8**	**3**	**7**	**18**

***Non credit Hours**

SEMESTER II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XMA201	BS	Calculus, Ordinary Differential Equations and Complex variables	3	1	0	4
XCP202	ES	Programming for Problem Solving	3	0	2	5
XGS203	HS	English	2	0	1	3
XAC204	BS	Applied Chemistry for Engineers	3	1	1	5
XWP205	ES	Workshop Practices	1	0	2	3
		TOTAL	**12**	**2**	**6**	**20**

SEMESTER III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XPS301	BS	Probability and Statistics	3	1	0	4
XBT302	PC	Material and Energy Balance	2	1	0	3
XBT303	PC	Biochemistry	3	1	0	4
XBT304	PC	Microbiology	3	0	1	4
XBT305	PC	Unit operations	3	1	1	5
XUM306	MC	Human Ethics	2*	0	0	0
XBT307	PROJ	In-Plant training-I	0	0	0	0
		TOTAL	**14**	**4**	**2**	**20**

***Non credit Hours**

SEMESTER IV

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XES401	ES	Material Science	3	0	0	3
XBT402	PC	Genetics	3	1	0	4
XBT403	PC	Cell Biology	3	0	2	5
XBT404	PC	Bioenergetics and Metabolism	3	0	2	5
XBT405	PC	Chemical Engineering Thermodynamics	3	1	0	4
XUM406	HS	Entrepreneurship Development	3	0	0	3
XUM407	MC	Constitution of India	3*	0	0	0
		TOTAL	**18**	**2**	**4**	**24**

***Non credit Hours**

SEMESTER V

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT501	PC	Bioinstrumentation	3	0	1	4
XBT502	PC	Molecular Biology	2	1	0	3
XBT503	PC	Bioprocess Engineering	3	1	1	5
XBT504	PE	Core Elective- I	3	0	0	3
XBT505	OE	Open Elective- I	3	0	0	3
XUM506	HS	Employability Skills and report writing	3	0	0	3
XUM507	MC	Essence of Indian Traditional Knowledge	3*	0	0	0
XBT508	PROJ	In-Plant training-II	0	0	0	0
XBTM01	PMC	Minor Course - I	0	0	2*	0
		TOTAL	**17**	**2**	**2**	**21**

***Non credit Hours**

SEMESTER VI

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XUM601	HS	Economics for Engineers	3	0	0	3
XBT602	PC	Bioreactor Design	3	1	1	5
XBT603	PC	Recombinant DNA Technology	3	1	1	5
XBT604	PC	Immunology	3	0	0	3
XBT605	PE	Core Elective- II	3	0	0	3
XBT606	OE	Open Elective- II	3	0	0	3
XBTM02	PMC	Minor Course - II	0	0	2*	0
		TOTAL	**18**	**2**	**2**	**22**

***Non credit Hours**

SEMESTER VII

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT701	PE	Core Elective- III	3	0	0	3
XBT702	PC	Bioinformatics and Computational Biology	1	0	2	3
XBT703	PC	Downstream processing	3	1	1	5
XBT704	PE	Core Elective- IV	3	0	0	3
XBT705	OE	Open Elective- III	3	0	0	3
XUM706	PMC	Cyber security	3*	0	0	0
XBT707	PROJ	In-Plant training-III	0	0	0	1
XBTM03	PMC	Minor Course - III	0	0	2*	0
		Total	**13**	**1**	**3**	**18**

***Non credit Hours**

SEMESTER VIII

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT801	PROJ	Project work	0	0	12	12
XBT802	OE	Open Elective- IV	3	0	0	3
		TOTAL	**3**	**0**	**12**	**15**

Total credits = 158

PROFESSIONAL ELECTIVE COURSES

The following Professional Specialized courses were identified to offer as electives.

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
Core Elective – I Options						
XBT504 A	PE	Plant biotechnology	3	0	0	3
XBT504 B	PE	Food Technology	3	0	0	3
XBT504 C	PE	Chemical Reaction Engineering	3	0	0	3
Core Elective – II Options						
XBT605 A	PE	Animal biotechnology	3	0	0	3
XBT605 B	PE	Nanobiotechnology	3	0	0	3
XBT605 C	PE	Heat Transfer	3	0	0	3
Core Elective – III Options						
XBT701 A	PE	Protein Engineering	3	0	0	3
XBT701 B	PE	Pharmaceutical Biotechnology	3	0	0	3
XBT701 C	PE	Mass Transfer Fundamentals	3	0	0	3
Core Elective – IV Options						
XBT704 A	PE	Cancer Biology	3	0	0	3

XBT704 B	PE	Stem cell biotechnology	3	0	0	3
XBT704 C	PE	Metabolic Engineering	3	0	0	3

SKILL ORIENTED MINOR COURSES

Sl no	Course Code	Category	Name of the Course	Credit
1.	XBTM01	PMC	Plant Tissue Culture Training	1
2.	XBTM02	PMC	Training on Instrumentation (GC-MS, HPLC, AFM, SEM, TEM, XRD)	1
3.	XBTM03	PMC	MAT-lab for biological applications	1
4.	XBTM04	PMC	Biofertilizer Technology	1
5.	XBTM05	PMC	Bioenergy	1

Note

L – Lecture, T – Tutorial, P – Practical, C - Credit

Each faculty made presentation on their suggestions on the courses allotted to them before the Board of studies members.

I. <u>Revisions /Deletions/changes /Modifications including percentage of revision</u>

S. No.	Course Code	Category	Name of the Course	Modification	% of revision
	Professional Core Subjects				
1.	XBT303	PC	Biochemistry	**Unit II**: XRD, NMR, Ramachandran Plot removed **Unit V:** Metabolic pathways are removed and incorporated "Lipids, biological membranes and transport"	20%
2.	XBT405	PC	Chemical Engineering Thermodynamics	No variation	0%
3.	XBT503	PC	Bioprocess Engineering	No variation	0%
4.	XBT603	PC	Recombinant DNA Technology	**Unit V:** Incorporated Genetic manipulation of animal cells – early	15%

				methods and Crispr-Cas9. Transgenic plants and animals. Bioethics regarding rDNA techniques. Lab Experiments have been modified.	
5.	XBT604	PC	Immunology	**Unit I:** Rephrased the topics while keeping the concept same. **Unit II:** Changed the title from "Antigen - Antibody Interactions" to "Antigens And Antibodies" Removed the topics "Multigene Organization of Ig Genes - Variable Region Gene Rearrangements - Generation of Antibody Diversity. Incorporated Immunoelectrophoresis, Western Blotting **Unit III:** Rephrased the topics while keeping the concept same. Changed the title from "Immune Responses" to "Complement, Hypersensitivity And Autoimmmunity" **Unit IV:** Rephrased the topics while keeping the concept same. Lab Experiments have been removed	20%
6.	XBT702	PC	Bioinformatics and Computational Biology	Lab included	10%
7.	XBT703	PC	Downstream processing	No variation	0%
	Professional Elective Subjects				
8.	XBT504A	PE	Plant Biotechnology	**Unit V:** Removed Plant vaccines, custom-made antibodies - *Arabidopsis* genome sequencing project technology and its applications - Mechanism of insecticidal crystal protein of *Bacillus thuringiensis*, strategy to generate BT cotton transgenic plants; their problems and solutions – Role of RNAi technology in plant	10%

				biotechnology Incorporated Therapeutic/Industrial applications of plant prodcuts - Plant vaccines, custom-made antibodies, Transgenic plants - their issues and solutions.	
9.	XBT 504 B	PE	Nanobiotechnology	**Unit I:** Included SEM, TEM, AFM	5%
10.	XBT504C	PE	Chemical Reaction Engineering	Unit IV – Removed Unit II – Split in to unit II & V.	25%
11.	XBT605A	PE	Animal Biotechnology	**Unit I**: Included 3D cell culture (spheroids) **Unit II**: Removed lentivirus, vaccinia virus, herpes virus and baculovirus Included gene therapy for animal diseases **Unit V:** Removed Ethics	10%
12.	XBT605B	PE	Pharmaceutical Biotechnology	**Unit III:** Included Adverse effects of drugs and drug toxicology: Reproductive toxicity and Teratogenicity, Mutagenicity, Carcinogenicity, Drug tolerance, Drug intolerance, drug allergy, drug induced side effects. Tachyphylaxis, biological effects of drug abuse and drug dependence Removed Haemopoietic growth factors – Granulocyte and Macrophage colony stimulating factor, Insulin like growth factors , Epidermal growth factor, Platelet growth factor, Neurotrophic factors – Hormones of therapeutic interest – Insulin, Glucagon – Human growth hormones – Gonadotrophins **Unit IV:** Included Biopharmaceutical and biological drug development, Manufacturing of biopharmaceutical, therapeutic proteins and peptides. Recombinant growth hormones, growth factors, therapeutic monoclonal antibodies, therapeutic enzymes and their application in health care	50%

				Removed Disease transmission – Whole blood, Platelets and red blood cells – Blood substitutes – Haemostasis – Antithrombin – Thrombolytic agents – Enzymes of therapeutic value **Unit V:** Included Pharmaceutical Testing, Analysis and Control: Analysis of pharmaceuticals using physical, chemical and biological methods, quality assurance and control, stability of pharmaceutical products Removed Polyclonal antibody – Monoclonal antibodies – Tumour immunology – Vaccine technology, Adjuvant technology – Anti-sense oligonucleotides, uses, advantages and disadvantages of oligos Vitravene, an approved anitsense agent – Antigene sequences and ribozymes.	
13.	XBT701A	PE	Protein Engineering	No variation	0%
14.	XBT 704 A	PE	Cancer Biology	**Unit V:** Removed Karyotyping, Classification of drugs, Gene therapy 2. Included New Genomic and proteomic technologies.	5%
15.	XBT 704 B	PE	Stem cell biotechnology	**Unit III**: Included iPSCs	1%
16.	XBT 704 C	PE	Metabolic Engineering	No change	0%
	Subjects offered by other Departments				
17.	XPS301	BS	Probability and Statistics		
18.	XUM306	HSMC	Human Ethics	No change	0%
19.	XUM406	UGCMC	Entrepreneurship Development		
20.	XES401	ESC	Material Science		
21.	XUM407	UGCMC	Constitution of India		
22.	XUM506	HS	Employability		

		MC	Skills and report writing		
23.	XUM507	MC	Essence of Indian Traditional Knowledge		
24.	XMC605	HS MC	Process Engineering Economics and Industrial Management		
	Subjects offered to other Departments				
25.	XBTOE 1	OE	Intellectual property Rights	No Change	0 %

II. List of new courses suggested

Professional Core subjects					
S.No.	**Course Code**	**Course Name**	**S.No.**	**Course Code**	**Course Name**
1.	XBT304	Microbiology	7.	XBT501	Bioinstrumentation
2.	XBT305	Unit operations	8.	XBT502	Molecular Biology
3.	XBT302	Material and Energy Balance	9.	XBT602	Bioreactor Design
4.	XBT402	Genetics	10.	XBTM01	Skill oriented Minor course I
5.	XBT403	Cell Biology	11.	XBTM02	Skill oriented Minor course II
6.	XBT404	Bioenergetics and Metabolism	12.	XBTM03	Skill oriented Minor course III
Professional Elective subjects					
S.No.	**Course Code**	**Course Name**	**S.No.**	**Course Code**	**Course Name**
1.	XBT 504 B	Nanobiotechnology	3.	XBT 701 C	Mass Transfer Fundamentals
2.	XBT 605 C	Heat Transfer			
	Skill oriented Course				
S.No.	**Course Code**	**Course Name**	**S.No.**	**Course Code**	**Course Name**
1.	XBTM01	Plant Tissue Culture Training	4.	XBTM04	Bioenergy
2.	XBTM02	Training on Instrumentation (GC-MS, HPLC, AFM,	5.	XBTM05	MAT-lab for biological applications

		SEM, TEM, XRD)			
3.	XBTM03	Biofertilizer Technology			
Open Elective					
1.	XBT OE 2	Industrial safety and Risk Management	3.	XBT OE 4	Introduction to MATLAB – For Engineering Applications
2.	XBT OE 3	Food and Nutrition	4.	XBT OE 5	Project Management

III. Employability / Skill /entrepreneurship components in the syllabus of each course

SL NO	Sub. Code	Category	Name of the Course	Components
	Professional Core Subjects			
1	XBT303	PC	Biochemistry	Biochemist
2	XBT304	PC	Microbiology	Microbial Testing Fermentation Quality Control
3	XBT305	PC	Unit operations	Process Engineer Production Engineer
4	XBT302	PC	Material and Energy Balance	Design Engineer Scientist
5	XBT402	PC	Genetics	Gene sequencing Evolutionary studies
6	XBT403	PC	Cell Biology	Cell Culture facility Embryology
7	XBT404	PC	Bioenergetics and Metabolism	Disease Diagnosis Treatment of Diseases Process Engineering
8	XBT405	PC	Chemical Engineering Thermodynamics	Scientific research
9	XBT501	PC	Bioinstrumentation	Analytical techniques
10	XBT502	PC	Molecular Biology	Gene Sequencing
11	XBT503	PC	Bioprocess Engineering	Fermentation Pilot scale production
12	XBT602	PC	Bioreactor Design	Design of bioreactor
13	XBT603	PC	Recombinant DNA Technology	Preparation of clones DNA finger printing
14	XBT604	PC	Immunology	Diagnostic Lab
15	XBT702	PC	Bioinformatics and Computational Biology	Gene Retrieval and Editing
16	XBT703	PC	Downstream processing	Upstream and downstream
	Professional Elective Subjects			
17	XBT504 A	PEC	Plant biotechnology	Tissue culturing

18	XBT504 B	PEC	Nanobiotechnology	Drug delivery systems, nanomedicine, nanosensors
19	XBT504 C	PEC	Chemical Reaction Engineering	Reactor design
20	XBT605 A	PEC	Animal biotechnology	Monoclonal antibody production, IVF
21	XBT605 B	PEC	Pharmaceutical Biotechnology	Design of biosimilars
22	XBT605 C	PEC	Heat Transfer	Process Industry
23	XBT701 A	PEC	Protein Engineering	Drug Delivery
24	XBT701 B	PEC	Food Technology	Techniques involved in Processing of food
25	XBT701 C	PEC	Mass Transfer Fundamentals	
26	XBT704 A	PEC	Cancer Biology	Drug Delivery
27	XBT704 B	PEC	Stem cell biotechnology	Regenerative Medicine
28	XBT704 C	PEC	Metabolic Engineering	
	Skill Oriented Minor Courses			
29	XBTM01	PMC	Plant Tissue Culture Training	Employability
30	XBTM02	PMC	Training on Instrumentation (GC-MS, HPLC, AFM, SEM, TEM, XRD)	Quality Analysis
31	XBTM03	PMC	MAT-lab for biological applications	Performance, modelling and stimulation of biological systems.
32	XBTM04	PMC	Biofertilizer Technology	Production and optimization process studies of biofertilizer
33	XBTM05	PMC	Bioenergy	Production of Biohydrogen, Bioethanol, Biopolymer etc
	Subjects offered by other Departments			
34	XPS301	BS	Probability and Statistics	
35	XUM307	UGCMC	Human Ethics	Employability
36	XES401	ESC	Material Science	
37	XUM406	HSMC	Entrepreneurship Development	Entrepreneurship
38	XUM407	UGC MC	Indian Constitution	
39	XUM506	HSMC	Employability Skills and report writing	Employability
40	XUM507	MC	Essence of Indian Traditional Knowledge	
41	XUM601	HSMC	Economics for Engineers	Entrepreneurship
	Subjects offered to other Departments			
42	XBT OE 1	OE	Intellectual property Rights	

43	XBT OE 2	OE	Industrial safety and Risk assessment	Employability
44	XBT OE 3	OE	Food and Nutrition	Employability
45	XBT OE 4	OE	Introduction to MATLAB – For Engineering Applications	
46	XBT OE 5	OE	Project Management	Employability

VALUE ADDED COURSES SUGGESTED

Sl no	Name of the Course	Components
1	Embryo Technology	IVF method, embryo development
2	Animal Handling Training	Employability
3	Biosimilar	Employability
4	Clone Development	Employability
5	Marine Biotechnology	Employability
6	Beverage Technology	Functioning process and optimization studies of
7	Membrane Separation Technology	Employability
8	Food Processing Technology	Employability
9	Solid/Liquid waste management	Employability

IV. Activities with direct bearing on enhancing employability/skill development/ entrepreneurship

	Course Name	List of Activities
	Professional Core subjects	
1.	Genetics Cell Biology	• Local Visit to Bharathidasan University, Trichy
2.	Chemical Engineering Thermodynamics	• Local visit to Central Electrochemical Research Institute, Karaikudi.
3.	Bioprocess Engineering	• Case Studies on Design aspects.

		• Local visit to EID Parry, Cuddalore • Wastewater Treatment Plant- Pudukottai • Guest Lecture on Bioprocess • Problem Solving Workshop on Bioprocess
4.	Bioreactor Design	• Case Studies on Design of fermenter. • Chemin Enviro Systems Pvt Ltd, Erode. • Interaction with industrial expert
5.	Recombinant DNA Technology	• Workshop on Recombinant DNA Technology.
6.	Immunology	• Local Visit to Periyar College of Pharmaceutical Sciences, Trichy.
7.	Bioinformatics and computational Biology	• Workshop on Bioinformatics.
8.	Downstream Processing	• Industrial visit to Mysore . • Shasun Pharmaceutical Limited , Cuddalore. • Interaction with industrial expert.
	Professional Elective subjects	
9.	Plant biotechnology	• Local visit to National Research centre for Banana (ICAR) Trichy
10.	Nanobiotechnology	• Local visit to Central Electrochemical Research Institute, Karaikudi.
11.	Chemical Reaction Engineering	• Local visit to EID Parry, Cuddalore
12.	Animal biotechnology	• Local Visit to Bharathidasan University, Trichy • Local Visit to Veterinary college & Research Institue, orthanadu
13.	Pharmaceutical Biotechnology	• Industrial Visit to Sami Labs Banglore
14.	Heat Transfer	• Local visit to EID Parry, Cuddalore
15.	Protein Engineering	• Industrial Visit to Banglore
16.	Food Technology	• Industrial Visit to Central Food Technological Research Institue, Mysore • Local visit to Indian Institute of Food Processing Technology (IIFPT), Thanjavur. • Interaction with industrial expert
17.	Cancer Biology	• Visit to Adayar Cancer Research Institute. • Interaction with industrial expert
	Other Departments	
18.	Mechanics of Materials	• Quality Control
19.	Professional Practice, Law &	• Collection of details on conflict and arbitrations

	Ethics	
20.	Constitution of India	• Collection and compilation of various constitution law

XMA 101			CALCULUS AND LINEAR ALGEBRA	L	T	P	C
				3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		4	1	0	5

Prerequisite: Differentiation and Integration

Learning Objectives:

Upon completion of this course, the students

- Would apply the Knowledge of Matrices, Eigenvalues and Eigen Vectors Reduce to Quadratics form in problems involving Science and Engineering
- Would gain familiarity in the knowledge of Maxima and Minima, Jacobian, and Taylor series and apply them in the problems involving Science and Engineering
- Would apply the Fundamental Theorem of Calculus

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Apply*** orthogonal transformation to reduce quadratic form to canonical forms.	Cognitive	Remembering Applying
CO2	***Apply*** and ***Respond*** power series to tests the convergence of the sequences and series, half range Fourier sine and cosine series.	Cognitive Psychomotor	Applying Remembering Guided Response
CO3	***Find*** the derivative of composite functions and implicit functions. Euler's theorem and Jacobian	Cognitive Psychomotor	Remembering Guided Response
CO4	***Explain*** the functions of two variables by Taylors expansion, by finding maxima and minima with and without constraints using Lagrangian Method. Directional derivatives, Gradient, Curl and Divergence.	Cognitive Affective	Remembering Understanding Receiving
CO5	***Apply*** Differential and Integral calculus to notions of Curvature and to improper integrals.	Cognitive	Applying

I – Matrices	**15**
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
II – Sequences and Series	**15**
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
III – Multivariable Calculus: Partial Differentiation	**15**
Limits and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.	
IV – Multivariable Calculus: Maxima and Minima and Vector Calculus	**15**
Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl.	
V – Differential and Integral Calculus	**15**
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	

Lecture	Tutorial	Practical	Total
60	15	0	75

Text Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015**. (Unit-1, Unit-3 and Unit-4).**
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014. **(Unit-2).**
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010. **(Unit-5).**

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

E-References:

1. https://nptel.ac.in/courses/111106051/
2. https://www.coursera.org/learn/linear-algebra-machine-learning

Mapping of COs with Gas

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with Gas

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
Original Value	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XES 102			ENVIRONMENTAL SCIENCES	L	T	P	C
				3	0	0	0
C	P	A		L	T	P	H
1.4	0.3	0.3		3	0	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- would have learn about natural energy resources.
- Would have learn about the pollution sources and control.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Describe*** the significance of natural resources and ***explain*** anthropogenic impacts.	Cognitive	Remember Understand
CO2	***Illustrate*** the significance of ecosystem, biodiversity and natural geo bio chemical cycles for maintaining ecological balance.	Cognitive	Understand
CO3	***Identify*** the facts, consequences, preventive measures of major pollutions and ***recognize*** the disaster phenomenon	Cognitive Affective	Remember Receive
CO4	***Explain*** the socio-economic, policy dynamics and ***practice*** the control measures of global issues for sustainable development.	Cognitive	Understand Apply
CO5	***Recognize*** the impact of population and the concept of various welfare programs, and ***apply*** the modern technology towards environmental protection.	Cognitive	Understand Analysis

I – Introduction to Environmental Studies and Energy — **12**

Definition, Scope And Importance – Need For Public Awareness – Forest Resources: Use, Deforestation, Case Studies. – Water Resources: Use And Over-Utilization Of Surface And Ground Water, Dams-Benefits And Problems – Mineral Resources: Uses, Environmental Effects Of Mining, Case Studies-Iron Mining(Goa), Bauxite Mining(Odisha) – Food Resources: 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 Degradation – Role Of An Individual In Conservation Of Natural Resources – Equitable Use Of Resources For Sustainable Lifestyles.

II – Ecosystems and Biodiversity — **7**

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Biogeochemical cycles – 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 ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

III – Environmental Pollution — **10**

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 – Solid waste management– Role of an individual in prevention of pollution – Pollution case studies – Disaster management: flood, earthquake, cyclone and landslide.

IV – Social Issues and the Environment — **10**

Rain water harvesting – Resettlement and rehabilitation of people; its problems and concerns, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents – 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 – Public awareness.

V – Human Population and the Environment	**6**

Population growth, variation among nations – Population explosion– Environment and human health – HIV / AIDS– Role of Information Technology in Environment and human health.

Lecture	Tutorial	Practical	Total
45	**0**	**0**	**45**

Text Books:

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co, USA, 2000.
2. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, UK, 2003
3. Trivedi R.K and P.K.Goel, Introduction to Air pollution, Techno Science Publications, India, 2003.
4. Disaster mitigation, Preparedness, Recovery and Response, SBS Publishers & Distributors Pvt. Ltd, New Delhi, 2006.
5. Introduction to International disaster management, Butterworth Heinemann, 2006.
6. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, New Delhi, 2004.

Reference Books:

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media, India, 2009.
2. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
3. S.K.Dhameja, Environmental Engineering and Management, S.K.Kataria and Sons, New Delhi, 2012.
4. Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, 2003.
5. Sundar, Disaster Management, Sarup & Sons, New Delhi, 2007.
6. G.K.Ghosh, Disaster Management, A.P.H.Publishers, New Delhi, 2006.

E-References:

1. http://www.e-booksdirectory.com/details.php?ebook=10526
2. https://www.free-ebooks.net/ebook/Introduction-to-Environmental-Science
3. https://www.free-ebooks.net/ebook/What-is-Biodiversity
4. https://www.learner.org/courses/envsci/unit/unit_vis.php?unit=4
5. http://bookboon.com/en/pollution-prevention-and-control-ebook
6. http://www.e-booksdirectory.com/details.php?ebook=8557
7. http://www.e-booksdirectory.com/details.php?ebook=6804
8. http://bookboon.com/en/atmospheric-pollution-ebook
9. http://www.e-booksdirectory.com/details.php?ebook=3749
10. http://www.e-booksdirectory.com/details.php?ebook=2604
11. http://www.e-booksdirectory.com/details.php?ebook=2116
12. http://www.e-booksdirectory.com/details.php?ebook=1026
13. http://www.faadooengineers.com/threads/7894-Environmental-Science

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	1	0	0	1	1	1	0	0	0
CO 2	3	3	1	1	1	1	0	0	1	1	1	0	0	0
CO 3	2	2	2	1	2	2	1	1	1	1	1	0	0	0
CO 4	2	2	1	1	1	1	1	1	1	1	1	0	0	0
CO 5	2	2	1	1	1	1	1	1	1	1	1	0	0	0
	12	12	6	5	6	6	3	3	5	5	5	0	0	0

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	12	12	6	5	6	6	3	3	5	5	5	0	0	0
Scaled Value	3	3	2	1	2	2	1	1	1	1	1	0	0	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBE 103			ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS	L	T	P	C
				2	1	2	5
C	P	A		L	T	P	H
3	1	0		3	2	2	7

Prerequisite: Physics

Learning Objectives:

Upon completion of this course, the students

- would have learn the basics of AC and DC related electrical and electronics aspect,
- would have learn about input and output devices.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Define, Relate,*** the fundamentals of electrical parameters and ***build*** and ***explain*** AC, DC circuits by Using measuring devices	Cognitive Psychomotor	Remember Understand Mechanism Set
CO2	***Define and Explain*** the operation of DC and AC machines.	Cognitive	Remember Understand
CO3	***Recall and Illustrate*** various semiconductor devices and their applications and displays the input output characteristics of basic semiconductor devices.	Cognitive Psychomotor	Remember Understand Mechanism
CO4	***Relate and Explain the*** number systems and logic gates. ***Construc***t the different digital circuit.	Cognitive Psychomotor	Remember Understand Origination
CO5	***Label and Outline the*** different types of microprocessors and their applications.	Cognitive	Remember Understand

I – Fundamental of Dc and Ac Circuits, Measurements **9+9+12**

Fundamentals of DC– Ohm's Law – Kirchoff's Laws - Sources - Voltage and Current relations – Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities - Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).

II – Electrical Machines **9+6+0**

Construction, Principle Of Operation, Basic Equations, Types And Application Of DC Generators, DC Motors - Basics Of Single Phase Induction Motor And Three Phase Induction Motor- Construction, Principle Of Operation Of Single Phase Transformer, Three Phase Transformers, Auto Transformer.

III – Semiconductor Devices **9+3+8**

Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications.

IV – Digital Electronics **9+6+10**

Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.

V – Microprocessors **9+6+0**

Architecture, 8085, 8086 - Interfacing Basics: Data transfer concepts – Simple Programming concepts

Electrical and Electronics Engineering Systems Lab

List of Practical Experiments

1. Study of Electrical Symbols, Tools and Safety Precautions, Power Supplies.
2. Study of Active and Passive elements – Resistors, Inductors and Capacitors, Bread Board.
3. Verification of AC Voltage, Current and Power in Series and Parallel connection.

4. Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
5. Fluorescent lamp connection with choke.
6. Staircase Wiring.
7. Forward and Reverse bias characteristics of PN junction diode.
8. Forward and Reverse bias characteristics of zener diode.
9. Input and Output Characteristics of NPN transistor.
10. Construction and verification of simple Logic Gates.
11. Construction and verification of adders.
12. Construction and verification of subtractor.

Lecture	Tutorial	Practical	Total
45	30	30	105

Text Books:

1. Metha V.K., 2008. Principles of Electronics. Chand and Company.
2. Malvino, A. P., 2006. Electronics Principles. 7th ed. New Delhi: Tata McGraw-Hill.
3. Rajakamal, 2007. Digital System-Principle & Design. 2nd ed. Pearson education.
4. Morris Mano, 1999. Digital Design. Prentice Hall of India.
5. Ramesh, S. Gaonkar, 2000. Microprocessor Architecture, Programming and its Applications with the 8085. 4th ed. India: Penram International Publications.

Reference Books:

1. Corton,H.,2004. Electrical Technology. CBS Publishers & Distributors.
2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.
3. Jacob Millman and Christos, C. Halkias, 1967. Electronics Devices.New Delhi: McGraw-Hill.
4. Millman, J. andHalkias, C. C., 1972. Integrated Electronics: Analog and Digital Circuits and Systems. Tokyo: McGraw-Hill, Kogakusha Ltd.
5. Mohammed Rafiquzzaman, 1999. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International.

E-References:

1. NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof. G. D. Roy, IIT Kharagpur.
2. Prof.L.Umanand, http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, IISc Bangalore.
3. http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura , IIT Madras.
4. Dr.LUmanand , http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, IISC Bangalore

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	2	3	1	1	2	3	3	3	-
CO 2	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO 3	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO 4	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO 5	3	3	3	1	3	1	3	1	1	1	2	3	3	-
	15	15	15	6	15	6	15	5	5	6	11	3	3	-

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	15	15	15	6	15	6	15	5	5	6	11	3	3	-
Scaled Value	3	3	3	2	3	2	3	1	1	2	3	3	3	-

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XAP 104			APPLIED PHYSICS FOR ENGINEERS	L	T	P	C
				3	1	2	6
C	P	A		L	T	P	H
2.8	0.8	0.4		3	1	3	7

Prerequisite: Basic Physics in HSC level

Learning Objectives:

Upon completion of this course, the students

- Would have learn various principle and laws of physics.
- Would have learn the way to use physics for engineering applications**.**

	Course Outcomes	Domain	Level
After the completion of the course, students will be able to			
CO1	***Identify*** the basics of mechanics, ***explain*** the principles of elasticity and ***determine*** its significance in engineering systems and technological advances.	Cognitive Psychomotor	Remember, Understand Mechanism
CO2	***Illustrate*** the laws of electrostatics, magneto-statics and electromagnetic induction; ***use*** and ***locate*** basic applications of electromagnetic induction to technology.	Cognitive Psychomotor Affective	Remember, Analyze, Mechanism Respond
CO3	***Understand*** the fundamental phenomena in optics by measurement and ***describe*** the working principle and application of various lasers and fibre optics.	Cognitive Psychomotor Affective	Understand, Apply Mechanism Receive
CO4	***Analyse*** energy bands in solids, ***discuss*** and ***use*** physics principles of latest technology using semiconductor devices.	Cognitive Psychomotor Affective	Understand, Analyze Mechanism Receive
CO5	***Develop*** Knowledge on particle duality and ***solve*** Schrodinger equation for simple potential.	Cognitive	Understand, Apply

I- Mechanics of Solids **9+3+9**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.

Elasticity: Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending.

II- Electromagnetic Theory **9+3+3**

Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarisation, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.

III- Optics, Lasers and Fibre Optics **9+3+12**

Optics: Dispersion- Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism- Interference of light in thin films: air wedge - Diffraction: grating.

LASER: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - CO_2 laser - Applications

Fibre Optics: Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

IV- Semiconductor Physics **9+3+6**

Semiconductors: Energy bands in solids - Energy band diagram of good conductors, insulators and

semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.

Diodes and Transistors: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

V- Quantum Physics	**9+3+0**

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

Applied Physics for Engineers Lab

List of Practical Experiments

1. Torsional Pendulum - determination of moment of inertia and rigidity modulus of the given material of the wire.
2. Uniform Bending - Determination of the Young's Modulus of the material of the beam.
3. Non-Uniform Bending - Determination of the Young's Modulus of the material of the beam.
4. Meter Bridge - Determination of specific resistance of the material of the wire.
5. Spectrometer - Determination of dispersive power of the give prism.
6. Spectrometer - Determination of wavelength of various colours in Hg source using grating.
7. Air wedge - Determination of thickness of a given thin wire.
8. Laser - Determination of wavelength of given laser source and size of the given micro particle using Laser grating.
9. Post office Box - Determination of band gap of a given semiconductor.
10. PN Junction Diode - Determination of V-I characteristics of the given diode.

Lecture	**Tutorial**	**Practical**	**Total**
45	**15**	**30**	**90**

Text Books:

1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

Reference Books:

1. Palanisamy P. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.
2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.
3. Senthil Kumar G., "Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.
4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.
5. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.
6. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.
7. Umayal Sundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.

E-References:

1. NPTEL , Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	1	-	-	-	1	-	-	1	-	-
CO 2	3		1		1	-	-	-	-	-	-	1	-	-
CO 3	3	2	2	2	1	-	-	-	1	-	-	1	-	-
CO 4	3	2	2	2	1	-	-	-	1	-	-	1	-	-
CO 5	3		2			-	-	-	-	-	-	1	-	-
	15	**6**	**9**	**6**	**4**	**-**	**-**	**-**	**3**	**-**	**-**	**5**	**-**	**-**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**15**	**6**	**9**	**6**	**4**	-	-	-	**3**	-	-	**5**	-	-
Scaled Value	**3**	**2**	**2**	**2**	**1**	-	-	-	**1**	-	-	**1**	-	-

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XEG 105			ENGINEERING GRAPHICS	L	T	P	C
				0	0	3	3
C	P	A		L	T	P	H

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn to use engineering graphics to design and project things in 2D.
- Would have learn to draw to design structures**.**

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Apply*** the national and international standards, ***construct*** and ***practice*** various curves	Cognitive, Psychomotor and Affective	Applying, Guided response and Responds to Phenomena
CO2	***Interpret***, ***construct*** and ***practice*** orthographic projections of points, straight lines and planes.	Cognitive, Psychomotor and Affective	Understanding, Mechanism and Responds to Phenomena
CO3	***Construct Sketch*** and ***Practice*** projection of solids in various positions and true shape of sectioned solids.	Cognitive, Psychomotor and Affective	Applying, Complex Overt Response and Responds to Phenomena
CO4	***Interpret***, ***Sketch*** and ***Practice*** the development of lateral surfaces of simple and truncated solids, intersection of solids.	Cognitive, Psychomotor and Affective	Understanding, Complex Overt Response and Responds to Phenomena
CO5	***Construct sketch*** and ***practice*** isometric and perspective views of simple and truncated solids.	Cognitive, Psychomotor and Affective	Applying, Complex Overt Response and Responds to Phenomena

I – Introduction, Free Hand Sketching of Engg Objects and Construction of Plane Curve **6+6**

Importance of graphics in engineering applications – use of drafting instruments – BIS specifications and conventions as per SP 46-2003.

Pictorial representation of engineering objects – representation of three dimensional objects in two dimensional media – need for multiple views – developing visualization skills through free hand sketching of three dimensional objects.

Polygons & curves used in engineering practice – methods of construction – construction of ellipse, parabola and hyperbola by eccentricity method – cycloidal and involute curves – construction – drawing of tangents to the above curves.

II – Projection of Points, Lines and Plane Surfaces **6+6**

General principles of orthographic projection – first angle projection – layout of views – projections of points, straight lines located in the first quadrant – determination of true lengths of lines and their inclinations to the planes of projection – traces – projection of polygonal surfaces and circular lamina

inclined to both the planes of projection.

III- Projection of Solids and Sections of Solids	**6+6**

Projection of simple solids like prism, pyramid, cylinder and cone when the axis is inclined to one plane of projection – change of position & auxiliary projection methods – sectioning of above solids in simple vertical positions by cutting plane inclined to one reference plane and perpendicular to the other and above solids in inclined position with cutting planes parallel to one reference plane – true shapes of sections.

IV- Development of Surfaces and Intersection of Solids	**6+6**

Need for development of surfaces – development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones – development of lateral surfaces of the above solids with square and circular cutouts perpendicular to their axes – intersection of solids and curves of intersection –prism with cylinder, cylinder & cylinder, cone & cylinder with normal intersection of axes and with no offset.

V – Isometric and Perspective Projections	**6+6**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones – principles of perspective projections – projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Lecture	**Tutorial**	**Practical**	**Total**
30	**0**	**30**	**60**

Text Books:

1. Bhatt,N.D, "Engineering Drawing", Charotar Publishing House, 46th Edition-2003.
2. Natarajan,K.V, " A Textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006.
3. Dr. P.K. Srividhya, P. Pandiyaraj, "Engineering Graphics", PMU Publications, Vallam, 2013

Reference Books:

1. Luzadder and Duff, "Fundamentals of Engineering Drawing" Prentice Hall of India PvtLtd, XI Edition - 2001.
2. Venugopal,K. and Prabhu Raja, V., "Engineering Graphics", New Age International(P) Ltd., 2008.
3. Gopalakrishnan.K.R,. "Engineering Drawing I & II", Subhas Publications, 1998.
4. Shah,M.B and Rana,B.C.,"Engineering Drawing", Pearson Education,2005.

E-References:

1. http://periyarnet/Econtent
2. http://nptel.ac.in/courses/112103019/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	2	3	1	1	2	3	3	3	-
CO 2	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO 3	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO 4	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO 5	3	3	3	1	3	1	3	1	1	1	2	3	3	-
	15	15	15	6	15	6	15	5	5	6	11	3	3	-

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	15	15	15	6	15	6	15	5	5	6	11	3	3	-
Scaled Value	3	3	3	2	3	2	3	1	1	2	3	3	3	-

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XMA 201			CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	L	T	P	C
				3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		3	1	0	4

Prerequisite: Mathematics I (Calculus and Linear Algebra)

Learning Objectives:

Upon completion of this course, the students

- Would have learn to solve differential equations and complex variables.
- Would have learn to apply the learned things in real life.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Find*** double and triple integrals and to find line, surface and volume of an integral by ***Applying*** Greens, Gauss divergence and Stokes theorem.	Cognitive	Applying Remembering
CO2	***Solve*** first order differential equations of different types which are solvable for p, y, x and Clairaut's type.	Cognitive	Applying
CO3	***Solve*** Second order ordinary differential equations with variable coefficients using various methods.	Cognitive	Applying
CO4	***Use*** CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation.	Cognitive Psychomotor	Remembering Applying Response
CO5	***Apply*** Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series.	Cognitive Affective	Applying Receiving

I – Multivariable Calculus (Integration)	**12**
Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes.	
II – First order ordinary differential equations	**12**
Exact - linear and Bernoulli's equations - Euler's equations - Equations not of first degree: equations solvable for p - equations solvable for y- equations solvable for x and Clairaut's type.	
III – Ordinary differential equations of higher orders	**12**
Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.	
IV – Complex Variable – Differentiation	**12**
Differentiation-Cauchy-Riemann equations- analytic functions-harmonic functions-finding harmonic conjugate- elementary analytic functions (exponential, trigonometric, logarithm) and their properties- Conformal mappings- Mobius transformations and their properties.	
V – Complex Variable – Integration	**12**
Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)- Liouville's theorem (without proof)- Taylor's series- zeros of analytic functions- singularities- Laurent's series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.	

Lecture	Tutorial	Practical	Total
45	15	0	60

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40thth Edition, 2008.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn. Wiley India, 2009.
4. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

Mapping of COs with GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
Original Value	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XCP 202			PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
				3	0	2	5
C	P	A		L	T	P	H
				3	0	2	5

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn to Solve simple programs.
- Would have learn to write simple programs.

	Course Outcomes	Domain	Level
After the completion of the course, students will be able to			
CO1	***Define*** programming fundamentals and ***Solve*** simple programs using I/O statements	Cognitive Psychomotor	Remember Understand Apply
CO2	***Define*** syntax and ***write simple programs*** using control structures and arrays	Cognitive Psychomotor	Remember Understand, Apply
CO3	***Explain*** and ***write simple programs*** using functions and pointers	Cognitive Psychomotor	Understand Apply
CO4	***Explain*** and ***write simple programs*** using structures and unions	Cognitive Psychomotor	Understand Apply, Analyze
CO5	***Explain*** and ***write simple programs*** using files and ***Build*** simple projects	Cognitive Psychomotor	Remember Understand Create

I – Programming Fundamentals and Input/ Output Statements	**9+6**
Introduction to components of a computer system, Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure -Header files – Data Types-Variables - Output statements – Input statements.	
II – Control Structure and Arrays	**9+6**
Control Structures – Conditional Control statements: Branching, Looping -Unconditional control structures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declaration – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional arrays - Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration – Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings.	
III – Functions and Pointers	**9+6**
Functions: Built in functions – User Defined Functions - Parameter passing methods - Passing arrays to functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address operator - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference - Pointer to arrays - Use of Pointers in self-referential structures- Notion of linked list(no implementation).	
IV – Structures and Unions	**9+6**
Structures and Unions - Giving values to members - Initializing structure -Functions and structures - Passing structure to elements to functions - Passing entire function to functions - Arrays of structure - Structure within a structure and Union.	
V – Files	**9+6**
File management in C - File operation functions in C - Defining and opening a file - Closing a file -	

The getw and putw functions - The fprintf & fscanf functions - fseek function – Files and Structures.

Practical:

1. Program to display a simple picture using dots.
2. Program for addition of two numbers
3. Program to swap two numbers
4. Program to solve any mathematical formula.
5. Program to find greatest of 3 numbers using Branching Statements
6. Program to display divisible numbers between n1 and n2 using looping Statement
7. Program to remove duplicate element in an array.
8. Program to perform string operations.
9. Performing basic sorting algorithms.
10. Program to find factorial of a given number using four function types.
11. Programs using Recursion such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort
12. Programs using Pointers.
13. Program to read and display student mark sheet Structures with variables
14. Program to read and display student marks of a class using Structures with arrays
15. Program to create linked list using Structures with pointers.
16. Program for copying contents of one file to another file.
17. Program using files using structure with pointer.

Lecture	Tutorial	Practical	Total
45	**0**	**30**	**75**

Text Books:

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 2010
2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008
3. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc. 2005

Reference Books:

1. Behrouz A. Forouzan and Richard. F. Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks–Cole Thomson Learning Publications, 2001
2. Johnson baugh R. and Kalin M., “Applications Programming in ANSI C”, III Edition, Pearson Education India, 2003

E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

E-References:

1. http://www.digimat.in/nptel/courses/video/106105171/L01.html

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2			3						2	3	2	
CO 2	3	2			2						2	3	2	
CO 3	2	2	1	2	2						2	2	2	
CO 4	2	2	1	2	2						2	2	2	
CO 5	2	2	1		2			1		2	2	2	2	
	12	**10**	**3**	**4**	**11**			**1**		**2**	**10**	**12**	**10**	

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**12**	**10**	**3**	**4**	**11**			**1**		**2**	**10**	**12**	**10**	
Scaled Value	3	2	1	1	3			**1**		1	2	3	2	

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XGS 203			ENGLISH	L	T	P	C
				2	0	1	3
C	P	A		L	T	P	H
2.6	0.4	0		2	0	2	4

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn to use good vocabulary for speaking and writing.
- Would have learn to find grammatical errors while writing.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Ability*** to recall the meaning for proper usage	Cognitive	Remember
CO2	***Apply*** the techniques in sentence patterns	Cognitive	Apply
CO3	***Identify*** the common errors in sentences	Cognitive	Remember
CO4	***Construct*** the Nature and Style of sensible Writing	Cognitive	Create
CO5	***Practicing*** the writing skills.	Psychomotor	Guided Response
CO6	***Grasping*** the techniques in learning sounds and etiquettes	Psychomotor	Adapting

I – Vocabulary Building	**9**
1.1 The concept of Word Formation 1.2 Root words from foreign languages and their use in English 1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. 1.4 Synonyms, antonyms, and standard abbreviations.	
II – Basic Writing Skills	**9**
2.1 Sentence Structures 2.2 Use of phrases and clauses in sentences 2.3 Importance of proper punctuation 2.4 Creating coherence 2.5 Organizing principles of paragraphs in documents 2.6 Techniques for writing precisely	
III – Identifying Common Errors in Writing	**9**
3.1 Subject-verb agreement 3.2 Noun-pronoun agreement 3.3 Misplaced modifiers 3.4 Articles 3.5 Prepositions 3.6 Redundancies 3.7 Clichés	
IV – Nature and Style of sensible Writing	**9**
4.1 Describing 4.2 Defining 4.3 Classifying 4.4 Providing examples or evidence 4.5 Writing introduction and conclusion	
V – Writing Practices	**9**
5.1 Comprehension 5.2 Précis Writing 5.3 Essay Writing	
VI – Oral Communication Lab	

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Lecture	Tutorial	Practical	Total
30	0	15	45

Text Books:

1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011
2. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Reference Books:

1. Practical English Usage. Michael Swan. OUP. 1995
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006

E-References:

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO 2	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO 3	1	0	0	0	0	0	1	0	1	0	0	0	0	0
CO 4	2	0	0	0	0	0	1	0	1	0	0	0	0	0
CO 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**4**	**0**	**0**	**0**	**0**	**0**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**7**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**4**	**0**	**0**	**0**	**0**	**0**
Scaled Value	2	0	0	0	0	0	2	0	1	0	0	0	0	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XAC 204			APPLIED CHEMISTRY FOR ENGINEERS	L	T	P	C
				3	1	1	5
C	P	A		L	T	P	H
3.5	1	0.5		3	1	3	7

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn about microscopic chemistry.
- Would have learn to how to use spectroscopy for engineering chemical reactions.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Identify*** the periodic properties such as ionization energy, electron affinity, oxidation states and electro negativity. ***Describe*** the various water quality parameters like hardness and alkalinity.	Cognitive Psychomotor	Remember Perception
CO2	***Interpret*** bulk properties and processes using thermodynamic and kinetic considerations.	Cognitive Psychomotor	Understand Set
CO3	***Explain*** *and* ***Measure*** microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive Psychomotor Affective	Apply Mechanism Receive
CO4	***Describe, Illustrate*** *and* ***Discuss*** the chemical reactions that are used in the synthesis of molecules.	Cognitive Psychomotor Affective	Remember Analyze Perception Respond
CO5	***Apply, Measure*** and ***Distinguish*** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	Cognitive Psychomotor	Remember Apply Mechanism

I – Periodic Properties and Water Chemistry **8+3+6**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity, electronegativity, polarizability and oxidation states. **Water Chemistry**-Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.

II – Use of Free Energy in Chemical Equilibria **12+3+6**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electroless plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).

III – Atomic and Molecular Structure **10+3+6**

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles.. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Intermolecular forces and potential energy surfaces

Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

IV – Spectroscopic Techniques and Applications	**7+3+6**
Principles of spectroscopy and selection rules. Electronic spectroscopy-chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.	
V – Stereochemistry and Organic Reactions	**8+3+6**
Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds ***Organic reactions and synthesis of a drug molecule*** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule- Aspirin and paracetamol.	
List of Practical Experiments 1. Determination of chloride ion present in the water sample by Argentometric method. 2. Determination of total, temporary and permanent hardness of water sample by EDTA 3. Determination of cell constant and conductance of solutions. 4. Potentiometry - determination of redox potentials and emfs. 5. Determination of surface tension and viscosity. 6. Adsorption of acetic acid by charcoal. 7. Determination of the rate constant of a reaction. 8. Estimation of iron by colorimetric method. 9. Synthesis of a polymer/drug. 10. Saponification/acid value of an oil.	

Lecture	**Tutorial**	**Practical**	**Total**
45	**15**	**45**	**90**

Text Books:

1. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd
2. edition), New Delhi, Shoban Lal Nagin Chand & Co., 1993
3. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science, 2006.
4. Trapp. C, Cady, M. Giunta. C, Atkins's Physical Chemistry, 10th Edition, Oxford publishers, 2014.
5. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd, 1983.
6. Morrison R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn
7. & Bacon Ltd., 1976.
8. Banwell. C.N, Fundamentals of Molecular Spectroscopy, (3th Edition), McGraw-Hill Book Company, Europe 1983.
9. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (4th edition), S./ Chand & Company Ltd. New Delhi, 1977.
10. P. S. Kalsi, Stereochemistry: Conformation and mechanism, (9th Edition), New Age International Publishers, 2017.

Reference Books:

1. Puri B R Sharma L R and Madan S Pathania, " Principles of Physical Chemistry", Vishal publishing Co., Edition 2004
2. Kuriocose, J C and Rajaram, J, "Engineering Chemistry", Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000
3. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
4. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.

E-References:

1. http://www.mooc-list.com/course/chemistry-minor-saylororg
2. https://www.canvas.net/courses/exploring-chemistry
3. http://freevideolectures.com/Course/2263/Engineering-Chemistry-I
4. http://freevideolectures.com/Course/3001/Chemistry-I
5. http://freevideolectures.com/Course/3167/Chemistry-II
6. http://ocw.mit.edu/courses/chemistry/
7. http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques
8. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011
9. http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

Mapping of COs with Gas

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2	1	2	2	1	1	0	2	0	1	1
CO 2	3	2	1	3	1	1	1	0	2	0	1	0
CO 3	3	3	1	3	2	0	1	0	2	0	1	0
CO 4	3	2	1	2	3	1	1	0	1	0	1	1
CO 5	2	2	1	2	1	0	1	0	1	0	1	0
	14	**11**	**5**	**12**	**9**	**3**	**5**	**0**	**8**	**0**	**5**	**2**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with Gas

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
Original Value	**14**	**11**	**5**	**12**	**9**	**3**	**5**	**0**	**8**	**0**	**5**	**2**
Scaled Value	3	3	1	3	2	1	1	0	2	0	1	1

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XWP 205			WORKSHOP PRACTICES	L	T	P	C
				1	0	2	3
C	P	A		L	T	P	H
1	3	0		2	0	4	6

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn to cast and mould things.
- Would have learn the use of various tools of carpentry.

	Course Outcomes	Domain	Level
After the completion of the course, students will be able to			
CO1	***Summarize*** the machining methods and ***Practice*** machining operation.	Cognitive Psychomotor	Understanding Guided response
CO2	***Defining*** metal casting process, moulding methods and **relates** Casting and Smithy applications.	Cognitive Psychomotor	Remembering Perception
CO3	***Plan*** basic carpentry and fitting operation and ***Practice*** carpentry and fitting operations.	Cognitive Psychomotor	Applying Guided response
CO4	***Summarize*** metal joining operation and ***Practice*** welding operation.	Cognitive Psychomotor	Understanding Guided response
CO5	***Illustrate*** the, electrical and electronics basics and ***Makes*** appropriate connections**.**	Cognitive Psychomotor	Understanding Origination

I – **6+12**

1. Introduction to Machining Process
2. Plain Turining Using Lathe Operation
3. Introduction to Cnc
4. Demonstration of Plain Turning Using Cnc

II – **6+9**

1. Study Of Metal Casting Operation
2. Demonstration Of Moulding Process
3. Study Of Smithy Operation

III – **6+18**

1. Study of carpentry tools
2. Half lap joint – Carpentry
3. Mortise and Tenon joint – Carpentry
4. Study of fitting tools
5. Square fitting
6. Triangular fitting

IV – **6+9**

1. Study Of Welding Tools
2. Square butt joint – welding
3. Tee joint – Welding

V – **6+12**

1. Introduction to house wiring
2. One lamp controlled by one switch
3. Two lamps controlled by single switch
4. Staircase wiring

Lecture	Tutorial	Practical	Total
30	0	60	90

Text Books:

1. Workshop Technology I,II,III, By S K Hajra, Choudhary And A K Chaoudhary. Media Promoters And Publishers Pvt. Ltd., Bombay 2. Workshop Technology By Manchanda Vol. I,II,III India Publishing House, Jalandhar.
Reference Books:
1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd. 2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi 3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi. 4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.
E-References:
1. http://nptel.ac.in/courses/112107145/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	2	2	1	0	0	1	1	0	1	2	0	0
CO 2	2	1	2	2	1	0	0	1	1	0	1	2	0	0
CO 3	2	1	2	2	1	0	0	1	1	0	1	2	0	0
CO 4	2	1	2	2	1	0	0	1	1	0	1	2	0	0
CO 5	2	1	2	2	1	0	0	1	1	0	1	2	0	0
	10	**5**	**10**	**10**	**5**	**0**	**0**	**5**	**5**	**0**	**5**	**10**	**0**	**0**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**10**	**5**	**10**	**10**	**5**	**0**	**0**	**5**	**5**	**0**	**5**	**10**	0	0
Scaled Value	2	1	2	2	1	0	0	1	1		1	2	0	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XPS 301			PROBABILITY AND STATISTICS	L	T	P	C
				3	1	0	4
C	P	A		L	T	P	H
3.5	0.25	0.25		3	1	0	4

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would appreciate the importance of probability and statistics in computing and research.
- Would develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries and to use appropriate statistical method in the analysis of simple datasets.
- Would interpret and clearly present output from statistical analyses in a clear concise and understandable manner.
- Would gain the knowledge in foundations of probabilities and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Explain*** conditional probability, independent events; **find** expected values and Moments of Discrete random variables with properties.	Cognitive	Understanding Remembering
CO2	***Find*** distribution function, Marginal density function, conditional density function, ***Define*** density function of conditional distribution functions normal, exponential and gamma distributions.	Cognitive	Remembering
CO3	***Find*** measures of central tendency, statistical parameters of Binomial, Poisson and Normal, correlation, regression. Rank Correlation coefficient of two variables.	Cognitive Psychomotor	Remembering Guided Response
CO4	***Explain*** large sample test for single proportion, difference of proportion, single mean, difference of means and difference of standard deviations with simple problems.	Cognitive	Understanding
CO5	***Explain*** small sample test for single mean, difference of mean and correlation coefficients, variance test, chi-square test with simple Problems.	Cognitive Affective	Understanding Receiving

I – Basic Probability	**12**
Probability spaces, conditional probability, independence, Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Chebyshev's Inequality.	
II – Continuous Probability Distributions & Bivariate Distributions	**12**
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities.	
III – Basic Statistics	**12**
Measures of Central tendency: Moments, Skewness and Kurtosis - Probability distributions: Binomial, Poisson and normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.	
IV – Applied Statistics	**12**

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.	
V – Small Samples	**12**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	

Lecture	Tutorial	Practical	Total
45	15	0	60

Text Books:

1. Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw-Hill, New Delhi, 2010.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003 (Reprint).
3. S. Ross, "A First Course in Probability", 6th Ed., Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.

E-References:

1. Probability And Statistics By Prof.Someshkumar, Department Of Mathematics, Iit Kharagpur (Http://Nptel.Ac.In/Noc/Noc_Courselist.Php)

Mapping of COs with GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2	1						1	1		1
CO 2	3	2	1						1	1		1
CO 3	3	2	1	1					1	1		1
CO 4	3	2	1	1	1	1			1	1	1	1
CO 5	3	2	1	1	1	1	1		1	1	1	1
	15	**10**	**5**	**3**	**2**	**2**	**1**		**5**	**5**	**2**	**5**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
Original Value	**15**	**10**	**5**	**3**	**2**	**2**	**1**	**0**	**5**	**5**	**2**	**5**
Scaled Value	3	2	1	1	1	1	1	0	1	1	1	1

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT302			MATERIAL AND ENERGY BALANCE	L	T	P	C
				2	1	0	3
C	P	A		L	T	P	H
1	0.5	0.5		2	1	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have understood the material and energy balance for process engineering.
- Would have understood the methods of calculations for reactive and chemical systems.
- Would apply their knowledge of principles of material and energy balance for engineering applications.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Interpret*** different unit systems and***Express***the composition gas liquid and solid systems	Cognitive	Understanding Remembering
CO2	***Compute*** the material balances across different unit operations	Cognitive	Understanding Analysing
CO3	**Compute** the material balances across chemical reactors	Cognitive	Understanding Analysing
CO4	***Explain*** the energy balance calculations for systems with and without chemical reactions	Cognitive	Understanding
CO5	***Describe*** the humidification operations	Cognitive	Understanding Receiving

I – Stoichiometric Principles and Basic Calculations	**6+3**
Introductory concepts of units, physical quantities in chemical engineering, dimensionless groups, "basis" of calculations - Methods of expression, compositions of mixture and solutions. Gases, Vapors and Liquids: Equations of state, Vapor pressure, Clausius-Clapeyron equation, Cox chart, Duhring's plot, Raoult's law.	
II – Material Balances for Unit Operations	**6+3**
Material balances to different unit operations - recycle - bypass and purging. Distillation, extraction, mixing, drying, crystallization, evaporation, adsorption and absorption, Material balance for multiple unit	
III – Material Balances for Reacting System	**6+3**
Material balances with chemical reaction - Limiting and excess reactants – Combustion – Yield, conversion and selectivity calculations, Material balance for multiple unit	
IV – Energy Balances	**6+3**
Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats	
V – Energy Balances for Chemical Systems	**6+3**
Energy balances with chemical reaction: Heat of reaction, Heat of combustion - Evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction.	

Lecture	Tutorial	Practical	Total
30	15	0	45

Text Books:

1. K.V.Narayanan and Lakshmikutty, ***Chemical Process Calculations***, Prentice Hall, 2004.
2. D. M. Himmelblau and J. B. Riggs, ***Basic Principles and Calculations in Chemical Engineering***, Pearson India Education Services, 8th Edition, 2015.
3. B. I. Bhatt and S.M. Vora, **Stoichiometry**, Tata McGraw Hill Publishing Company Ltd, 4th Edition, 2004.
4. Richard M. Felder and Ronald W. Rousseau, ***Elementary Principles of Chemical Processes***, John Wiley & Sons, INC. 3rd Edition, 2000.

Reference Books:

1. V. Venkataramani, N. Anantharaman, and Begum, K. M. MeeraSheriffa, Process Calculations, Prentice Hall of India, 2nd Edition.
2. D. C. Sikdar, Chemical Process Calculations, Prentice Hall of India.

E-References:

1. http://nptel.ac.in/syllabus/103106076/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	3	2	0	2	0	0	0	0		2	2
CO 2	3	3	2	3	2	0	2	0	0	0	0		2	2
CO 3	3	3	2	3	2	0	2	0	0	0	0		2	2
CO 4	3	3	2	3	2	0	2	0	0	0	0		2	2
CO 5	3	3	2	3	2	0	2	0	0	0	0		2	2
	15	**15**	**10**	**15**	**10**	**0**	**10**	**0**	**0**	**0**	**0**		**10**	**10**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**15**	**15**	**10**	**15**	**10**	**0**	**10**	**0**	**0**	**0**	**0**		**10**	**10**
Scaled Value	3	3	2	3	2	0	2	0	0	0	0		2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 303			BIOCHEMISTRY	L	T	P	C
				3	1	0	4
C	P	A		L	T	P	H
3	1.75	0.25		3	1	0	4

Prerequisite: Applied Physics, Applied Chemistry, Biology

Learning Objectives:

Upon completion of this course, the students

- Would have learn the fundamentals of biomolecules.
- Would have learn the functions of proteins and biosignalling.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Recognize*** and ***Understand*** about role of water and amino acids.	Cognitive Psychomotor	Remembering Recieving
CO2	***Recognize*** and ***Understand*** proteins and their structures. Also, will learn about enzymes.	Cognitive Psychomotor	Recalling Origination
CO3	***Recognize*** and ***Understand*** about carbohydrate and glycobiology.	Cognitive Psychomotor	Create Guided Response
CO4	***Recognize*** and ***Understand*** about Nucleotides and Nucleic acids.	Cognitive Psychomotor	Create Guided response
CO5	***Recognize*** and ***Understand*** lipids and biosignalling.	Cognitive Psychomotor	Create Guided response

I – Water, Amino acids and Proteins	**9+3**
Water, Weak Interactions in Aqueous Systems, Ionization of Water, Weak Acids, and Weak Bases, Buffering against pH changes in biological systems. Water as a reactant. Amino acids, structures of 20 common acids and properties, Peptides, Proteins, Genetic codon. Structure of Proteins- Primary, Secondary, Tertiary structure and Quaternary Structures – Fibrous Proteins.	
II – Protein Function and Enzymes	**11+3**
Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins: Complementary Interactions between Proteins and Ligands: Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors: An Introduction to Enzymes: How Enzymes Work, Mechanism, Examples of Enzymatic Reactions, Regulatory Enzymes.	
III – Carbohydrates and Glycobiology	**10+3**
Monosaccharides and Disaccharides: Polysaccharides: Glycoconjugates: Proteoglycans, Glycoproteins, and Glycolipids: Carbohydrates as Informational Molecules: The Sugar Code: Working with Carbohydrates.	
IV – Nucleotides and Nucleic acids	**6+3**
Fundamentals of nucleotides and nucleic acids: Nucleic Acid Structure: Nucleic Acid Chemistry: Other Functions of Nucleotides.	
V – Lipids, biological membranes and transport	**9+3**
Storage Lipids: Structural Lipids in Membranes: Lipids as Signals, Cofactors, and Pigments: Working with Lipids: Biological membranes and transport: Composition and architecture of membranes, membrane dynamics and solute transport across membranes.	

Lecture	Tutorial	Practical	Total

45	15	0	60

Text Books:

1. Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, W. H. Freeman; 6th edition (13 February 2013), 1158 pages ISBN-10: 1464109621, ISBN-13: 978-1464109621.
2. Biochemistry, Donald Voet, Judith G. Voet 4th Edition, 2011, 1520 pages ISBN: 978-0-470-91410-6.
3. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999.

Reference Books:

1. Introduction to Protein structure, 2nd Ed by Carl Branden and John Tooze, Garland Press, 1999.
2. Structure and Mechanism in Protein Science, Alan Fersht, Freeman, 1999.
3. Protein engineering in Industrial biotechnology, Ed. Lilia Alberghina, Harwood Academic Publishers, 2002.
4. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993.

E-References:

1. http://vlab.amrita.edu/?sub=3&brch=63
2. https://www.youtube.com/channel/UCbWTmSK7bYM9kRZAdfy_gyg

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	0	1	0	0	1	1	1	1	3	2	3
CO 2	1	1	2	0	1	0	0	1	1	1	1	0	3	2
CO 3	1	1	2	0	1	0	0	1	1	1	1	2	2	1
CO 4	1	1	2	0	1	0	0	1	1	1	1	0	1	0
CO 5	1	1	2	0	1	0	0	1	1	1	1	2	0	0
	5	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**7**	**8**	**6**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**5**	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**7**	**8**	**6**
Scaled Value	1	1	2	0	1	0	0	1	1	1	1	2	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 304			MICROBIOLOGY	L	T	P	C
				3	0	2	4
C	P	A		L	T	P	H
2	0.5	0.5		3	0	2	5

Prerequisite: Biology, Chemistry

Learning Objectives:

Upon completion of this course, the students

- Would have understand the existence of microbial world through the study of the characteristics of microorganisms, multiplication, growth in different media and their control.
- Would apply their knowledge of microbiology to demonstrate aseptic microbiological techniques in the laboratory.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Comprehend*** knowledge about historical perspective of microbiology and its developments. ***Recognize*** the fundamental concepts in the structure and functioning of a prokaryotic cell. ***Perform*** staining techniques to observe microorganisms	Cognitive Psychomotor	Understanding Remembering Applying Guided response
CO2	***Acquire*** knowledge about microbial taxonomy and microbial classification methods.	Cognitive Psychomotor	Understanding Remembering Applying Guided response
CO3	***Demonstrate*** the microbial nutritional requirements. ***Perform*** culturing techniques to isolate microorganisms	Cognitive Psychomotor	Understanding Remembering Guided response
CO4	***Choose*** the appropriate media for the cultivation of microorganisms and ***Acquire*** knowledge on the bacterial growth, growth curve and control of microorganisms.	Cognitive Psychomotor	Understanding Remembering Guided response
CO5	***Demonstrate*** the various industrial applications of microorganisms.	Cognitive	Understanding Remembering

I- Introduction to Microbiology	**7 + 3 + 9**
History and Scope of Microbiology – Study of microbial structure: Microscopy (light, dark-field, phase contrast, electron), Specimen preparation, Staining techniques (simple and differential) – Overview of Prokaryotic cell structure: Cell membrane, Cytoplasmic matrix, Cell wall, Flagella, Capsule.	
II- Classification of Microorganisms	**9 + 3 + 3**
Taxonomy: Binomial Nomenclature – Five Kingdom classification system: Monera, Protista, Fungi, Plantae, Animalia – Three Domain classification: Bacteria, Archea, Eukarya – Classification of viruses – Methods of Classification: Morphological characteristics, Physiological and metabolic characteristics, Biochemical characteristics, Ecological characteristics, Molecular characteristics.	
III- Microbial Nutrition and Culturing Techniques	**11 + 3 + 12**
Nutritional types of microorganisms: Autotrophs, Heterotrophs, Phototrophs, Chemotrophs, Lithotrophs, Organotrophs – Culture media: defined, complex – Culture techniques: spread plate, streak plate, pour plate) – Preservation of microbial cultures – Microbe-microbe interaction: Mutualism, Parasitism,	

Commensalism	
IV- Microbial Growth and Control	**11 + 3+ 6**
Microbial Growth: Growth curve (lag, exponential, stationary, death phase), Measurement (cell number, cell mass), Factors influencing growth (water activity, pH, temperature, oxygen, pressure, radiation) – Microbial Control: Use of physical methods (moist heat, dry heat, radiation), Use of chemical agents (phenols, alcohols, gases).	
V- Industrial Microbiology	**7 + 3**
Microbial products: Antibiotics, Amino acids, Organic acids, Biopolymers, Biosurfactants, Biocatalysts, Vaccines – Biofuel production – Wastewater treatment – Microbial fuel cells – Biodegradation and Bioremediation	
Microbiology Lab	
List of Practical Experiments	
1. Media preparation and Sterilization	CO1
2. Preparation of slants /plates and aseptic transfer of microbial cultures	CO1
3. Staining and identification of microbes using simple and differential staining	CO1
4. Biochemical characterization of microbes	CO2
5. Isolation of microbes using spread plate method	CO3
6. Isolation of microbes using streak plate method	CO3
7. Isolation of microbes using pour plate method	CO3
8. Microbial growth control using Kirby-Bauer method	CO4
9. Cell counting	CO4
10. Screening of microorganisms for enzyme production	CO5

Lecture	Tutorial	Practical	Total
45	**15**	**30**	**90**

Text Books:

1. Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. *McGrawJ Hill Higher Education*, 2005.

Reference Books:

1. Morcello, J. A., Mizer, H. E., & Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003
2. Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.
3. Black, Jacquelyn G. *Microbiology: principles and explorations.* John Wiley & Sons, 2008.
4. Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. *Microbiology: an introduction*. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.

E-References:

1. http://www.austincc.edu/rohde/noteref.htm
2. http://www.uwyo.edu/molb2210_lect/lecture/lectures.html

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	0	1	0	1	1	1	1	0	0
CO 2	3	3	1	1	1	2	2	1	1	1	1	1	0	0
CO 3	3	1	2	3	1	2	1	0	1	1	1	1	2	0
CO 4	3	3	2	0	1	0	2	0	1	1	1	1	0	2
CO	3	2	2	3	1	2	2	1	1	0	1	1	2	2

5														
	15	**12**	**8**	**8**	**5**	**6**	**8**	**2**	**5**	**4**	**5**	**5**	**4**	**2**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**15**	**12**	**8**	**8**	**5**	**6**	**8**	**2**	**5**	**4**	**5**	**5**	**4**	**2**
Scaled Value	3	3	2	2	1	2	2	1	1	1	1	1	1	1

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 305			UNIT OPERATIONS	L	T	P	C
				3	1	2	5
C	P	A		L	T	P	H
3	1	1		3	2	2	7

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have understood the existence of unit operations through the study of the characteristics of fluid mechanics, particle mechanics, heat transfer and mass transfer.
- Would have understood the phenomena and function of basic sciences for the engineering principles.
- Would apply their knowledge of principles techniques in the laboratory.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Interprets*** and ***Analyze*** the dimensional homogeneity of unit operations	Cognitive	Understanding Remembering Applying Guided response
CO2	***Distinguishes*** types of fluids and fluid flow, ***Explain*** the energy balances across fluid moving systems	Cognitive Psychomotor	Understanding Remembering Applying Guided response
CO3	***Demonstrates*** the Particles, Size reduction, agitation, mixing, centrifugation and filtration operations	Cognitive Affective	Understanding Remembering Guided response
CO4	***Analyse*** the mechanism of conduction and convection mode of heat transfer	Cognitive Psychomotor	Understanding Remembering Guided response
CO5	***Outlines*** the modes of mass transfer operations and ***Describes*** the basic principles in distillation, extraction and drying	Cognitive Affective	Understanding Remembering

Course content	Hours
I – Dimensional Analysis	**8+6+6**
Units and Dimensions, dimensional homogeneity and dimensionless numbers and similitude	
II – Fluid Mechanics	**10+6+6**
Definition and classification, types of fluids, types of flow. Equations for flow, Continuity equation, Bernoulli equation, Hagen-Poiseuille equation. Fluid flow measuring devices, valves, pumps, energy calculations and characteristic of pumps.	
III – Mechanical Operations	**9+6+6**
Characterization of particles shape and size, Size reduction, settling and sedimentation. Agitation and Mixing - power consumption in mixing. Fluid solid interactions, Centrifugation, membrane filtration and filtration equipment's.	
IV – Heat Transfer	**9+6+6**
Heat conduction, conduction through single and multi-layers walls, insulations. Convective heat transfer,	

forced and natural convection, condensation. Type of heat exchangers.

V – Mass Transfer	**9+6+6**

Basics, modes of mass transfer, Fick's law of Diffusion, mass transfer correlations. Mass transfer operations: Distillation, extraction and drying.

Unit Operations Lab

List of Practical Experiments

1. Identification of fluid types and flow
2. Flow measurements by flow meters
3. Centrifugal and Reciprocating pump characteristics
4. Settling and sedimentation
5. Centrifugation
6. Rotary drum filter
7. Mixing power consumption
8. Heat transfer by Conduction
9. Heat transfer by Convection
10. Heat exchangers

Lecture	Tutorial	Practical	Total
45	**30**	**30**	**105**

Text Books:

1. McCabe, Warren L., Julian C. Smith, and Peter Harriott, Unit Operations of Chemical Engineering,McGraw-Hill, 2010.
2. Warren, L. M., C. S. Julian, and H. Peter, Unit operations of chemical engineering, McGraw Hill Book Company, 2005.
3. Geankoplis, Christie John, Allen H. Hersel, and Daniel H. Lepek, Transport processes and separation process principles, Prentice hall, 2018.
4. Welty J, Rorrer GL, Foster DG.,Fundamentals of Momentum, Heat, and Mass Transfer,. Wiley, Revised 6th Edition; 2014.

Reference Books:

1. Benitez, Jaime, Principles and modern applications of mass transfer operations, John Wiley & Sons, 2016.
2. Ravi, R., R. Vinu, and Sathyanarayana N. Gummadi, eds. Coulson and Richardson's Chemical Engineering: Volume 3A: ,Chemical and Biochemical Reactors and Reaction Engineering, Butterworth-Heinemann, 2017.

E-References:

1. http://ce-iitb.vlabs.ac.in/List%20of%20experiments.html?domain=Chemical%20Engineering
2. http://uorepc-nitk.vlabs.ac.in/#
3. http://iitg.vlab.co.in/?sub=58

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	2	2	2	0	0	0	1	3	0	0
CO 2	3	3	2	2	1	2	2	0	0	0	2	2	1	1
CO 3	3	3	2	3	1	2	2	0	0	0	2	3	2	3
CO 4	3	3	2	3	1	2	2	0	0	0	2	2	2	2
CO 5	3	3	2	3	1	2	2	0	0	0	2	3	3	3

	15	**15**	**9**	**12**	**6**	**10**	**10**	**0**	**0**	**0**	**9**	**13**	**8**	**9**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**15**	**15**	**9**	**12**	**6**	**10**	**10**	**0**	**0**	**0**	**9**	**13**	**8**	**9**
Scaled Value	3	3	2	3	2	2	2	0	0	0	2	3	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XUM 306			HUMAN ETHICS	L	T	P	C
				2	1	0	0
C	P	A		L	T	P	H
1	0	0		2	1	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn about ethics of human relationships.
- Would have learn about gender equality, women issues and empowerment.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Relate*** and ***Interpret*** the human ethics and human relationships	Cognitive	Remember, Understanding
CO2	***Explain*** and ***Apply*** gender issues, equality and violence against women	Cognitive	Understanding, Applying
CO3	***Classify*** and ***Develop*** the identify of women issues and challenges	Cognitive Affective	Analyzing Receiving
CO4	***Classify*** and ***Dissect*** human rights and report on violations.	Cognitive	Understanding, Analyze
CO5	***List*** and ***respond*** to family values, universal brotherhood, fight against corruption by common man and good governance.	Cognitive Affective	Remember, (Respond)

Course content	Hours
I – Human Ethics and Values	**4+3**
Human Ethics and values - Understanding of oneself and others- motives and needs- Social service, Social Justice, Dignity and worth, Harmony in human relationship: Family and Society, Integrity and Competence, Caring and Sharing, Honesty and Courage, WHO's holistic development - Valuing Time, Co-operation, Commitment, Sympathy and Empathy, Self-respect, Self-Confidence, character building and Personality.	
II – Gender Equality	**6+3**
Gender Equality - Gender Vs Sex, Concepts, definition, Gender equity, equality, and empowerment. Status of Women in India Social, Economical, Education, Health, Employment, HDI, GDI, GEM. Contributions of Dr.B.R. Ambethkar, Thanthai Periyar and Phule to Women Empowerment.	
III – Women Issues and Challenges	**6+3**
Women Issues and Challenges- Female Infanticide, Female feticide, Violence against women, Domestic violence, Sexual Harassment, Trafficking, Access to education, Marriage. Remedial Measures – Acts related to women: Political Right, Property Rights, and Rights to Education, Medical Termination of Pregnancy Act, and Dowry Prohibition Act.	
IV – Human Rights	**6+3**
Human Rights Movement in India – The preamble to the Constitution of India, Human Rights and Duties, Universal Declaration of Human Rights (UDHR), Civil, Political, Economical, Social and Cultural Rights, Rights against torture, Discrimination and forced Labour, Rights and protection of children and elderly. National Human Rights Commission and other statutory Commissions, Creation of Human Rights Literacy and Awareness. - Intellectual Property Rights (IPR). National Policy on	

occupational safety, occupational health and working environment.			
V – Good Governance and Addressing Social Issues			**8+3**
Good Governance - Democracy, People's Participation, Transparency in governance and audit, Corruption, Impact of corruption on society, whom to make corruption complaints, fight against corruption and related issues, Fairness in criminal justice administration, Government system of Redressal. Creation of People friendly environment and universal brotherhood.			
Lecture	**Tutorial**	**Practical**	**Total**
30	**15**	**0**	**45**

Text Books:

1. Aftab A, (Ed.), Human Rights in India: Issues and Challenges, (New Delhi: Raj Publications, 2012).
2. Bajwa, G.S. and Bajwa, D.K. Human Rights in India: Implementation and Violations (New Delhi: D.K. Publications, 1996).
3. Chatrath, K. J. S., (ed.), Education for Human Rights and Democracy (Shimala: Indian Institute of Advanced Studies, 1998).

Reference Books:

1. Jagadeesan. P. Marriage and Social legislations in Tamil Nadu, Chennai: Elachiapen Publications, 1990).
2. Kaushal, Rachna, Women and Human Rights in India (New Delhi: Kaveri Books, 2000)
3. Mani. V. S., Human Rights in India: An Overview (New Delhi: Institute for the World Congress on Human Rights, 1998).
4. Singh, B. P. Sehgal, (ed) Human Rights in India: Problems and Perspectives (New Delhi: Deep and Deep, 1999).
5. Veeramani, K. (ed) Periyar on Women Right, (Chennai: Emerald Publishers, 1996).
6. Veeramani, K. (ed) Periyar Feminism, (Periyar Maniammai University, Vallam, Thanjavur: 2010).
7. Planning Commission report on Occupational Health and Safety http://planningcommission.nic.in/aboutus/committee/wrkgrp12/wg_occup_safety.p
8. Central Vigilance Commission (Gov. of India) website: http://cvc.nic.in/welcome.html.
9. Weblink of Transparency International: https://www.transparency.org/

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1								3	3	3				
CO 2								3	3	3				
CO 3								3	3	3				
CO 4								3	3	3				
CO 5								3	3	3				
								15	**15**	**15**				

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15**	**15**	**15**	**0**	**0**	**0**	**0**
Scaled	0	0	0	0	0	0	0	3	3	3	0	0	0	0

Value														

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XES 401			MATERIAL SCIENCE	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn the properties of various materials and the processing system.
- Would have gain knowledge over the different materials in different domains.
- Would have learn about modern materials and their applications.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Study*** and ***understanding*** the basic properties of materials	Cognitive	Remembering Understanding
CO2	***Study*** and ***analyze*** the heat treatment process and its applications	Cognitive	Understanding, analyzing
CO3	***Compare*** and ***analyze*** the non-metallic materials and applications	Cognitive	Remembering, Understanding
CO4	***Explain*** and ***distinguish*** of engineering materials (mechanical and metallurgical)	Cognitive	Understanding Analyzing
CO5	***List*** and ***discuss*** the properties and applications of modern engineering materials.	Cognitive	Remembering, Applying

Course content	Hours
I – Basic Properties of Metallic Materials	**9**
Basic Crystallography- Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number. Frank Reed source of dislocation Elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application effect, yield point phenomenon, cold/hot working, recovery, re-crystallization, and grain growth, strengthening of metals.	
II – Heat Treatment of Materials	**9**
Heat Treatment- Definition – Full annealing, stress relief, recrystallisation – normalising, hardening and tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on I.T. diagram CCR Hardenability, Austempering, martempering.Case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening. Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti& W) - stainless and tool steels – HSLA. Gray, White malleable, spheroidal -Graphite - alloy cast-iron. Copper and Copper alloys – Brass, Bronze and Cupronickel. Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys.	
III – Non Metallic Materials	**9**
Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes. Fibre and particulate reinforced composites and resin plastics. Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing. Properties of Powder processed materials, high energy compaction. Metal matrix	

composites, preparation properties and uses.	
IV – Inspection of Engineering Materials	**9**
Mechanical Properties and Testing- Mechanism of plastic deformation, slip and twinning. Types of fracture – Testing of materials under tension, compression and shear loads – tests (Brinell, Vickers and Rockwell) Impact test, Izod and charpy, fatigue and creep test.	
V – Modern Engineering Materials	**9**
Metallic glasses- preparation of metallic glasses- properties – applications of the metallic glasses - Shape Memory Alloys (SMA) - Characteristics, properties of NiTi alloy - applications of the Shape memory alloys - advantages and disadvantages of SMA - Nanomaterials-synthesis –chemical vapour deposition – Sol Gels – ball Milling – properties of nanoparticles and applications of nanoparticles - Carbon Nanotubes(CNT)–structure–properties–applications of the CNTs.	

Lecture	Tutorial	Practical	Total
45	**0**	**0**	**45**

Text Books:

1. Engineering Materials: Properties and selection/ Kenneth G. Budinski, Michael K. Budinski/ Prentice Hall
2. Engineering materials / R K Rajput / S Chand and company Ltd.
3. Deformation and Fracture Mechanics of Engineering Materials/R. W. Hertzberg/ John Wiley & Sons.
4. Powder Metallurgy: An Advanced Technique Of Processing Engineering Materials/ B. K. DATTA/ PHI Learning Pvt. Ltd.
5. Materials Science and Engineering /Raghavan/ Prentice-Hall of India.

Reference Books:

1. Koch, C. C. Nanostructured materials: processing and applications: William Andrew Pub.
2. James F Shackelford, S "Introduction to materials Science for Engineers", 6 th Macmillan Publishing Company, New York, 2004
3. William D CallisterJr, "Materials Science and Engineering – An Introduction", John Wiley and Sons Inc., 6 th edition, New York, 2003
4. Jayakumar S, "Materials Science", RK Publishers, Coimbatore, 2004
5. Bolton, W., Engineering materials technology: Butterworth-Heinemann.

E-References:

1. NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112: related web and video resources under Mechanical Engineering &Metallurgy and Material Science categories
2. http://www.intechopen.com/books

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3										1	2	1	1
CO 2	2	3		1					1			1	1	1
CO 3		1	3									1	1	1
CO 4		1	2									1	1	1
CO 5	1	2	3	1								1	1	1
	6	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**6**	**5**	**5**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**6**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**6**	**5**	**5**
Scaled Value	2	2	2	1	0	0	0	0	1	0	1	2	1	1

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 402			GENETICS	L	T	P	C
				3	1	0	4
C	P	A		L	T	P	H
3	0	1		3	1	0	4

Prerequisite: Biochemistry and Microbiology

Learning Objectives:

Upon completion of this course, the students

- Would have learnt the fundamentals of genetics
- Would have learnt the gene mutations

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Relate*** and ***Interpret*** Reproduction as the basis of heredity and Gene interactions	Cognitive	Remember, Understanding
CO2	***Explain*** and ***Apply*** principles of dominance and segregation	Cognitive	Understanding, Applying
CO3	***Classify*** and ***Develop*** Quantitative traits and polygenic inheritance	Cognitive & Affective	Analyzing Receiving
CO4	***Classify*** and ***Dissect*** linking the inheritance of genes to chromosomes and chromosomes as arrays of genes	Cognitive	Understanding, Analyze
CO5	***List*** and respond DNA Replication and Transcription	Cognitive & Affective	Remember, (Respond)

Course content	Hours
I – Reproduction as Basis of Heredity	**7+3**
The relationship between genes and traits, the branches of genetics, relationship of genetics to other areas of biology, genetics and society. The cell as the unit of life, overview of chromosomes, cell division, gametogenesis, the life cycles of some genetically important organisms.	
II – Mendelian Principles of Genetics and Gene Interactions	**8+3**
The principles of dominance and segregation, the principle of independent assortment, applications of Mendelian principles. Gene interactions that produce new phenotypes, epistasis.	
III – Quantitative Inheritance	**8+3**
Quantitative traits, polygenic inheritance, heritability, Extranuclear genomes and inheritance: Organization of extranuclear genomes, role of extranuclear inheritance, examples of extranuclear inheritance, maternal effect, genomic imprinting.	
IV – Chromosomal Basis of Inheritance and Linkage	**8+3**
Experimental evidence linking the inheritance of genes to chromosomes, chromosomes as arrays of genes, non-disjunction as proof of the chromosome theory, the chromosomal basis of Mendelian principles.	
V – Construction of Genetics and Physical Maps and Gene Mutations and Chromosomal Changes	**14+3**
Linkage and crossing over, genetic mapping in eukaryotes, genetic transfer and mapping in bacteria, intragenic mapping in bacteriophages. DNA Replication in prokaryote and eukaryotes, enzymes and accessory proteins, telomere replication. DNA repair, Transcription process in prokaryote & eukaryotes, regulation of transcription. RNA processing, nuclear export and stability of RNA, Translation in	

prokaryote and eukaryotes translation, translational control , co and post translational modification of proteins, Regulation of Gene expression in prokaryotes & eukaryotes.
Occurrence and causes of DNA mutations, spontaneous and induced mutations, DNA repair, Types of chromosomal mutations, variations in chromosome structure, variations in chromosome number, chromosome rearrangements, consequences of mutations and Transposable elements.

Lecture	Tutorial	Practical	Total
45	15	0	60

Text Books:

1. Lewin's Lewin's Genes XII, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, 2017.

Reference Books:

1. Basic genetics : a human approach / BSCS. Dubuque, IA, Kendall/Hunt Pub. Co., c1999. 147 p. QH431.B305 1999.
2. Beighton, Peter and Greta Beighton. The person behind the syndrome. London, New York, Springer, c1997. 231 p. R134.B45 1997, Foreword by Hans-R. Wiedemann.
3. Bland, Jeffrey with Sara Benum. Genetic nutritioneering. Los Angeles, Keats Pub., c1999. 272 p. B155.B59 1999.
4. Bouchard, Claude, Robert M. Malina and Louis Pérusse. Genetics of fitness and physical performance. Champaign, IL, Human Kinetics, c1997. 400 p. QP301.B76 1997
5. Childs, Barton. Genetic medicine : a logic of disease. Baltimore, Johns Hopkins University Press, c1999. 326 p. RB155.C496 1999.
6. Connor, J. M. and Malcolm Ferguson-Smith. Essential medical genetics. Oxford, Eng., Malden, MA, Blackwell Science, 1997. 236 p. RB155.C66 1997.
7. Culture, kinship, and genes : towards cross-cultural genetics. Edited by Angus Clarke and Evelyn Parsons. New York, St. Martin's Press, 1997. 272 p. GN289.C55 1997.

E-References:

1. https://nptel.ac.in/syllabus/102107030/
2. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/video-lectures/lecture-6-genetics-1/
3. https://cosmolearning.org/courses/principles-mendelian-molecular-genetics/video-lectures/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	0	1	0	0	1	1	1	1	1	1	1
CO 2	1	1	2	0	1	0	0	1	1	1	1	1	1	2
CO 3	1	1	2	0	1	0	0	1	1	1	1	2	2	3
CO 4	1	1	2	0	1	0	0	1	1	1	1	3	3	1
CO 5	1	1	2	0	1	0	0	1	1	1	1	1	1	2
	5	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**8**	**8**	**9**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**5**	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**8**	**8**	**9**
Scaled Value	1	1	2	0	1	0	0	1	1	1	1	2	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 403			CELL BIOLOGY	L	T	P	C
				3	1	2	5
C	P	A		L	T	P	H
2	0.5	0.5		3	1	2	6

Prerequisite: Biology, Chemistry, Microbiology, Biochemistry

Learning Objectives:

Upon completion of this course, the students

- Would develop a deeper understanding of cell structure and how it relates to cell functions.
- Would understand how cells grow, divide, and die and how these important processes are regulated.
- Would understand cell signaling and how it regulates cellular functions.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Study*** and ***understand*** the origin of eukaryotic cells and cells specialization	Cognitive	Understanding Remembering Applying
CO2	***Recognize*** the fundamental concepts in the structure and functioning of a eukaryotic cell.	Cognitive	Understanding Remembering Applying
CO3	***Acquire*** knowledge on the transport of proteins between intracellular compartments	Cognitive	Understanding Remembering
CO4	***Acquire*** knowledge about cell cycles mitosis and meiosis	Cognitive Psychomotor	Understanding Remembering Guided response
CO5	***Describe*** cellular signalling and types of signaling receptors	Cognitive	Understanding Remembering

I – Cells and Tissues	**7+3+6**
Unity and Diversity of Cells – Origin of Eukaryotic cells – Plant cells – Viruses – Cell specialization: Epithelia, Connective tissue, Nervous tissue, Muscle – Cells as experimental models	
II – Cellular Organization and Membrane Transport	**11+3+6**
Overview of Eukaryotic cell structure: Cytoplasmic matrix, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast, Nucleus – Functions of cell organelles – Membrane Transport: Passive and Active transport – Sodium/potassium pumps, Ca2+, ATPase pumps, Uniport, Symport and Antiport system.	
III – Intracellular Protein Trafficking	**11+3+6**
Transport to and from the Nucleus – Transport Across Membranes – Vesicular Trafficking Between Intracellular Compartments	
IV – Cell Division and Control	**9+3+6**
The cell cycle – General description and different stages of mitosis and meiosis (Interphase, Prophase, Metaphase, Anaphase, Telophase) – Cell Growth Control: Apoptosis	
V – Cell Signaling	**7+3+6**
Cell Signaling: Types of Cell Signaling, General Principles of Cell Signaling – Receptors in Signaling: Types of Receptors, Signaling via G-Protein-linked Cell Surface Receptors, Signaling via Enzyme-	

linked Cell-Surface Receptors.

Cell Biology Lab

List Of Practical Experiments

1. Staining and observation of eukaryotic cells
2. Cell viability assay by trypan blue exclusion method.
3. Isolation of chloroplasts from spinach leaves
4. Osmosis and Tonicity
5. Extraction of lipids from tissues
6. Extraction of proteins from tissues
7. Separation of proteins by SDS-PAGE electrophoresis
8. Study of different stages of mitosis in onion root tip cells.
9. Study of different stages of meiosis in grasshopper testis cells

Lecture	Tutorial	Practical	Total
45	**15**	**30**	**90**

Text Books:

1. Bolsover, S. R., Shephard, E. A., White, H. A., and Hyams, J. S. *Cell biology: a short course*. John Wiley & Sons, 2011.

References:

1. Sadava, D. E. *Cell biology: organelle structure and function*. Jones & Bartlett Learning, 1993.
2. Alberts, Bruce, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. *Essential cell biology*. Garland Science, 2013.
3. Julio E. Celis. *Cell biology: A Laboratory Handbook*. 3rd Edition, Vol. 1, Elsevier Academic Press, 2006.

E-References:

1. http://nptel.ac.in/courses/102103012/
2. https://cellbiology.med.unsw.edu.au/cellbiology/index.php/Cell_Biology_Introduction

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	0	0	0	1	0	0	0	0	0	1	1	0	0
CO 2	3	1	0	1	1	1	0	0	1	1	0	0	0	0
CO 3	3	1	0	0	1	0	0	0	0	0	1	1	0	0
CO 4	3	1	0	1	1	1	0	0	1	1	1	1	0	0
CO 5	3	1	0	1	1	1	0	0	1	1	1	1	0	0
	15	**4**	**0**	**3**	**5**	**3**	**0**	**0**	**3**	**3**	**4**	**4**	**0**	**0**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**15**	**4**	**0**	**3**	**5**	**3**	**0**	**0**	**3**	**3**	**4**	**4**	**0**	**0**
Scaled Value	3	1	0	1	1	1	0	0	1	1	1	1	0	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 404			BIOENERGETICS AND METABOLISM	L	T	P	C
				3	1	2	5
C	P	A		L	T	P	H
3	0.5	0.15		3	1	2	6

Prerequisite: Biochemistry, Applied Physics, Applied Chemistry, Microbiology.

Learning Objectives:

Upon completion of this course, the students

- Would have learn various metabolic pathways.
- Would have learn how all the metabolic pathways related to each other.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Discuss*** and ***Remember*** fundamental and metabolism pathways	Cognitive Psychomotor	Remembering Receiving
CO2	***Discuss*** and ***Remember*** biosynthesis of fatty acid and cholesterol	Cognitive Psychomotor	Recalling Guided Response
CO3	***Discuss*** and ***Remember*** oxidative phosphorylation and photophosphorylation	Cognitive Psychomotor	Remembering Guided Response
CO4	***Discuss*** and ***Remember*** biosynthesis of amino acids and nucleotides	Cognitive Psychomotor	Remembering Receiving
CO5	***Discuss*** and ***Remember*** report on metabolic order and disease	Cognitive Psychomotor	Create Guided response

Course content	Hours
I – Bioeneregetics and Glycolytic pathways	**9+3+6**
Bioenergetics and Thermodynamics, Phosphoryl Group Transfers and ATP, Biological Oxidation-Reduction Reactions, metabolic pathways: Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway, The Citric Acid Cycle.	
II – Fatty acid, Cholestrol, Lipid and amino acid metabolism	**9+3+6**
Biosynthesis of fatty acids, Oxidation of fatty acid – beta oxidation and omega oxidation, Ketone Bodies, Biosynthesis of Cholesterol, Biosynthesis of phospholipids and glycolipids, Metabolic Fates of Amino Groups, Pathways of Amino Acid Degradation.	
III – Oxidative phosphorylation and photophoshorylation	**9+3+6**
Electron-Transfer Reactions in Mitochondria, ATP Synthesis, Regulation of Oxidative Phosphorylation, General Features of Photophosphorylation – Photosystem I and II.	
IV – Biosynthesis of amino acids and nucleotides	**9+3+6**
Overview of Nitrogen Metabolism, Biosynthesis of amino acids, biosynthesis and degradation of nucleotides – De Novo Purine Nucleotide synthesis – Purine Nucleotide Biosynthesis – Pyrimidine Nucleotide-Nucleotide Monophosphates-Ribosomal – Purine and Pyrimidine bases are restricted by Salvage Pathways.	
V – Metabolic disorders and diseases	**9+3+6**
Qualitative and quantitative analysis of metabolism involving in disease and disorders. Report writing on metabolic disorders or diseases.	
Bioenergetics and Metabolism Lab	
List of Practical Experiments 1. Buffer preparation and calculation of molar extinction coefficient	

2. Separation of Amino Acids by Thin Layer Chromatography
3. Qualitative/Qualitative analysis of proteins
4. Qualitative/Qualitative analysis of Carbohydrates
5. Determination of β-carotene, Flavonoid
6. Estimation and purity of DNA
7. Acid hydrolysis and action of salivary amylase on starch
8. Detection of Adulteration in Milk
9. Titration Curves of Aminoacids
10. Quantitative estimation of serum cholesterol by Zak's method

Estimation of Saponification Value of Fats/Oils

Lecture	Tutorial	Practical	Total
45	15	30	90

Text Books:

1. Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, W. H. Freeman; 6th edition edition (13 February 2013), 1158 pages ISBN-10: 1464109621, ISBN-13: 978-1464109621.
2. Biochemistry, Donald Voet, Judith G. Voet 4th Edition, 2011, 1520 pages ISBN: 978-0-470-91410-6.
3. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999.

Reference Books:

1. Introduction to Protein structure, 2nd Ed by Carl Branden and John Tooze, Garland Press, 1999.
2. Structure and Mechanism in Protein Science, Alan Fersht, Freeman, 1999.
3. Protein engineering in Industrial biotechnology, Ed. Lilia Alberghina, Harwood Academic Publishers, 2002.
4. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993.

E-References:

1. https://nptel.ac.in/courses/102104063/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	0	1	0	0	1	1	1	1	1	3	2
CO 2	1	1	2	0	1	0	0	1	1	1	1	2	2	3
CO 3	1	1	2	0	1	0	0	1	1	1	1	3	1	2
CO 4	1	1	2	0	1	0	0	1	1	1	1	2	1	1
CO 5	1	1	2	0	1	0	0	1	1	1	1	1	1	1
	5	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**9**	**8**	**9**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**5**	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**9**	**8**	**9**
Scaled Value	1	1	2	0	1	0	0	1	1	1	1	2	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 405			CHEMICAL ENGINEERING THERMODYNAMICS	L	T	P	C
				3	1	0	4
C	P	A		L	T	P	H
3	0	1		3	2	0	5

Prerequisite: Engineering chemistry

Learning Objectives:

Upon completion of this course, the students

- Would have gained knowledge about the laws of thermodynamics
- Would have understood the thermodynamic properties on engineering aspects

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***State*** the basic laws of thermodynamics and **explain** the fundamentals of thermodynamics.	Cognitive	Remembering Understanding
CO2	***Interpret*** and ***analyze*** the PVT relationship for various systems.	Cognitive	Interpretation, analyzing
CO3	***Know*** the thermodynamic relations and ***estimate*** the thermodynamic properties.	Cognitive	Remembering, Understanding
CO4	***Analyze*** and ***evaluate*** the phase equilibrium in various systems like miscible and immiscible systems.	Cognitive	Analyzing, evaluating
CO5	***Knows*** the chemical equilibrium for industrial reactions and will ***calculate*** required free energy, equilibrium rate constant and conversion.	Cognitive	Remembering, Applying

Course content	Hours
I – Fundamentals of Thermodynamics	**9+3**
Definitions of System, Surroundings and Processes, Open and Closed systems, State properties, Intensive and Extensive Properties, State and Path functions, equilibrium state and Phase Rule, Zeroth Law of Thermodynamics, Reversible and Irreversible processes, General Statement of First law of thermodynamics	
II – PVT Relationships for Gases and Liquids	**9+3**
PVT behaviour of pure fluids-Equations of state and the concept of ideal gas –Processes involving ideal gases – Equation of state for real gases -Compressibility charts –heat effects on chemical reactions - General Statement of Second and Third laws of thermodynamics – application of the law of thermodynamics.	
III – Thermodynamic Properties of Pure Fluids	**9+3**
Classification of thermodynamic properties –relationship on thermodynamic properties – method of Jacobians – Fugacity – properties of solution – chemical potential – Effect of temperature and pressure on chemical potential - fugacity in solutions –Activity in solutions – heat effects of mixing processes.	
IV – Phase Equilibria	**9+3**
Criteria of phase equilibria, phase equilibria in multi-component systems, phase rule for nonreacting systems, Vapour-Liquid Equilibria, P-xy, T-xy and VLE for ideal systems; Bubble and Dew Point for ideal binary or ternary component systems, Non-Ideal solutions: azeotropes, Calculation of activity coefficients using Van laar and Margules equation and azeotropic data - Liquid-Liquid Equilibrium diagrams.	
V – Chemical Equilibria	**9+3**

Reaction stoichiometry – Criteria of chemical Reaction Equilibrium – Equilibrium Constant – Equilibrium constant and standard free Energy change – Effect of temperature on equilibrium constant – Effect of pressure on equilibrium – Factors affecting equilibrium conversion - Liquid phase reactions – Heterogeneous reaction equilibria.			
Lecture	**Tutorial**	**Practical**	**Total**
45	**15**	**0**	**60**

Text Books:

1. Narayanan K.V.A textbook of Chemical Engineering Thermodynamics'', PHI 2006.
2. Smith, J.M., Van Ness HC and Abbott MM.2005. Introduction to Chemical Engineering Thermodynamics, 7th Edition, McGraw-Hill International Edition,2005

Reference Books:

1. S.I.Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Edition, Wiley India, 2006.
2. Rao., Y.V.C., Chemical engineering Thermodynamics, University Press, Hyderabad, 2005.

E-References:

1. Thermodynamics of Biomolecular Systems: http://ocw.mit.edu/courses/biologicalengineering/20-110j-thermodynamics-of-biomolecular-systems-fall-2005/

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2									2	2		2
CO 2	3	3	2	2	1		2				2	2	3	2
CO 3	3	3	2	2	1		2				2	2	3	2
CO 4	3	3	2	3	1	1	2				2	2	2	2
CO 5	3	3	3	3	1	1	2	1	1		2	3	3	3
	15	**14**	**9**	**10**	**4**	**2**	**8**	**1**	**1**		**10**	**11**	**11**	**11**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**15**	**14**	**9**	**10**	**4**	**2**	**8**	**1**	**1**	**0**	**10**	**11**	**11**	**11**
Scaled Value	3	3	2	2	1	1	2	1	1	0	2	3	3	3

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XUM406			ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
				2	0	0	2
C	P	A		L	T	P	SS	H
2.7	0	0.3		2	0	0	1	3

PREREQUISITE: Nil

COURSE OUTCOMES:

	Course Outcomes	Domain	Level
After the completion of the course, students will be able to			
CO1	***Recognise*** and ***describe*** the personal traits of an entrepreneur.	Affective Cognitive	Receiving Understanding
CO2	***Determine*** the new venture ideas and ***analyse*** the feasibility report.	Cognitive	Understanding Analysing
CO3	***Develop*** the business plan and ***analyse*** the plan as an individual or in team.	Affective Cognitive	Receiving Analysing
CO4	***Describe*** various parameters to be taken into consideration for launching and managing small business.	Cognitive	Understanding
CO5	***Explain the*** technological management and Intellectual Property Rights	Cognitive	Understanding

I	**ENTREPRENEURIAL TRAITS AND FUNCTIONS**	**9**

Definition of Entrepreneurship; competencies and traits of an entrepreneur; factors affecting Entrepreneurship Development; Role of Family and Society ; Achievement Motivation; Entrepreneurship as a career and national development;

II	**NEW PRODUCT DEVELOPMENT AND VENTURE CREATION**	**9**

Ideation to Concept development; Sources and Criteria for Selection of Product; market assessment; Feasibility Report; Project Profile; processes involved in starting a new venture; legal formalities; Ownership; Case Study.

III	**ENTREPRENEURIAL FINANCE**	**9**

Financial forecasting for a new venture; Finance mobilization; Business plan preparation; Sources of Financing, Angel Investors and Venture Capital; Government support in startup promotion.

IV	**LAUNCHING OF SMALL BUSINESS AND ITS MANGEMENT**	**9**

Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units.

V	**TECHNOLOGY MANAGEMENT, IPR PORTFOLIO FOR NEW PRODUCT VENTURE**	**9**

Technology management; Impact of technology on society and business; Role of Government in supporting Technology Development and IPR protection; Entrepreneurship Development Training and Other Support Services.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	**0**	**0**	**45**

TEXT BOOKS:

1. Hisrich, 2016, *Entrepreneurship*, Tata McGraw Hill, New Delhi.
2. S.S.Khanka, 2013, *Entrepreneurial Development*, S.Chand and Company Limited, New Delhi.

REFERENCES:

1. Mathew Manimala, 2005, *Entrepreneurship Theory at the Crossroads, Paradigms & Praxis*, Biztrantra, 2nd Edition.
2. Prasanna Chandra, 2009, *Projects – Planning, Analysis, Selection, Implementation and Reviews*, Tata McGraw-Hill.
3. P.Saravanavel, 1997, *Entrepreneurial Development*, Ess Pee kay Publishing House, Chennai. Arya Kumar,2012, *Entrepreneurship: Creating and Leading an Entrepreneurial Organisation*, Pearson Education India. Donald F Kuratko, T.V Rao, 2012, *Entrepreneurship: A South Asian perspective*, Cengage Learning India.
4. Dinesh Awasthi, Raman Jaggi, V.Padmanand, *Suggested Reading / Reference Material for Entrepreneurship Development Programmes* (EDP/WEDP/TEDP), EDI Publication, Entrepreneurship Development Institute of India, Ahmedabad. Available from: http://www.ediindia.org/doc/EDP-TEDP.pdf

E-REFERENCES:

1. Jeff Hawkins, " Characteristics of a successful entrepreneur", ALISON Online entrepreneurship courses, "https://alison.com/learn/entrepreneurial-skills
2. Jeff Cornwall, "Entrepreneurship -- From Idea to Launch", Udemy online Education, https://www.udemy.com/entrepreneurship-from-idea-to-launch/

Table 1: Mapping of COs with POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO 1	0	0	0	1	2	0	1	1	1	1	2	1	0	0
CO 2	0	0	0	0	0	2	0	1	0	1	1	1	0	0
CO 3	0	0	2	0	0	3	2	1	3	3	3	3	0	1
CO 4	1	0	1	3	0	0	0	0	0	1	2	0	0	0
CO 5	1	1	1	3	0	0	0	0	0	2	2	1	0	0
Total	2	1	4	7	2	5	3	3	4	8	10	6	0	0
Scaled to 0,1,2, 3	1	1	1	2	1	1	1	1	1	2	2	2	0	1

1-5 →1, 6-10 →2, 11-15 →3

0 – No Relation, 1- Low Relation, 2- Medium Relation, 3- High Relation

XUM407			CONSTITUTION OF INDIA	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0					
Prequisite: Nil				3	0	0	3

Learning Objectives:

Upon completion of this course, the students

- Would have gained knowledge about the constitution and its history.
- Would have learn about the functioning of law in the country.

Course Outcomes		Domain	Level
CO1	***Understand*** the Constitutional History	Cognitive	Understanding
CO2	***Understand*** the Powers and Functions	Cognitive	Understanding
CO3	***Understand*** the Legislature	Affective	Remembering
CO4	***Understand*** the Judiciary	Affective	Remembering
CO5	***Understand*** the Centre State relations	Cognitive	Understanding

I - Constitutional History- The Constitutional Rights- Preamble- Fundamental Rights- Fundamental Duties- Directive principles of State Policy.	**08**
II - The Union Executive- The President of India (powers and functions)- Vice-President of India-The Council of Ministers-Prime Minister- Powers and Functions.	**09**
III - Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya Sabha- Legislative Procedure in India- Important Committes of Lok Sabha- Speaker of the Lok Sabha.	**10**
IV - The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appelete jurisdictions- Advisory Jurisdiction- Judicial review.	**09**
V- Centre State relations- Political Parties- Role of governor, powers and functions of Chief Minister-Legislative Assembly- State Judiciary- Powers and Functions of the High Courts.	**09**

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

REFERENCES

1. W.H.Morris Shores- Government and politics of India, NewDelhi,B.1.Publishers,1974.
2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House, 1977.
3. R.Thanker- The Government and politics of India, London:Macmillon, 1995.
4. A.C.Kapur- Select Constitutions S,Chand & Co.,NewDelhi, 1995
5. V.D.Mahajan- Select Modern Governments,S,Chand &Co, NewDelhi,1995.
6. B.C.Rout- Democractic Constitution of India.
7. Gopal K.Puri- Constitution of India, India 2005.

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	2	0	0	1	0	0	0	0	0
CO 2	2	0	0	1	0	0	0	0	0
CO 3	2	0	0	1	0	0	0		1
CO 4	2	0	0	1	0	0	0	1	1
CO 5	2	2	0	1	0	0	0	1	1
Total	10	2	0	5	0	0	0	2	3
Scaled to 0,1,2,3	2	1	0	1	0	0	0	1	1

1-5 →1, 6-10 →2, 11-15 →3
0 – No Relation, 1- Low Relation, 2- Medium Relation, 3- High Relation

XBT 501			BIOINSTRUMENTATION	L	T	P	C
				3	0	2	4
C	P	A		L	T	P	H
1	0.5	0.5		3	0	2	5

Prerequisite: Physics, Applied Physics

Learning Objectives:

Upon completion of this course, the students

- Will be able to identify the different techniques used in the experiments in biotechnology.
- Will be able to distinguish various techniques involved in the processing of various biological systems

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Explain*** the basics and fundamentals of analytical techniques and ***describe*** the various calibration techniques.	Cognitive Affective	Understanding Remembering
CO2	***Describe*** the spectrophotometric methods and ***perform*** the experiments related to spectroscopy.	Cognitive Affective	Understanding Remembering
CO3	***Understand*** the electrochemical techniques and ***apply*** it in various applications in biotechnology.	Cognitive	Understanding Remembering Guided response
CO4	***Know*** the principle of instrumentation and ***applications*** of various imaging techniques in biological field.	Cognitive	Understanding Remembering Guided response
CO5	***Distinguish*** the various separation and sequencing techniques	Cognitive	Understanding Remembering

Course content	Hours
I – Introduction	**9+6**
Classification of instrumental methods; Concepts of accuracy, precision and limits of detection (LOD); Types of errors: random and systematic; Calibration of instrumental methods: Comparison with standards, external and internal standard addition methods; Introduction and significance of signal to noise ratio	
II – Spectroscopic Techniques	**9+6**
Regions and properties of electromagnetic radiation, Absorption, transmittance and their relationship, Beer lamberts law and its limitations, Deviations (Real, chemical and instrumental; Principle, Instrumentation and applications of UV-Visible, IR & FTIR and Circular Dichroism Spectroscopy. Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique).	
III – Electrochemical	**9+6**
Basic concept of indicators, Principle of pH meter- hydrogen electrode and glass electrode, Ion selective electrodes – Conductometry-Electrochemical cells and batteries. Standard electrodes. Three-electrode cell. Case study of blood glucose meter.	
IV – Bioimaging	**9+6**
Mass spectrometry and MALDI – TOF Analysis – Crystalline structure analysis using XRD and NMR, Scanning Electron Microscope, Transmission Electron Microscope.	
V – Separation and Sequencing Techniques	**9+6**
Importance and challenge of separations. Mass spectrometry. Affinity-based separations. Chromatography. Gas chromatography (GC). High-performance liquid chromatography (HPLC). Thin-layer chromatography (TLC). Electrophoresis. Electroosmotic flow. DNA sequencing. Sanger	

sequencing.

Bioinstrumentation Lab

List of Practical Experiments:

1. Precision, accuracy and validation in an experiment using absorption spectroscopy
2. Analysis of sample size and surface through SEM and AFM analysis. (Demonstration with instrument).
3. Isolation of pigments from leaf extract through column chromatography.
4. Absorption spectra for $KMnO_4$
5. UV spectra of nucleic acids, protein.
6. Estimation of chloride using conductivity meter.
7. Extraction of caffeine using HPLC and analysis of chromatogram.
8. Analysis of amino acids using TLC.
9. Analysis of amino acids using ethanol using GC.
10. Compositional analysis of by XRD

Lecture	Tutorial	Practical	Total
45	**0**	**30**	**75**

Text Books:

1. Willard, H.H., Merritt. I.I., Dean J.a., and Settle, F.A.,"Instrumental methods of analysis", Sixth edition, CBS publishers, 1986.
2. Skoog D.A. and West D.M., "Fundamentals of Analytical Chemistry", Saunders college Publishing, 1982.

Reference Books:

1. A.I.Vogel., "Qualitative Inorganic analysis ", V.Edition, Prentice-Hall of India (P) Ltd., New Delhi, 1991.
2. Sharma, B.K., "Instrumental Methods of Analysis ", Goel publishing House, 1995.
3. Parikh V.M., "Absorption spectroscopy of organic molecules ", Addison – Wesley Publishing Company, 1974.

E-References:

1. http://www.ncbi.nlm.nih.gov/books/NBK26851/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	0	0	1	0	0	0	0	2	0	1
CO 2	3	3	2	2	0	0	1	0	0	0	0	0	0	1
CO 3	3	2	2	1	0	0	1	0	0	0	0	0	0	1
CO 4	2	3	2	2	0	0	0	0	0	0	0	1	0	1
CO 5	3	2	3	1	0	0	1	0	0	0	0	1	0	1
	14	**12**	**11**	**7**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**5**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**14**	**12**	**11**	**7**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**5**
Scaled Value	3	3	3	2	0	0	2	0	0	0	0	2	0	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 502			MOLECULAR BIOLOGY	L	T	P	C
				2	1	0	3
C	P	A		L	T	P	H
3	0	0		2	1	0	3

Prerequisite: Biochemistry, Genetics.

Learning Objectives:

Upon completion of this course, the students

- Would have learnt structures of DNA, RNA and its replication and repair
- Would have learnt gene regulations

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Relate*** and ***Interpret*** DNA and RNA structure and its role	Cognitive	Remember, Understanding
CO2	***Explain*** and ***Apply*** and its replication and repair	Cognitive	Understanding, Applying
CO3	***Classify*** and ***Develop*** transcription and post transcriptional modifications	Cognitive & Affective	Analyzing Receiving
CO4	***Classify*** and ***Dissect*** translation and post translational processing	Cognitive	Understanding Analyze
CO5	***List*** and respond gene regulations	Cognitive & Affective	Remember (Respond)

Course content	Hours
I – Introduction to Molecular Biology - DNA and RNA	**6+3**
Scope and History. Structure of DNA-Nucleoside, Nucleotide, Base pairing, Base stacking, Double Helix, features of Watson and Crick model, major and minor groove, Supercoiling- twist, writhe and linking number. Forms of DNA- A, B, Z. Structure and function of mRNA, rRNA, tRNA. Secondary structures in RNA.	
II – Replication and Repair	**6+3**
Types and functions of DNA polymerases in Prokaryote and Eukaryote. Replication in prokaryote and Eukaryote. Proof reading activity, 5'Æ 3' exonuclease activity, topoisomerase activity, Telomeric DNA replication and Plasmid Replication-theta model, strand displacement model and rolling circle model. DNA Repair- Nucleotide excision repair, base excision repair, mismatch repair, photo-reactivation, recombination repair and SOS repair.	
III – Transcription and Post Transcriptional Modifications	**6+3**
Fine structure of prokaryotic and eukaryotic gene, structure and function of the promoters in mRNA, rRNA, tRNA genes. RNA polymerases in prokaryote and eukaryote, types and function. Transcription of mRNA, rRNA, and tRNA genes in Prokaryote and eukaryote. Post transcriptional processing of mRNA – 5'capping, splicing (including different types), polyadenylation and RNA editing.	
IV – Translation and Post Translational Processing	**6+3**
Genetic code and Wobble hypothesis. Translation in prokaryote and eukaryote. Post translational modifications. Principles protein sorting and targeting into endoplasmic reticulum, mitochondria, chloroplast, and nucleus.	
V – Gene Regulation	**6+3**
Principles of gene regulation- Transcriptional and post transcriptional gene regulation-activators, co-activators, suppressors, co-suppressors, moderators, silencers, insulators, enhancers. Operon-lac operon, trp operon, ara operon and gal operon.	

Lecture	Tutorial	Practical	Total

30	15	0	45

Text Books:

1. Verma P.S. (Author), Agarwal V.K. Molecular Biology, 2010.
2. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press; Eighth edition, 2018.

Reference Books:

1. Molecular Biology of the Gene, James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael, Losick Richard, Pearson Education; Seventh edition, 2017.
2. Molecular Biology Made Simple and Fun, David P. Clark (Author), Lonnie Dee Russell (Author), 2010.

E-References:

1. https://nptel.ac.in/courses/102106025/
2. https://www.embl.de/training/e-learning/
3. https://swayam.gov.in/course/5065-molecular-biology
4. https://www.ox.ac.uk/admissions/undergraduate/courses-listing/biochemistry-molecular-and-cellular?wssl=1
5. https://vlab.amrita.edu/?sub=3&brch=77
6. https://www.youtube.com/watch?v=V4CRCQfXUrg

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	0	1	0	0	1	1	1	1	3	3	2
CO 2	1	1	2	0	1	0	0	1	1	1	1	2	2	3
CO 3	1	1	2	0	1	0	0	1	1	1	1	1	2	2
CO 4	1	1	2	0	1	0	0	1	1	13	1	1	1	2
CO 5	1	1	2	0	1	0	0	1	1	1	1	1	1	2
	5	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**8**	**9**	**10**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**5**	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**8**	**9**	**11**
Scaled Value	1	1	2	0	1	0	0	1	1	1	1	2	2	3

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 503			BIOPROCESS ENGINEERING	L	T	P	C
				3	1	2	5
C	P	A		L	T	P	H
1	0.5	0.5		3	1	2	6

Prerequisite: Microbiology, Biochemistry, Bioenergetics and Metabolism

Learning Objectives:

Upon completion of this course, the students

- Would be able to identify the parts of a fermenter
- Would be knowing about the media components for fermentation process.
- Would be able to select the parts of a bioreactor for designing a particular production process.
- Would be study the rheological properties of media.
- Would be able to design the scale up procedure of a bioreactor.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Recall*** and ***identify*** the basic parts of a fermentor and its operations.	Cognitive Psychomotor	Remembering Understanding
CO2	***Identify, reproduce,*** and ***demonstrate*** the different media components involved in a fermentation process.	Cognitive Affective Psychomotor	Remembering Valuing Applying
CO3	I***nterpret***, ***describe*** and ***differentiate*** various control systems involved in bioreactor.	Cognitive Affective Psychomotor	Understanding Receiving Phenomena Perception
CO4	***Recognize, discuss*** and ***measure*** the various transport phenomena involved in bioprocesses.	Cognitive Affective Psychomotor	Understanding Mechanism
CO5	***understand*** the scale up procedure of mixing ,aeration and know the applications to ***develop*** a bio product.	Cognitive Affective Psychomotor	Understanding Creating

I – Introduction to Bioprocesses **9+3+6**

Introduction and need for bioprocess Engineering- Biologist and Engineers differ in their approach of research- general requirements of fermentation processes – basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled – operation of fermentation processes.

II – Media Formulation and Fermentation Process Design **9+3+6**

Sterilization of media, Composition of 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 - factorial designs, Plackett- Burmann screening designs. Process Optimization experiments: Response surface methodology – concepts & methods, design considerations, central composite designs and Box-Behnken response surface design.

III – Bioreactor Instrumentation and Control **9+3+6**

Instrumentation, measurement and control of the bioprocess parameter such as temperature, pressure, pH, dissolved oxygen, redox, microbial biomass, flow measurement-Agitation and aeration-Detection and prevention of foam. Bioreactor controlling probes-manual control and automatic control system- Exhaust gas analysis and computation of oxygen transfer rate and carbon dioxide production rates-Online, offline and real time monitoring of process parameters.

IV – Transport Phenomena in Bioreactors **9+3+6**

Flow properties of Fermentation Broths, Factors affecting broth viscosity. Mixing in a Bioreactor – Flow regimes - Power Requirements for Mixing, Un gassed Newtonian Fluids, Gassed Fluids, Improving Mixing in Fermenters, and Effect of Rheological Properties on Mixing. Application of heat transfer in bioprocessing, Heat transfer in Bioreactors, Oxygen requirements of microbial cultures .Determination of oxygen mass transfer coefficient by various methods.

V – Applications to Biological Systems	**9+3+6**

Scale up consideration for constant K_La, shear forces, mixing time-Bioprocess considerations in using Animal and Plant cell cultures. Case studies on Single Cell protein Production, Bioethanol - Case studies on Applications of Bioprocess Engineering.

Bioprocess Engineering Lab

List of Practical Experiments

1. Study of Fermenter.
2. Determination of thermal death rate constant for a fermentation process.
3. Comparison of bioprocess efficiencies in synthetic and complex industrial media.
4. Medium formulation and optimization studies.
5. Estimation of biomass concentration for microbial production.
6. Determination of oxygen mass transfer coefficient by Sulphite oxidation method.
7. Determination of oxygen mass transfer coefficient by Dynamic Gassing out method
8. Residence time distribution studies.
9. Production of Single cell proteins.

Various product assay techniques.

Lecture	**Tutorial**	**Practical**	**Total**
45	**15**	**30**	**90**

Text Books:

1. Schuler and Kargi, Bioprocess engineering. Prentice Hall
2. Najafpour, Ghasem. Biochemical engineering and biotechnology. Elsevier, 2015.
3. Bailey and Ollis, Biochemical Engineering Fundamentals, McGraw Hill, Co. 2004.

References:

1. Pauline Doran, Bioprocess Principles, Academic press, 2004.
2. Neilson J and Villadsen J, Biochemical Engineering Principles I ed, Plenum Press, 2000.
3. Stanbury P F Whitaker, A and Hall S.J, Principles of Fermentation Technology 2nd ed, Aditya Book Pvt Ltd, 2001.
4. Lee J.M, Biochemical Engineering 2nd ed, Prentice Hall, 2000.

E-References:

1. http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=102107029
2. http://users.ox.ac.uk/~dplb0149/publication/NPRBiocatalysisRev.pdf
3. http://link.springer.com/book/10.1007%2F978-1-4684-0324-4

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3											1	2	2
CO 2	2	3	2		1		1		1		3	2	3	3
CO 3	1	2	2	1					1			1	0	0
CO 4	1	3	2	3								1	0	0
CO 5	1	3	2	3	1		1		2		2		1	1
	8	**11**	**8**	**7**	**2**	**0**	**2**	**0**	**4**	**0**	**5**	**5**	**6**	**6**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**8**	**11**	**8**	**7**	**2**	**0**	**2**	**0**	**4**	**0**	**5**	**5**	**6**	**6**
Scaled Value	2	3	2	2	1	0	1	0	1	0	1	1	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 504A			PLANT BIOTECHNOLOGY	L	T	P	C
				2	1	0	3
C	P	A		L	T	P	H
2.5	0	0.5		2	1	0	3

Prerequisite: Cell biology, Genetics and Molecular biology

Learning Objectives:

Upon completion of this course, the students

- Would have understand the fundamentals of plant cells.
- Would have learn the techniques in Plant Tissue Culture.
- Would have understood various techniques of gene transfer in plants.
- Would have learn production of Biomolecules from plants for various applications.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Describe*** the plant tissue culture and ***knows*** various media for tissue culture.	Cognitive	Remembering Understand
CO2	***Compare*** the various gene transfer methods in plants and ***relate*** each other with its pros and cons.	Cognitive Affective	Organizing Responds to Phenomena
CO3	***Explain*** the various tissue culture techniques and ***describes*** the protoplast isolation techniques	Cognitive	Remembering Understanding
CO4	***Relate*** and ***analyze*** various plant breeding and related techniques	Cognitive	Understanding Analyzing
CO5	***Choose*** and **apply** the plant genetics to develop commercially important products.	Cognitive	Understanding Applying

Course content	Hours
I – Introduction to Plant Tissue Culture	**6+3**
Scope of plant biotechnology – Plasticity and totipotency - History of plant tissue culture – Types and composition of tissue culture media – Role of plant growth regulators and hormones – Physiochemical conditions for tissue culture – Measurement of growth and viability in the tissue culture.	
II – *In vitro* Propagation	**6+3**
Types of plant tissue culture - Organogenesis and somatic embryogenesis - Culture types: Callus, cell-suspension culture, shoot and root tip culture, hairy root culture, Meristem culture, pollen culture, Anther culture and haploid production – protoplast culture: isolation, fusion and regeneration of protoplast – Germplasm conservation and cryopreservation.	
III – Plant Breeding Techniques	**6+3**
Simple and complex inheritance - back cross - Molecular Markers: RFLP and PCR based SSR markers - Marker-Assisted selection, Hybrid seeds production - Herbicide tolerant plants: Different strategies to achieve, strategy to generate glyphosate tolerant plants and their related problems – Production of marker free transgenic plants.	
IV – Genetic Transformation of Plants	**6+3**
Agrobacterium mediated gene transfer – Crown gall disease, Genes involved in DNA transfer, Ti plasmid, Ri plasmid - Binary vector system - Plant viruses and different types of Viral Vectors – Gemini virus, Cauliflower mosaic virus – Direct gene transfer methods – particle gun bombardment, electroporation.	
V – Applications of Plant Biotechnology	**6+3**
Molecular farming/Pharming of proteins – Bioreactors for recombinant protein, Secondary metabolite production using plant cell culture. Antisense technology in crop improvement - Therapeutic/Industrial applications of plant products - Plant vaccines, custom-made antibodies, Transgenic plants - their issues and solutions.	

Lecture	Tutorial	Practical	Total
30	15	0	45

Text Books:

1. Slater A., Nigel W., Scott, and Fowler MR., Plant biotechnology: The Genetic Manipulation of Plants, Oxford University Press, London, 2nd Edition, 2008.
2. Neal Stewart, Jr., Plant Biotechnology and Genetics: Principles, Techniques, and Applications. John Wiley & Sons Inc. USA, 2008.

Reference Books:

1. Chawla HS. Introduction to Plant Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 2nd Edition, 2003.
2. Neumann, Karl-Hermann, Ashwani Kumar, and Sudhir K. Sopory. Recent Advances in Plant Biotechnology and Its Applications: Prof. Dr. Karl-Hermann Neumann Commemorative Volume. IK International Pvt Ltd, 2008.
3. Hammond, John, Peter McGarvey, and Vidadi Yusibov, eds. Plant biotechnology: new products and applications. Vol. 240. Springer Science & Business Media, 2012.

E-References:

1. http://www.ncbi.nlm.nih.gov/books/NBK26851/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	0	1	1	2	1	0	0	1	1	1	3	3	3
CO 2	3	2	2	2	3	2	1	1	2	1	1	2	2	2
CO 3	2	1	3	1	2	2	1	0	2	2	1	2	2	2
CO 4	3	2	2	2	2	2	1	1	1	1	0	3	2	2
CO 5	3	3	3	2	3	2	3	2	2	2	2	3	1	1
	13	**8**	**11**	**8**	**14**	**9**	**5**	**4**	**8**	**7**	**5**	**13**	**10**	**10**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**13**	**8**	**11**	**8**	**14**	**9**	**5**	**4**	**8**	**7**	**5**	**13**	**10**	**10**
Scaled Value	3	2	3	2	3	2	1	1	2	2	1	3	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 504B			FOOD TECHNOLOGY	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisite: Microbiology, Biochemistry, Bioprocess Engineering

Learning Objectives:

Upon completion of this course, the students

- Would be able to describe to modify foods using biotechnology
- Would be able to know the role of bacteria, yeast and mould in food processing and fermentation of foods
- Would be able to explain the role of functional foods and nutraceuticals in the promotion of human health and nutrition.
- Would be able to know packaging materials, their need according to different foods and to food quality parameters and their maintenance during storage.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Outline*** the scope and importance of food biotechnology and ***describe*** the biotechnological approaches to modify the foods	Cognitive	Analyzing Understanding
CO2	***Discuss*** on the fermentation strategies for different fermented foods and their microbiology aspects	Cognitive	Analyzing Understanding
CO3	***Explain*** different biotechnological approaches to produce genetically modified foods	Cognitive	Analyzing Understanding
CO4	***Describe*** the techniques adapted to preserve different kinds of foods	Cognitive	Analyzing Understanding
CO5	***Discuss*** the guidelines and regulations given for food safety and analysis	Cognitive	Analyzing Understanding

Course content	Hours
I- Introduction	**4+3**
Introduction to Food Technology: Conventional and nonconventional foods, Biotechnological approaches to improve nutritional quality and shelf life of foods, Scope and importance of food biotechnology, Future Foods	
II- Microbiology of Fermented Foods	**7+3**
Microbes associated with food products – Yeasts, bacteria, moulds – Fermented Foods: Yoghurt, Cheese, Soysauce, Vinegar, Wine, Beer – Cocoa, tea and coffee fermentation.	
III- Functional Foods and Genetically Modified Foods	**7+3**
Functional foods: categories of functional foods, role of biotechnology in functional foods, Nutrition related diseases and relevant functional foods: cardiovascular disease, cancer, obesity. Genetically modified foods: Faster maturation- Coho Salmon, Modification of poultry and egg.	
IV- Food Preservation and Packaging	**8+3**
Mechanisms of food spoilage- Food preservation by low-temp: Refrigeration, freezing and freeze-drying. Food preservation by heating: drying, osmotic dehydration, blanching, canning, pasteurization, sterilization, Non-thermal preservation: ionizing radiation, High Hydrostatic pressure, pulsed electric field. Packaging of food- packaging materials -atmosphere in the package –Vaccum packaging, Controlled atmosphere packaging, Modified atmosphere packaging	
V- Food Quality and Safety Analysis	**4+3**

Food Quality and maintenance: Food quality, different factors inside and outside the food, Analytical instruments used in food analysis, Biosensors for food quality assessment. Food Regulations: Hazard Analysis Critical Control Points (HACCP), Food Safety and Standards Authority of India (FSSAI)			
Lecture	**Tutorial**	**Practical**	**Total**
30	**15**	**0**	**45**

Text Books:

1. Shetty, K., Plaiyath, G., Pometto A. and Levin, R.E., *Food Biotechnology,* CRC press, 2005.
2. M. Shafiur Rahman, Handbook of food preservation, 2nd edition, CRC Press, Taylor & Francis Group, NW. 2007.
3. Richard Coles, Derek McDowell and Mark J. Kirwan, Food Packaging Technology, CRC Press, Blackwell publishing ltd. 2004.

References:

1. Jean-Richard Neeser, and J. Bruce German, eds. *Bioprocesses and biotechnology for functional foods and nutraceuticals*. CRC Press, 2004.
2. Fortin ND. 2008. Food Regulation: Law, Science, Policy and Practice. Wiley, USA. ISBN: 978-0470409695.
3. Food Safety and Standards Act and Regulations by FSSAI.
4. Byong H. Lee, *Fundamentals of Food Biotechnology*, 2nd Edition, WileyBlackwell. 2014

E - References:

1. https://nptel.ac.in/courses/103103029/34
2. https://nptel.ac.in/courses/126105015/

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	1	3	1	2						3	3	3
CO 2	2	1	3	2	2	2						2	2	2
CO 3	2		3	2	3	1					2	2	2	2
CO 4	2		2	2	3	1					3	3	2	2
CO 5	2		3		3	3						3	1	1
	10	**3**	**12**	**9**	**12**	**9**					**5**	**13**	**10**	**10**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**10**	**3**	**12**	**9**	**12**	**9**	**0**	**0**	**0**	**0**	**5**	**13**	**10**	**10**
Scaled Value	2	1	3	2	3	2	0	0	0	0	1	3	2	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 504C			CHEMICAL REACTION ENGINEERING	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have understood the concepts of reaction kinetics, the types of reactors and their performance equations

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Recall*** and ***explain*** the kinetics of a chemical reaction	Cognitive	Remembering Understanding
CO2	***Interpret*** and ***modify*** the batch reactor data	Cognitive	Understanding, analyzing
CO3	***Compare*** and ***evaluate*** the performance of batch, PFR and CSTR reactors.	Cognitive	Remembering, Understanding
CO4	***Identify*** and ***discuss*** the designs for single and multiple reactions.	Cognitive	Understanding Analyzing
CO5	**Describe** characteristics of RTD curves.	Cognitive	Remembering, Applying

Course content	Hours
I – Reaction Kinetics	**9**
Kinetics of Homogeneous Reactions. Elementary, non-elementary reactions – intermediates, reaction mechanism, definition of reaction rate, rate law. Temperature-dependency of a rate - Arrhenius theory-collision theory and transition state theory Concentration dependency of rate- power law model.	
II – Interpretation of Batch Reactor Data	**9**
Integral and differential methods of analysis – Half-life method – Zero-order reaction – Empirical rate equation of nth order – Irreversible first and second order reactions for variable and constant volume systems.	
III – Design of reactors	**9**
Ideal Reactors – Batch reactor, plug flow reactor, mixed flow reactor– Space time, space velocity -- Performance equations and their graphical representation.	
IV – Design of reactor for single & multiple reactions	**9**
Single reactions – Size comparison of single reactors – Auto catalytic reactions – Multiple reactions – Irreversible reactions in series and parallel.	
V – RTD Studies	**9**
General characteristics- Residence time distribution Function-Measurement of the RTD –pulse input experiment- step tracer experiment –Characteristics of the RTD –RTD in ideal Reactors – E the age distribution of fluid in RTD- Relationship between the F and E curves.	

Lecture	Tutorial	Practical	Total
45	**0**	**0**	**45**

Text Books:

1. Gavhane K. A. Chemical Reaction Engineering – I Nirali Prakashan, Educational Publishers, 13th Edition 2013.
2. Scott Fogler, H., "Elements of Chemical Reaction Engineering", 4th Edition, Prentice Hall of India, 2006.

3. Levenspiel, O. Chemical Reaction Engineering, 3rd Edition, 3/e, John Wiley & Sons, New York, 1999.
Reference Books:
1. Smith, J. M. *Chemical Engineering Kinetics*,3/e, McGraw-Hill International, New York, 1981. 2. S.D.Dawande, "Principles of Reaction Engineering", 1st Edition, Central Techno Publications, 2001. 3. Richardson, J.F. and Peacock, D.G., "Coulson Richardson's Chemical Engineering." Vol III, 3rd Edition, Asian Books (P) Ltd, 2000.
E-References:
1. http://nptel.ac.in/courses/103101001/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3										1	3	1	1
CO 2	2	3		1					1			2	1	1
CO 3		1	3									3	1	1
CO 4		1	2									2	1	1
CO 5	1	2	3	1								1	1	1
	6	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**11**	**5**	**5**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**6**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**11**	**5**	**5**
Scaled Value	2	2	2	1	0	0	0	0	1	0	1	3	1	1

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XUM 506			EMPLOYABILITY SKILL AND REPORT WRITING	L	T	P	C
				2	1	0	3
C	P	A		L	T	P	H
0.5	1	1.5		2	1	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learnt to convert learning process into employability.
- Would able to write scientific article, research and review papers.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	Prepare how to face an interview and to learn how to prepare for an interview	Cognitive	Understand
CO2	Knowledge on a career related communication and learning the different formats of CV	Affective	Response
CO3	Communicates with the group of people in discussion	Affective	Value
CO4	Learn to search research papers, prepare seminars.	Psychomotor	Perception set
CO5	Execute the learning by writing scientific papers	Cognitive	Evaluate

Course content	Hours
I – Technical Skills	**6**
Interview skills; tips for various types of interviews. Types of questions asked; body language, etiquette and dress code in interview, interview mistakes, telephonic interview, frequently asked questions. Planning for the interview.	
II – CV Writing	**6**
CV Writing; difference between resume and CV; characteristics of resume and CV; basic elements of CV and resume, use of graphics in resume and CV; forms and functions of Cover Letters.	
III – Workshop	**6**
Mock interviews - workshop on CV writing – Group Discussion	
IV – Writing and Reading Activity Topics	**6**
Scientific internet search and presentation; Entrepreneurship and Project Preparation	
V – Report Writing	**6**
Article writing, review, research paper and book chapter writing.	

Lecture	Tutorial	Practical	Total
30	**15**		**45**

Text Books:

1. Business Correspondence & Report Writing by R.C. Sharma and K. Mohan, TMH
2. How to prepare for Group Discussion & Interview (With Audio Cassette) by Prasad, TMH
3. Mary Ellen Guffey, Dana Loewy Essentials of Business Communication,Cengage Learning, 2012
4. Michael Spiropoulos, Interview Skills that win the job: Simple techniques for answering all the tough questions, Allen &Unwin, 2005

Reference Books:

1. Paul McGee, How To Write a CV That Really Works: A Concise, Clear and Comprehensive Guide to Writing an Effective CV, Hachette UK, 2014

2. William L. Fleisher,Effective Interviewing and Interrogation Techniques, Nathan J. Gordon, Academic Press, 2010.

E-References:

1. https://nptel.ac.in/noc/individual_course.php?id=noc18-hs29
2. https://nptel.ac.in/courses/109104031/
3. https://nptel.ac.in/courses/109106094/26
4. https://www.coursera.org/browse/personal-development
5. https://nptel.ac.in/courses/110105034/SM_Web/Ch14%20revised.pdf
6. http://www.utsa.edu/careercenter/PDFs/Interviewing/Types%20of%20Interviews.pdf
7. http://www.amu.apus.edu/career-services/interviewing/types.htm
8. http://www.careerthinker.com/interviewing/types-of-interview/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	0	0	0	0	0	0	0	0	0	0	0	2	0
CO 2	0	0	0	0	0	0	1	3	0	0	1	0	0	0
CO 3	0	0	0	0	0	0	0	0	3	1	3	1	0	0
CO 4	0	1	2	1	3	0	0	0	0	0	0	3	0	0
CO 5	0	0	0	3	0	0	0	0	0	3	0	1	0	0
	2	1	2	4	3	0	1	3	3	4	4	5	2	0

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	2	1	2	4	3	0	1	3	3	4	4	5	2	0
Scaled Value	1	1	1	1	1	0	1	1	1	1	1	1	1	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XUM 507			ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
				1	0	1	0
C	P	A		L	T	P	H
1	0.5	0.5		1	0	1	2

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learnt Indian Traditional knowledge
- Would able to carry out yoga and benefited

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Relate*** and ***Interpret*** the Indian Traditional Knowledge Systems	Cognitive	Remember, Understanding
CO2	***Explain*** and ***Apply*** Yogic-science and wisdom capsules	Cognitive	Understanding, Applying
CO3	***Classify*** and ***Develop*** of Yoga and holistic health care system	Cognitive Affective	Analyzing Receiving
CO4	Classify and Dissect human rights and report on	Cognitive	Understanding, Analyze
CO5	List and respond to family values, universal brotherhood,	Cognitive Affective	Remember, (Respond)

Course content	Hours
I – Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.	**6+3**
II – Holistic life style of Yogic-science and wisdom capsules in Indian literature are also important in modern society with rapid technological advancements and societal disruptions.	**6+3**
III –Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health	**6+3**
IV – Connect up and explain basics of Indian Traditional knowledge modern scientific perspective	**6+3**
V – Modern Science and Indian Knowledge System • Yoga and Holistic Health care • Case Studies.	**6+3**

Lecture	Tutorial	Practical	Total
30	**0**	**15**	**45**

Text Books:

a. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
b. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
c. Fritzof Capra, Tao of Physics
d. Fritzof Capra, The wave of Life

e. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
f. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta

Reference Books:

1. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016
2. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016 9. P R Sharma (English translation), Shodashang Hridayam

E-References:

1. https://nptel.ac.in/courses/109106059/14

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1								3	3	3	3			
CO 2								3	3	3	3			
CO 3								3	3	3	3			
CO 4								3	3	3	3			
CO 5								3	3	3	3			
	0	0	0	0	0	0	0	**15**	**15**	**15**	15	0	0	0

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	0	0	0	0	0	0	0	**15**	**15**	**15**	15	0	0	0
Scaled Value	0	0	0	0	0	0	0	3	3	3	3	0	0	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE	XUM601	L	T	P	C
COURSE NAME	ECONOMICS FOR ENGINEERS	3	0	0	3
PREREQUISITES		L	T	P	H
C:P:A	2.64:0.24:0.12	3	0	0	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Explain*** the concepts of economics in engineering and ***identify*** element of cost to prepare cost sheet	Cognitive Psychomotor	Understand Perception
CO2	***Calculate and Explain***the Break-even point and marginal costing	Cognitive Psychomotor	Understand &Apply Perception
CO3	***Summarize***and ***Use***value engineering procedure for cost analysis	Cognitive Affective	Understand Receive
CO4	***Estimate*** replacement problem	Cognitive	Understand

UNIT I INTRODUCTION TO ECONOMICS	**08**
Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- types of costing, element of costs, preparation of cost sheet and estimation, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost	
UNIT IIBREAK-EVEN ANALYSIS&SOCIAL COST BENEFIT ANALYSIS	**12**
Margin of Safety, Profit, Cost & Quantity analysis-Product Mix decisions and CVP analysis, Profit/Volume Ratio (P/V Ratio), Application of Marginal costing, Limitations **Social Cost Benefit Analysis**: compare different project alternatives, Calculate direct, indirect and external effects; Monetizing effects; Result of a social cost benefit analysis.	
UNIT III VALUE ENGINEERING &COST ACCOUNTING:	**10**
Value engineering – Function, aims, Value engineering procedure - Make or buy decision Business operating costs, Business overhead costs, Equipment operating costs	
UNIT IV REPLACEMENT ANALYSIS	**07**
Replacement analysis –Types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset.	
UNIT V DEPRECIATION	**08**
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.	

	LECTURE	TUTORIAL	TOTAL
HOURS	**45**	**0**	**45**

1. Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad, Haryana, 2012

2. S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012

3. PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

4. William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.

REFERENCES

1. Luke M Froeb / Brian T Mccann, " Managerial Economics – A problem solving approach" Thomson learning 2007
2. Truett&Truett, "Managerial economics- Analysis, problems & cases " Wiley India 8th edition 2004.
3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
4. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002

Table 1 : Mapping of CO's with POs

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO1	**1**	**2**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**
CO2	**2**	**2**	**1**	**2**	**0**	**0**	**2**	**1**	**1**	**2**	**3**	**3**
CO3	**2**	**2**	**1**	**3**	**0**	**0**	**2**	**2**	**1**	**2**	**2**	**3**
CO4	**1**	**2**	**1**	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**3**
CO5	**1**	**2**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**2**	**3**
Scaled	**1**	**2**	**1**	**2**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**

0 – No relation 1- Low relation 2- Medium relation 3 – High relation

XBT 602			BIOREACTOR DESIGN	L	T	P	C
				3	1	2	5
C	P	A		L	T	P	H
1	0.5	0.5		3	1	2	6

Prerequisite: Bioenergetics and Metabolism, Bioreactor Design Lab, Chemical Engineering Thermodynamics, Bioprocess Engneering.

Learning Objectives:

Upon completion of this course, the students

- Would able to known about the basics of biochemical process.
- Would have understood the concepts of enzyme kinetics.
- Would have knowledge on the kinetic model for biochemical reactions.
- Would able to design a bioreactor for a particular biochemical process.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Understand*** and ***describe*** the fundamentals of enzyme catalyzed reaction and its kinetics.	Cognitive Affective Psychomotor	Remembering Receiving Phenomena
CO2	***Outline*** the cell kinetics and ***choose*** an appropriate method For finding the parameters for growth.	Cognitive Psychomotor	Understanding Perception
CO3	***Recognize***, ***perform*** and ***detect*** various immobilization techniques for a biochemical process.	Cognitive Psychomotor	Understanding Perception
CO4	***Identify*** and ***select*** a kinetic model and design a bioreactor according to a biochemical process	Cognitive Affective Psychomotor	Understanding Responds to Phenomena Perception
CO5	***Identify, select*** and ***follow*** a bioreactor for a particular process.	Cognitive Affective Psychomotor	Understanding Receiving Phenomena

Course content	Hours
I – Enzymes Production and Its Kinetics	**9+3+6**
M-M kinetics – enzyme inhibition – enzyme stability& specificity- factors affecting reaction rates – industrial production process- Industrial production and applications of enzymes: α-amylase – cellulase – protease – lipase, Vitamins: Cyanaocobalamin – Riboflavin.	
II – Cell Kinetics	**9+3+6**
Microbial, animal and plant cell cultivation –growth kinetics – factors affecting the growth – Monod Model – modeling of batch and continuous cell growth Batch growth-quantifying cell concentration, growth patterns and kinetics in batch culture, environmental conditions affect growth kinetics. Quantifying growth kinetics- Unstructured non segregated models to predict specific growth rate, cell growth in continuous cultures Definitions and stoichiometric calculations-elemental balances, Degree of reduction, Theoretical predictions of yield coefficients	
III – Immobilized Systems	**9+3+6**
Application of hydrolytic enzymes-Immobilized microbial cells, carrier binding, Entrapping, Cross linking, Advantages and disadvantages of immobilized cells, -methods and effect of mass transfer – Immobilization of microbial cells for the production of bioproducts–Immobilized cell reactor experiments-Experimental reactor systems Various immobilization Technology Case Study: Ethanol fermentation. – immobilized biocatalysts and its applications – free cell and immobilized cell reactors. Case study on immobilized cell reactor using Saccharomyces cerevisiae.	
IV – Design Considerations	**9+3+6**
Choosing the cultivation method, modifying batch and continuous reactors, Bioreactor consideration for	

plant and animal cell cultures, Scale up, cosiderations on aeration, agitation and heat transfer, scale down

V – Bioreactors	**9+3+6**

Ideal Bioreactors-Type of bioreactor-Airlift bioreactors-Airlift pressure cycle bioreactors—Fluidized bed reactors-trickle bed reactors-loop reactor-Stirred tank reactors-Bubble column fermeter -Heat transfer-Monod model for a chemostat- Temperature effect on rate constant.

List of Practical Experiments

1. Study of M-M kinetics and determination of M-M constants.
2. Extraction of enzyme from fruits and vegetable.
3. Effect of temperature on Enzyme Activity.
4. Effect of pH on Enzyme Activity.
5. Effect of substrate concentration on Enzyme Activity.
6. Enzyme immobilization by physical adsorption.
7. Enzyme immobilization by Gel Entrapment.
8. Study of Production of growth and/or non-growth associated products.
9. Study of Microbial Growth kinetics and estimation of Monod parameters.

Estimation of alcohol concentration in wine production.

Lecture	Tutorial	Practical	Total
45	**15**	**30**	**90**

Text Books:

1. Bailey J.E. and Ollis D.F, Biochemical Engineering Fundamentals, Second edition, McGraw Hill Co, Newyork, 2010.
2. Rajiv Dutta, Fundamentals of Biochemical Engineering, First Edition, Springer, 2008.

Reference Books:

1. Jens Nielsen, John Villadsen and Gunnar Liden, Bioreaction Engineering Principles, Second edition, Kluwer Academic/Plenum Publishers, Newyork, 2003.
2. Ghasem Najafpour, Biochemical Engineering and Biotechnology, Elsevier, 2007.

E-References:

1. http://nptel.ac.in/courses/103105054/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3										1	1	1	
CO 2	2	3		1					1			1	2	
CO 3		1	3									2	3	1
CO 4		1	2									3	1	2
CO 5	1	2	3	1								2	1	3
	6	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**9**	**8**	**6**

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**6**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**9**	**8**	**6**
Scaled Value	2	2	2	1	0	0	0	0	1	0	1	3	2	2

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 603			RECOMBINANT DNA TECHNOLOGY	L	T	P	C
				3	1	2	5
C	P	A		L	T	P	H
1.5	1	0.5		3	1	2	6

Prerequisite: Genetics, Molecular biology

Learning Objectives:

Upon completion of this course, the students

- Would have learned the concepts of gene cloning and its application.
- Would have learned the various techniques involved in Recombinant DNA Technology.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Recall*** the basic concepts of gene cloning and various Restriction and modification enzymes	Cognitive	Remembering
CO2	***Explain*** and ***distinguish*** various vector systems	Cognitive Psychomotor	Understanding Perception
CO3	***Describes, Compares*** and ***Identifies*** various techniques involved.	Cognitive Psychomotor	Remembering Analyzing Perception
CO4	***Discusses, Manipulates*** and ***Describes*** various screening and selection methods.	Cognitive Affective Psychomotor	Applying Resp. Phen. Perception
CO5	***Explain*** and ***Apply*** the applications of rDNA technology under Biosafety guidelines.	Cognitive	Remember Applying

Course content	Hours
I – Basic Concepts Of Gene Cloning	**9+3**
Introduction to recombinant DNA technology - Restriction & modification enzymes **(**restriction endonuclease II, DNA polymerases, Polynucleotide kinases and alkaline phosphatases, DNA ligases and RNase)- Restriction mapping, Design of linkers and adaptors.	
II – Plasmids and Vectors	**9+3+6**
Characteristics of cloning vectors, types of bacterial plasmid vectors (pBR322, pUC57, pSC101), λ vectors, M13 vectors, cosmids, phagemids, yeast artificial chromosome, bacterial artificial chromosome and *Mammalian artificial chromosomes as cloning vector*. Expression vectors**:** pET vectors, Baculovirus vectors.	
III – Molecular Techniques	**9+3+12**
DNA labelling (radioactive and non-radioactive method); DNA sequencing (Maxum & Gilbert, Sangers, pyro-sequencing, shotgun sequencing method)'; Southern, northern and western blotting- PCR – Principle- types- applications- DNA fingerprinting (RAPD; RFLP, AFLP).	
IV – Screening and Selection of Transformants	**9+3+12**
Transfer of rDNA into cells- transformation, transfection, Sonoporation, Microinjection and Calcium phosphate methods- Genomic and cDNA library construction- Selection and screening of recombinants – nucleic acid hybridization- Grunstein hogness and benten- Davis plaque method, immunological screening- Blue – white selection- Reporter gene based selection- GUS, GFP and Luciferase.	
V – Applications of Recombinant DNA Technology	**9+3**
Production of recombinant- insulin, human growth factor, vaccine and gene therapy- gene silencing using RNAi. Genetic manipulation of animal cells – early methods and Crispr-Cas9. Transgenic plants and animals. Bioethics regarding rDNA techniques.	
Recombinant DNA Technology Lab	
List of Practical Experiments	

1. Isolation of Plasmid and Genomic DNA. .
2. Restriction enzyme digestion.
3. Agarose gel Electrophoresis.
4. Southern blotting
5. SDS PAGE.
6. Western blotting.
7. Purification of digested DNA.
8. Ligation of restricted vector and genomic DNA
9. Competent cell preparation- calcium chloride method

Screening and selection of recombinants

Lecture	Tutorial	Practical	Total
45	15	30	90

Text Books:

1. Primrose S.B. and Twymann R.H., "Principles of Gene Manipulation: An Introduction to Genetic Engineering", Sixth Edition, Blackwell Scientific Publications, 2004.

Reference Books:

1. Brown T.A., "Gene Cloning and DNA Analysis", Fourth Edition, Blackwell Scientific Publications, 2003.
2. Glick B.R. and Pasternak J.J., "Molecular Biotechnology", Third Edition, ASM Press, 2003.
3. Sandhu, Sardul Singh. Recombinant DNA technology. IK International Pvt Ltd, 2010.

E-References:

1. http://nptel.ac.in/courses/102103013/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	1	1	1	0	0	1	0	1	0	0	0
CO 2	3	0	3	2	2	1	0	0	0	0	1	0	0	0
CO 3	3	0	3	1	3	0	0	1	0	2	0	0	0	0
CO 4	3	0	3	1	3	0	0	2	0	1	0	0	0	0
CO 5	3	0	3	2	3	2	3	3	0	1	2	0	0	0
	13	**1**	**14**	**7**	**12**	**4**	**3**	**6**	**1**	**4**	**4**	0	0	0

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	**13**	**1**	**14**	**7**	**12**	**4**	**3**	**6**	**1**	**4**	**4**	0	0	0
Scaled Value	3	1	3	2	3	1	1	2	1	1	1	0	0	0

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 604			IMMUNOLOGY	L	T	P	C
				3	0	1	4
C	P	A		L	T	P	H
1.5	1	0.5		3	0	2	5

Prerequisite: Genetics

Learning Objectives:

Upon completion of this course, the students

- Would be able to explain role of immune cells and their mechanism in preventing the body from foreign attack and infectious disease, cancer and other disease development.
- Would apply the knowledge of immune associated mechanisms in medical biotechnology research.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Outline*** the general concepts of immune system and ***describe*** the cells and organs of the immune system	Cognitive	Remembering Evaluating
CO2	***Explains*** the properties of antigens and antibodies and ***identify*** their interactions via various tests.	Cognitive Psychomotor	Understanding Perception
CO3	***Describe*** various mechanisms of antigen presentation and ***discuss*** the role of MHC in Ag Presentation.	Cognitive Affective	Remembering Responds to Phenomena
CO4	***Compares*** the different types of hypersensitive reactions and ***explain*** the autoimmune diseases.	Cognitive	Analyzing Understanding
CO5	***Comprehend*** the types, mechanism of vaccines and ***respond*** to the various immunization techniques	Cognitive Psychomotor	Understanding Guid. Resp.

I- Immune System	**9 + 6**
Organization of the immune system – Types of immune system: Innate and adaptive – Structure and functions of important immune cells: T cell, B cell, Macrophage, Neutrophil, NK cell, Dendritic cell, Stem cells – Immune organs: Bone marrow, Spleen, Thymus, Lymph node, Mucosal and Cutaneous associated Lymphoid tissue (MALT & CALT).	
II- Antigens and Antibodies	**9 + 9**
Antigens: Immunogenicity, Antigenicity, Epitope, haptens and Adjuvants – Antibody: Structure, Classes and Biological Activities – Monoclonal antibodies – Antigen-antibody interactions: Cross-Reactivity, Affinity, Avidity, Precipitation and agglutination reactions. Immunotechniques: ELISA, RIA, Flow cytometry, Immunoelectrophoresis, Western Blotting	
III- MHC and Antigen Presentation	**9 + 6**
Major Histocompatibility Complex: Structure, Function and classes of MHC molecules, Immune responsiveness to MHC – Antigen processing and presentation: Endogenous antigens (The Cytosolic Pathway), Exogenous antigens (The Endocytic Pathway)	
IV- Complement, Hypersensitivity and Autoimmunity	**9 + 6**
Complement System: Functions, Components, Activation and Regulation of complement system – Allergy and hypersensitivity: Types of hypersensitivity – Autoimmunity, Auto immune disorders	
V- Vaccines and Cancer Immunology	**9 + 3**
Vaccines: Active and Passive Immunization, Whole-Organism Vaccines, Purified Macromolecules as Vaccines, Recombinant-Vector Vaccines, DNA and Multivalent Subunit Vaccines. Tumors of the	

Immune System - Tumor Antigens - Immune Response to Tumors – Cancer immunotheraphy.			
Lecture	**Tutorial**	**Practical**	**Total**
45	**0**	**30**	**75**

Text Books:

1. Janes Kuby., Immunology, WH Freeman and Company, Newyork.,7th Edition, 2013.
2. Roitt, I., Essential Immunology, Blackwell Scientific Publications, Oxford, 12th Edition, 2011.

References:

1. Abbas, K. A., Litchman, A. H. and Pober, J. S. (2007). Cellular and Molecular Immunology, 4th Edn., W. B. Saunders Co., Pennsylvania, USA.
2. Tizard, R.I. (2007). Immunology: An Introduction 1st Edition (English) 4th Edition, Brooks/Cole publishers.

E - References:

1. http://www.raymondcheong.com/Year1/immuno.html
2. http://ocw.mit.edu/courses/health-sciences-and-technology/hst-176-cellular-andmolecular immunology-fall-2005/lecture-notes/
3. http://www.umich.edu/~bmsteach/lopatin/Immunology/Immunology.html

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	2	2	1	1	1	1				1	1	3	3
CO 2	3	2	2	1		1	1				1	1	2	2
CO 3	2				1								2	1
CO 4	3	2	1										1	2
CO 5	3	2	2	1	1	1	1				1	1	1	1
	14	**8**	**7**	**3**	**3**	**3**	**3**				**3**	**3**	**9**	**9**

Mapping of Subjects with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original Value	**14**	**8**	**7**	**3**	**3**	**3**	**3**				**3**	**3**	**9**	**9**
Scaled Value	3	2	2	0	0	0	0	0	0	0	0	0	2	2

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

XBT 605 A			ANIMAL BIOTECHNOLOGY	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
2.5	0	0.5		3	0	0	3

Prerequisite: Cell biology, Genetic engineering

Learning Objective:

Upon completion of this course, the students

- Would have learnt animal cell culturing techniques.
- Would have learnt techniques for production of transgenic animals and cloning.

Course Outcomes	Domain	Level
After the completion of the course, students will be able to		
CO1: ***Explain*** animal cell culture media and animal cell culture techniques.	Cognitive	Understanding
CO2: ***Describe*** various gene transfer methods in animal cells.	Cognitive	Evaluating
CO3: ***Analyze*** various micromanipulation techniques and **reproduce** them in fertilization technology.	Cognitive Affective	Applying Resp. phen.
CO4: ***Distinguish*** various methods and techniques for production of transgenic animals and cloning.	Cognitive	Understanding
CO5: ***Describe*** manipulation strategies to improve livestock production including meat and milk production	Cognitive	Evaluating

I- Cell Culture Techniques	**9**
Types and composition of media – Culture vessels and substrates used for cell culture - Primary and secondary cell lines – Monolayer culture – Suspension culture – 3D cell culture (spheroids) - Types, establishment and characterization of cell lines; Differentiation and Scaling up of animal cell culture- Measurement of cell death, viability and cytotoxicity; Immobilized cultures.	
II- Gene Transfer Techniques	**9**
Types of Gene transfer methods - Micromanipulation technology; Biology and Construction of viral vectors like SV40, adenovirus, and adeno associated virus,Transfection methods; stable and transient methods – Cloning techniques and strategies, gene therapy for animal diseases.	
III- Invitro Fertilization and Embryo Transfer	**9**
Invitro fertilization and its limitations - Artificial insemination, Super ovulation, Embryo splitting, Biopsy and Sexing of embryos and Embryo transfer- Embryo cryopreservation techniques – Limitations in embryo transfer - Breeding of farm animals.	
IV- Manipulations for Product Improvement	**9**
Manipulation of Growth hormone; Role of Somatotropic and Thyroid hormone in growth - Probiotics as growth promoters; Ideal characteristics, Mode of action and uses of probiotics; Manipulation of lactation – Lactogenesis and galactopoiesis, wool growth and rumen microbial digestive system.	
V- Transgenic Animals	**9**
Scope and importance of transgenic animal technology - Various strategies for the production of transgenic animals: pronuclear microinjection, embryonic stem cells and somatic cell nuclear transfer – Gene knock in and knock out models for studying human disorders - Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutics.	

Lecture	Tutorial	Practical	Total
45	**0**	**0**	**45**

Text Books:

1. Freshney, R. I., Culture of Animal Cells: A manual of Basic technique, John , Wiley and sons, 6th Edition, 2010.
2. Ramadoss, P., Animal Biotechnology: Recent Concepts and Developments, MJb Publishers, Chennai, 1st Edition, 2008.

References:

1.Masters, J.R.W., Animal Cell Culture: Practical Approach, Oxford University Press, New York, 3rd Edition, 2000.
2.Holland, A. and Johnson, A., Animal Biotechnology and Ethics, Springer Verlag, New York,1st Edition, 1998.

E References:

1. http://www.biotechnology4u.com/question_bank_question_answer.html

COs Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	2	2	0	1	1	2	1	1	2	1	2
CO 2	3	1	2	1	2	0	0	1	0	2	1	3	2	1
CO 3	3	1	2	3	3	2	2	1	2	2	2	3	3	3
CO 4	3	2	2	2	3	1	1	1	1	2	2	2	1	2
CO 5	3	2	3	1	2	2	1	1	1	2	2	2	1	1
	15	8	10	9	12	5	4	5	6	9	8	12	8	9

Subject Versus POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original value	15	8	10	9	12	5	4	5	6	9	8	12	8	9
Scaled to 0,1,2,3 scale	3	2	2	2	3	1	1	1	2	2	2	3	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 605B			NANOBIOTECHNOLOGY	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
2.5	0	0.5		3	0	0	3

Prerequisite: Bioinstrumentation

Learning Objective:

Upon completion of this course, the students

- Would be able to learn fundamentals of nano technology.
- Would be able to learn the nano particle synthesis and its application in biotechnology

Course Outcomes	Domain	Level
After the completion of the course, students will be able to		
CO1: ***Recall*** the basic concepts characterization techniques and ***illustrate*** the methods of nanoparticles synthesis.	Cognitive Affective	Remembering Understanding
CO2: ***Construct*** microfluidic devices and ***relate*** its advantages.	Cognitive	Creating Understanding
CO3: ***Design*** and ***Develop*** theranostics nanoparticles	Cognitive	Creating
CO4: ***Outlines*** the environmental applications of nanoparticles	Cognitive	Understanding
CO5: ***Understands*** the Fundamentals of Nanocarriers and ***design*** a drug delivery system.	Cognitive Affective	Receiving Phenomena Creating

I- Introduction to Nanoparticles Synthesis and Characterization	**9**
Nanoparticles- physical, chemical and biological properties- Synthesis- Physical methods: laser vaporization, laser Pyrolysis, ion implantation. Chemical methods for synthesis of Nanomaterials: sol-gel method. Biological synthesis: using microorganisms, plant extracts. Characterization techniques: UV- Spectroscopy, Dynamic Light Scattering, Zeta potential, Energy Dispersive X-Ray Analysis (EDX), Selected Area Diffraction Pattern (SAED), SEM, TEM, AFM.	
II- Microfluidics Meets Nano: Lab-on-a-Chip Devices	**9**
Concepts and advantages of microfluidic devices – Fluid transport – Stacking and sealing – Materials and methods for the manufacture of microfluidic component, fluidic structures, surface modifications.	
III- Nanoparticles As Theranostic Agents	**9**
Theranostic agents- properties- advantages- Carbon dots and Quantum dots- ability to cross across Blood Brain Barriers- theranostic approach for Cancer treatment and neurodegenerative disorders- Alzheimer's, Parkinson's disease.	
IV- Environmental Applications of Nanoparticles	**9**
Role of iron oxide, biopolymers and metal nanoparticles in Waste water treatment- heavy metal removal, nanofilter devices. Role of antimicrobial coating in infectious disease prevention. Nanobiosensors for environmental monitoring.	
V- Nanoparticles and Novel Drug Delivery Systems	**12**

Fundamentals of Nanocarriers - Size, Surface, Magnetic and Optical Properties, Pharmacokinetics and Pharmacodynamics of Nano drug carriers. Drug delivery systems- microcapsules and microspheres- hydrogels- Polymers - Dendrimers- Dendritic Nanoscafold system. pH based targeted delivery- chitosan and alginate. Copolymers- PLA, PLGA. Lipid Based Nanocarriers - Liposomes, niosomes- Cubosomes. Hydrophobic drug delivery.			
Lecture	**Tutorial**	**Practical**	**Total**
45	**0**	**0**	**45**
Text Books:			
1. Niemeyer, Christof M., and Chad A. Mirkin. Nanobiotechnology: concepts, applications and perspectives. Vol. 1. John Wiley & Sons, 2004. 2. Mirkin, Chad A., and Christof M. Niemeyer, eds. Nanobiotechnology II: more concepts and applications. John Wiley & Sons, 2007.			
References:			
1. Goodsell, David S. Bionanotechnology: lessons from nature. John Wiley & Sons, 2013. 2. Freitas Jr. R.A., "Nanomedicine", First Edition, Volume IIA, Landes Biosciences, 2004.			
E- References:			
1. http://www.chem.latech.edu/~ramu/msnt505/lec_notes/Ji/MSNT505_Ji_notes.htm 2. http://nptel.ac.in/courses/118107015/			

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	3	2		2		2					2	1	2
CO 2	2	2	2	2	2	2	2				2	3	2	1
CO 3	1	2			3	3					2	3	3	3
CO 4	2	3	3	3	2	3	3				1	2	1	2
CO 5	1	2			3	2		1				2	1	1
	8	12	7	5	12	10	7	1			5	12	8	9

Mapping of Subject Vs Pos

	PO1	PO2	PO 3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PS O2
Original value	8	12	7	5	12	10	7	2			5	12	8	9
Scaled to 0,1,2,3 scale	2	3	2	1	3	2	2	1			1	3	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 605C			HEAT TRANSFER	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Pre-requisites : Nil

Learning Objectives:

Upon completion of this course, the students

- To facilitate the learners understand the basic concepts and principles of heat transfer and their applications.

Course Outcomes: After the completion of the course, students will be able to	**Domain**	**Level**
CO1: Calculate the thermal resistance and compute the conduction heat transfer rates in any system.	Cognitive	Understand and Analysing
CO2: Compute the heat transfer rate in any convection system.	Cognitive	Understand and Analysing
CO3:understanding of heat exchangers equipments and applications	Cognitive	Understand and Analysing
CO4: Calculate the heat transfer coefficients and heat transfer rates for a given radiation-system	Cognitive	Understand and Analysing
CO5: Compute the key parameters for any single effect evaporator.	Cognitive	Understand and Analysing

I- Conduction	**9 hrs**
Heat Transfer Fundamentals: Modes of heat transfer, thermal diffusivity and heat transfer coefficient, heat conduction through series and parallel resistances. Analogy between flow of heat flow of electricity and thermal conductivity; effect of temperature on thermal conductivity, conduction through extended surfaces-rectangular fin and pin-fin.	
II- Convection	**9 hrs**
Convective heat transfer - natural and forced convection; Dimensional analysis; Thermal boundary layer; Analogies and Correlations.	
III- Heat Exchangers	**9 hrs**
Types of heat exchangers; parallel & counter-flow heat exchangers; - double pipe heat exchanger, shell and tube heat exchanger -concept of LMTD - Fouling factors and Wilson's plot, heat transfer area calculation.	
IV- Radiation	**9 hrs**
Concepts of thermal radiation, absorptivity, reflectivity, transmissivity.Concept of black body and gray body, Stefan-Boltzmann's law, Kirchoff's law- the effect of radiation on temperature measurement.	
V- Evaporation	**9 hrs**
Types of evaporators; single-effect evaporator - capacity; economy, the effect of boiling-point elevation; Duhring's rule. Material & energy balance in single-effect evaporator.	

Lecture	**Tutorial**	**Practical**	**Total**
45	**0**	**0**	**45**

Text Books:

1. Holman JP "Heat Transfer (SI units)" 9th Edition, McGraw Hill companies, 2010.
2. Gavhane K A "Heat Transfer (SI units)" 10th Edition Nirali Prakashan , 2010.
3. Frank Kreith Mark S.Bohn "Principles of Heat Transfer" 6th Edition, Cengage Learning india private limited, 2009.

References:

1. McCabe, W. L., J.C. Smith and P. Harriott, *Unit Operations of Chemical Engineering*, 7/e,

McGraw-Hill International Edition, 2005.
2. Nag P K Heat Transfer Tata McGraw-Hill Edition, New Delhi, 2002.
3. Donald Q.Kern Process Heat Transfer 20th Edition, Tata McGraw-Hill Edition, New Delhi ,1997

Mapping of COs with POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	1	3	2	1	2	1	1	0	2	2	3	3
CO 2	3	3	1	3	2	1	2	1	1	0	2	2	3	3
CO 3	3	3	1	3	2	1	2	1	1	0	2	2	3	3
CO 4	2	1	1	1	1	1	1	1	1	0	1	1	1	1
CO 5	3	3	1	1	1	1	1	1	1	0	1	1	1	1
	14	13	5	11	8	5	8	5	5	0	8	8	11	11

Mapping of Subject Vs Pos

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original value	14	13	5	11	8	5	8	5	5	0	8	11	11	11
Scaled to 0,1,2,3 scale	3	3	1	2	2	1	2	1	1	0	2	3	3	3

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

MINOR COURSE ON MATLAB FOR BIOLOGICAL APPLICATIONS
XBTM02 – MATLAB for Biological Applications

Exp.No	Title	Mode of conduction	No. of hours	Domain Level
01	Introduction to MATLAB *(mode of enter the input of various mathematical equations applicable to biotechnology)*	MatLab software	3	Cognitive – Psychomotor
02	Plotting graphs in MATLAB *(Analysis of various bio experiment data through different plots by Matlab)*	MatLab software	3	Cognitive – Psychomotor
03	Apply MATLAB on Equation of state	MatLab software	3	Cognitive – Psychomotor
04	Apply MATLAB on Reaction Equilibria	MatLab software	6	Cognitive – Psychomotor
05	Apply MATLAB on Mass Balances	MatLab software	6	Cognitive – Psychomotor
06	Apply MATLAB on Bioimage processing	MatLab software	6	Cognitive – Psychomotor
07	Hints When Using MATLAB	MatLab software	3	Cognitive – Psychomotor
		Total hours	**30**	

Text Book:

Introduction to Chemical Engineering Computing by Bruce A. Finlayson Wiley Publication, 2nd Edition.

Getting Started with MATLAB by Rutra Pradap, Oxford Publication.

XBT 701 A			PROTEIN ENGINEERING	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
2.5	0	0.5		3	0	0	3

Prerequisite: Biochemistry, Molecular Biology

Learning Objective:

Upon completion of this course, the students

- Would learn to make up of proteins, structure and function.
- Would able to give mechanism of protein build up and function.
- Would learn the strategy to engineer proteins for benefits of human beings.

Course Outcomes	Domain	Level
After the completion of the course, students will be able to		
CO1*: Explain* and understand the aminoacid characteristics and primary structure of proteins	Cognitive	Understanding
CO2: *Explain* and ***analyze*** the secondary and super secondary structural features	Cognitive	Understanding Analyzing
CO3: *Describe* and ***compare*** the different level of protein structure and their folding mechanism.	Cognitive	Remembering Analyzing
CO4: *Explain* the protein structure its function al relationship and ***relate*** that in various examples.	Cognitive Affective	Applying Organization
CO5: *Explain* the protein engineering concepts and ***assist*** that in various engineered protein production.	Cognitive	Applying Responds to phenomena

I- Structure and Functional Aspects of Amino acids	**9 + 3**
Acid–base properties of amino acids - Stereochemical representations of amino acids - Peptide bonds - chemical and physical properties of amino acids - Detection, identification and quantification of amino acids and proteins – Stereoisomerism - Non-standard amino acids – Primary structure of proteins – peptide mapping and peptide sequencing – Edman degradation method.	
II- Protein Architecture	**9 + 3**
Ramachandran plot – Tertiary structure – Interactions that stabilize the tertiary structure – Organization of Domains – Quaternary structure – Importance of quaternary structures in globin family – haemoglobin and allosteric regulation – Methods to determine the three-dimensional structure of proteins.	
III- Protein Folding and Assembly	**9 + 3**
Protein folding: Molten globule state – Role of hydrophobic residues in folding – Single and multiple protein folding pathway – Role of disulphide bonds in protein folding – Invivo protein folding: Structure of Molecular chaperones and their role in protein folding – osmolyte assisted protein folding - Amide exchange and measurement of protein folding – Membrane protein folding – Protein misfolding and the diseased state: amyloidosis.	
IV - Protein Structure and Function Relationship	**9 + 3**
Helix turn helix motif in DNA binding proteins - Role in prokaryotic and eukaryotic transcription factors - Trp repressor - Zn fingers & Leucine zippers - Membrane proteins and receptors : bacteriorhodopsin – Structure function relationship in Immunoglobulin – Enzymes: Serine proteases mechanism of action.	
V- Protein Engineering	**9 + 3**
Strategies for protein engineering: Effect of Disulfide bridges, Dipoles of α helices - Random and site-directed mutagenesis in protein engineering - Role of low-fidelity enzymes in protein	

engineering – SNP –Production of Peptide Vaccines – Protein microarray and its role on disease diagnosis.

Lecture	Tutorial	Practical	Total
45	15	0	60

Text Books:

1. Voet D., Voet G. Biochemistry, 4th edition, John Wiley & Sons, 2010.
2. Branden, C. and Tooze, R., Introduction of Protein structure, Garland, 2nd Edition, 1999.
3. Alan Fersht. Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding. 3rd revised edition, W.H.Freeman & Co Ltd, 1999.

References:

1. Creighton T.E. Proteins: Structure and Molecular Properties, , 2nd Edition, Freeman, WH, 1992.
2. Creighton T.E. Protein Structure: A Practical Approach, 2nd Edition, Oxford University Press, 1997.
3. Lilia Alberghina. Protein Engineering in Industrial Biotechnology, CRC press, Harwood Academic Publishers, 2003.

E- References:

1. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2763986/
2. www.niscair.res.in/sciencecommunication/ResearchJournals/rejour/ijbt/ijbt2k6/ijbt_july06.asp
3. http://books.google.co.in/books?id=x0UyTLIhWSAC&pg=PA227&source=gbs_toc_r&cad=3#v=onepage&q&f=false

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PO12
CO 1	1	1	0	1	2	2	1	1	0	2	2	3	1	1	3
CO 2	2	3	2	2	2	1	1	0	1	0	0	2	1	1	2
CO3	3	1	2	1	2	0	0	0	1	1	1	3	2	3	3
CO4	1	3	2	3	2	1	2	1	1	2	1	2	2	2	2
CO5	3	2	3	3	3	2	2	2	3	2	2	3	3	3	3
	10	10	9	10	11	6	6	4	5	7	6	13	9	10	13

Mapping of Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original value	10	10	9	10	11	6	6	4	5	7	6	13	9	10
Scaled to 0,1,2,3 scale	2	2	2	2	3	2	2	1	1	2	2	3	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 701B			PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisite: Biochemistry, Immunology, r-DNA technology

Learning Objectives:

Upon completion of this course, the students

- Would able to understand principles of biotechnology in pharmaceutical product development.
- Would apply advanced biotechnology methods in novel drug development
- Would able to review the production processes for antibiotics, vitamins, alkaloids and steroids

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***identify*** the potential avenues and requirements from the biotechnologists in pharmaceutical industries and ***describe*** the scope and applications of biotechnology in pharmacy	Cognitive	Analyzing Understanding
CO2	***Outline*** the pharmacodynamics, pharmacokinetics of drugs	Cognitive	Analyzing Understanding
CO3	***Describe*** various adverse effects of drugs	Cognitive	Analyzing Understanding
CO4	***Explain*** the manufacturing process for various therapeutical products including vaccines, enzymes, interleukins, hormones	Cognitive	Analyzing Understanding
CO5	***Comprehend*** the methods applied to test the quality of drugs and other biopharmaceuticals	Cognitive	Analyzing Understanding

I- Introduction	**7**
Introduction to Pharmaceutical industry & development of drugs; types of therapeutic agents and their uses. Pharmaceutical Biotechnology and Drug discovery. Scope and applications of biotechnology in pharmacy, biological /research advances and approved biologicals for pharmaceutical uses.	
II- Drugs and Their Metabolism	**10**
Physiochemical properties of drugs, factors modifying drug action. Pharmacodynamics, pharmacokinetics and drug metabolism.	
III- Drugs and Their Interaction	**10**
Adverse effects of drugs and drug toxicology: Reproductive toxicity and Teratogenicity, Mutagenicity, Carcinogenicity, Drug tolerance, Drug intolerance, drug allergy, drug induced side effects. Tachyphylaxis, biological effects of drug abuse and drug dependence.	
IV- Production of Biopharmaceuticals	**11**
Biopharmaceutical and biological drug development, Manufacturing of biopharmaceutical, therapeutic proteins and peptides. Recombinant growth hormones, growth factors, therapeutic monoclonal antibodies, therapeutic enzymes and their application in health care.	
V- Testing and Analysis of Biopharmaceuticals	**7**
Pharmaceutical Testing, Analysis and Control: Analysis of pharmaceuticals using physical, chemical and biological methods, quality assurance and control, stability of pharmaceutical products	

Lecture	Tutorial	Practical	Total

45	0	0	45

Text Books:

1. Purohit,Kulkarni,Saluja—Pharmaceutical biotechnology, Agrobios publishers, 2003
2. Pharmaceutical biotechnology edition2 by crommel, Freeman publishers, 2004

References:

5. Crommelin.D.J.A, Robert D. Sindela, Bernd Meibohm "Pharmaceutical Biotechnology: fundamentals and applications", Informa Healthcare, 2008.
6. Pharmaceutical biotechnology:drug discovery and clinical applications by Kayser,Wiley publishers, 1st edition 2007
7. Katzung B.G. Basic and Clinical Pharmacology,(6th Ed) Prentice Hall of Intl., 1995

E- References:

1. https://archive.org/details/PharmaceuticalBiotechnology/page/n111

Mapping Of COs and POs

	Program Outcomes													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	2	-	1	1	2	2	-	-	1	1	1	1	0	0
CO2	1	1	1	1	2	2	1	2	1	2	2	2	1	0
CO3	2	2	2	2	1	2	2	-	2	2	1	1	2	0
CO4	2	1	3	2	2	3	2	-	1	1	-	-	3	0
CO5	2	3	2	2	3	3	2	2	2	2	1	1	3	0
	9	**7**	**9**	**8**	**10**	**12**	**7**	**4**	**7**	**8**	**5**	**5**	**9**	**0**

Mapping of Subject Vs POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Original value	**9**	**7**	**9**	**8**	**10**	**12**	**7**	**4**	**7**	**8**	**5**	**5**	**9**	**0**
Scaled to 0,1,2,3 scale	2	2	2	2	2	3	2	0	2	2	0	0	2	0

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 701 C			MASS TRANSFER FUNDAMENTALS	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisites : Nil

Objectives:

- To facilitate the learners understand the basic concepts and principles of mass transfer and apply them in distillation, absorption adsorption drying and humidification operations.

Course Outcomes: At the end of this course, the students should be able to		**Domain**	**Level**
CO1	Explain the basic principles in diffusional mass transfer and calculate the rate of the mass transfer under one dimensional steady state diffusion	Cognitive	Understand Analysing
CO2	Describe the operations of Distillation and absorption and calculate number trays for distillation and absorption tower	Cognitive	Understand Analysing
CO3	List situations where liquid–liquid extraction might be preferred to distillation	Cognitive	Understand Analysing
CO4	Discuss the salient features of Separation by adsorption, chromatographic separation process and Explain the concept of breakthrough in fixed-bed adsorption.	Cognitive	Understand Analysing
CO5	Describe the salient features and mechanism involved in Drying and Design cooling towers.	Cognitive	Understand Analysing

I- Mass Transfer and Diffusion **9 hrs**

Steady state molecular diffusion in fluids and solids. One dimensional steady state and unsteady state molecular diffusion through stationary media – molecular diffusion in laminar flow – diffusivity measurements – mass transfer analogies – inter phase mass transfer, models of mass transfer at fluid – fluid interface – two film theory and overall mass transfer coefficients – Diffusion in multi component gaseous mixtures – Diffusion in solids.

II- Distillation **9 hrs**

Vapour liquid equilibrium – methods of distillation – simple, steam, flash distillation, azeotropic, Extractive and molecular distillation – Continuous distillation – McCabe - Thiele method, ponchon savarit method

III - Extraction and Leaching **9 hrs**

L-L equilibrium – staged and continuous extraction concepts, Equipments for extraction – general design considerations. Solid – liquid equilibria, leaching principles – Equipments for leaching – equilibrium stage model for leaching and washing - simple problems.

IV- Absorption and Adsorption **9 hrs**

Theory of absorption – Factors affecting gas absorption-Equilibrium and operating line concept in absorption stage determination – Pressure drop and limiting flow rates – weeping; coning; entrainment; flooding; channelling Adsorption and its types -sorbents – equilibrium consideration-kinetic and transport considerations – sorption systems.

V - Humidification and Drying **9 hrs**

Basic terminologies in humidification – psychrometric chart, construction and use. Methods of humidification and dehumidification – equipments – spray chamber– cooling tower principles, types and operation – process design of cooling tower.

Theory and mechanism of drying – drying characteristics of materials -batch and continuous drying – drying equipment – design and performance of various drying equipments.

Lecture	Tutorial	Practicals	Total

45	0	0	45

Text Books

1. Treybal R.E., "Mass Transfer Operations", Third Edition, McGraw Hill, 1980.
2. Anantharaman, N. and K.M. MeeraSherifa Begum, "*Mass Transfer Theory and Practice"*, PHI Learning Private Limited, New Delhi,2011
3. Gavhane K.A "Mass Transfer" 8th Edition, Nirali Prakashan, 2010.

References

1. Dutta, B. K., " *Principles of mass transfer and separation processes"*, Prentice Hall of India, Delhi, 2007
2. Coulson and Richardson, "Chemical Engineering" Vol. I & II, Asian Books Pvt.ltd., 1998.
3. McCabe, W.L., J.C. Smith and P. Harriott, "*Unit Operations of Chemical Engineering"*, 7/e, McGraw-Hill International Edition, 2005.

Mapping of COs Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	3	2	1	2	1	1		2	2	3	3
CO 2	3	3	1	3	2	1	2	1	1		2	2	3	3
CO 3	3	3	1	3	2	1	2	1	1		2	2	3	3
CO 4	2	1	1	1	1	1	1	1	1		1	1	1	1
CO 5	3	3	1	1	1	1	1	1	1		1	1	1	1
	14	13	5	11	8	5	8	5	5		8	8	11	11

Mapping of Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original value	14	13	5	11	8	5	8	5	5		8	8	11	11
Scaled to 0,1,2,3 scale	3	3	0	3	2	0	2	0	0	0	2	2	3	3

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 702			BIOINFORMATICS AND COMPUTATIONAL BIOLOGY	L	T	P	C
				3	0	1	4
C	P	A		L	T	P	H
1	0.5	0.5		3	0	1	4

Prerequisite: Computer programming, biochemistry

Learning Objectives:

Upon completion of this course, the students

- Will be able identify different databases and will be able to know about the application of the bioinformatics for data retrieval and for drug designing and development.

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	**Explain** the importance and basic concepts in bioinformatics and **differentiate** various databases.	Cognitive Psychomotor	Understanding Perception
CO2	**Understands** the significance of sequence analysis and **performs** sequence alignment.	Cognitive Psychomotor	Applying Guided response
CO3	**Explain** and **Construct** phylogenetic trees to study phylogenetic relationships	Cognitive Psychomotor	Understand Guided response
CO4	**Predict** and **Analysis** the protein structure and molecular docking	Cognitive Psychomotor	Create mechanism
CO5	**Understand** the steps involved in drug discovery process.	Affective	Receiving phenomena

I- Introduction to Bioinformatics **9+6**

Important contributions - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities – Biological databases- Classification of biological databases- Primary and Secondary databases, Sequence and structure databases, Specialized databases- retrieval system- Entrez- SRS.

II- Introduction to Computational Biology and Sequence Analysis **9+6**

Sequence alignment, Pairwise alignment, Multiple sequence alignment its applications, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, Database similarity searching -FASTA and BLAST.

III- Phylogenetics **9+6**

Introduction to Phylogenetics, Molecular Evolution and Molecular Phylogenetics, Phylogenetic tree, Forms of Tree Representation, Rooted and un-rooted trees, Phylogenetic Tree Construction Methods: Distance based methods- NJ, UPGMA, Character based methods –Maximum Parsimony, Phylogenetic programs, Bootstrapping.

IV- Protein Structure, Modelling and Simulations **9+3+3**

Protein structure basics, Protein structural visualization and comparison, Secondary structure prediction- Chau-Fasman, GOR, Neural networks, Protein tertiary structure prediction Homology modeling, Threading and Fold recognition.

V- Role of Bioinformatics in Drug Discovery **9+3**

Drug designing- objectives- Rational drug design- Computer assisted drug design and drug development- Molecular docking and its applications- QSAR, In Silico drug design- role of structural bioinformatics in drug design and development- Pharmacogenomics- prospects and uses.

List of Experiments

1. Accession and retrieval of data from various biological databases.
2. Unix/Linux – basic operations and working with terminal.
3. Perl programming - Simple programs using Operators, Control Structures, Subroutines, Hash,

Creating a static HTML file by a Perl Program.

4. Heuristic methods (BLAST, FASTA) of searching for homologous sequences
5. Pair-wise (Needleman – Wunch Algorithm & Smith waterman Algoritghm)and Multiple sequence alignment.
6. Gene prediction methods (ORF Finder).
7. Phylogenetic tree building using Phylip.
8. Protein Secondary structure prediction.
9. Homology Modeling.
10. Molecular Visualization and 3D structural studies using Rasmol - Commands, Domain identification.
11. Molecular Visualization and 3D structural studies using Chimera.
12. Small molecule building, using ISIS Draw and CHEM SKETCH – Tutorial

Lecture	Tutorial	Practical	Total
45	0	30	75

Text Books:

1. David W. Mount Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, Second Edition, 2004
2. Ghosh, Zhumur, and Bibekanand Mallick. Bioinformatics: Principles and Applications. Oxford University Press, 2008.
3. S. Harisha , "Fundamentals of Bioinformatics", I. K. International Pvt Ltd, 2010

References:

1. Arthur M. Lesk, Introduction to Bioinformatics by Oxford University Press, 2008
2. T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005
3. Stephen A. Krawetz, David D. Womble, Introduction To Bioinformatics A Theoretical and Practical Approach, Humana Press, 2003

E-References:

1. http://nptel.ac.in/courses/102103044/40
2. vlab.amrita.edu/?sub=3&brch=273

Mapping of Cos Vs PO s

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2
CO 1			1		2				2					
CO 2		2	2	1	3								1	
CO 3		2	1	1	2							3	3	1
CO 4	1	3	3	1	3						3	1	2	3
CO 5	1	2	3		3						2	1	1	1
	2	9	10	3	13				2		5	4	7	5

Mapping of Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
Original value	2	9	10	3	13	0	0	0	4	0	0	
Scaled to 0,1,2,3 scale	1	2	2	1	3	0	0	0	1	0	0	

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 703			DOWNSTREAM PROCESSING	L	T	P	C
				2	1	1	4
C	P	A		L	T	P	H
1	0.5	0.5		2	1	1	4

Prerequisite: Microbiology, Bioprocess Engineering, Biochemical Engineering

Learning Objectives:

Upon completion of this course, the students

- Will be able understand the principle behind the different processes involved in the downstream processing.

Course Outcomes:

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Recall*** and ***describe*** the basics of bioseparation process.	Cognitive Affective	Remembering Receiving Phenomena
CO2	***Outline*** and ***differentiate*** the different methods of downstream processing.	Cognitive Affective Psychomotor	Understanding Valuing Perception
CO3	***Identify***, ***locate*** and ***select*** a specific method for a production process.	Cognitive Affective Psychomotor	Understanding Receiving Phenomena Perception
CO4	***Recognize***, ***perform*** and ***detect*** various separation technique for a bioproduct development	Cognitive Affective Psychomotor	Understanding Responding phenomena Perception
CO5	***Identify, choose*** and ***follow*** the different methods for the purification of a particular product.	Cognitive Affective Psychomotor	Understanding Receiving Phenomena Guided response

I- Introduction to Downstream Processing Processes **9+3+3**

Scope and overview-Economics, strategies for initiation of project, Process Design Criteria cost reduction strategies, upstream and downstream processing in biotechnology, various biotechnology products and their biological properties, fundamentals of bioseparation. Separation process design criteria-Characteristics of biological mixtures, Morphological features of the cell, Concentration of product of interest and impurities, physical and rheological characteristics.

II- Downstream Processing Methods **9+3+3**

Cell disruption Techniques, types of cells, location of products inside the cells and products , cell distruption Methods, Mechanical and Non mechanical methods- Filtration, types of filtration equipments, filter media and filter aids, basic theory of filtration, principle of rotary drum filter- centrifugation-principle of sedimentation , types of centrifuges, flocculation and sedimentation.

III- Product Identification Techniques **9+3+3**

Characterization of product- Electrophoresis, Principle and methods-Analysis of product purity-Chromatography,Enzyme Linked Immuno Sorbent Assay (ELISA),Ion exchange chromatography, Reverse phase chromatography, Affinity Ligand Technology HPLC Radial Flow Chromatography.
Experiment No 4: Extraction of pigments from spinach and estimation by thin layer chromatography.

IV- Product Separation Techniques **9+3+3**

Distillation- Principle and types, Extractive distillation, Steam Distillation, Vaccum Distillation-Extraction- Solvent extraction principles, Extraction methods, modes of aqueous two-phase extraction, Super critical fluid extraction -Adsorption, principle, Isotherms, different types of adsorption- Evaporation, principle, factors influencing rate of evaporation, types of evaporators.

V- Product Purification and Resolution	**9+3**

Precipitation methods (with salt, organic solvents, and polymers, extractive separations, aqueous two-phase extraction)- Membrane based separation process, Types of membranes, Membrane process, theory and types of membrane-Application of ultrafiltration- Application of microfiltration - Crystallization, theory of crystallization- Freeze drying- Principle, process and application of freeze drying integrated bio-processing- product polishing stages

List of Experiments:

1: Yeast cell disruption studies by sonication.
2: Design of thickener for batch sedimentation using yeast by Kynch's theory.
3: Determine the specific cake resistance of a media by filtration.
4: Centrifugation studies during the settling of E.coli cells.
5: Determination of partition coefficient and yield of yeast cells using aqueous two phase extraction.
6: High-resolution purification preparative liquid chromatographic techniques.
7: Ammonium Sulfate precipitation of protein using yeast cell suspension.
8: Crystallization of a product.
9. Determination of drying time for the given sample in vacuum tray drier.
10:Lyophillization

Lecture	**Tutorial**	**Practical**	**Total**
45	**15**	**15**	**75**

Text Books:

1. Nooralabettu Krishna Prasad,Downstream Process Technology, A New Horizon in Biotechnology,PHI Pvt Ltd,2nd Edition, 2012.
2. Sivasankar, B. Biosperations: Principles and Techniques. PHI Learning Pvt. Ltd., 2005..

References:

1. Hatti-Kaul, Rajni, and Bo Mattiasson. "Downstream processing in biotechnology." Basic biotechnology. Cambridge University Press, Cambridge ,2001.
2. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides1, " Bioseparations Science and Engineering, oxford University Press, 2015.
3. J. A. Wesselingh, Johannes Krijgsman, "Downstream Processing in Biotechnology" , Delft Academic Press/VSSD, 2013.

E-References:

1. http://vlab.amrita.edu/?sub=2&brch=191&sim=341&cnt=1
2. http://vlab.amrita.edu/?sub=2&brch=191&sim=1547&cnt=1
3. http://vlab.amrita.edu/?sub=2&brch=190&sim=606&cnt=1
4. vlab.amrita.edu/?sub=3&brch=273

Mapping of Cos Vs POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3		2	1		1	1		1					1
CO 2	2	3	2	1		1			1			1	1	1
CO 3	2	3	1	2					1			1	1	2
CO 4	2	1	3	2			3		1			1	2	1
CO 5	2	2	3	1		2	1		1		2	2	3	3
	11	9	11	7		4	5		5		2	5	7	8

Mapping of Subject Vs POs

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2
Original value	11	9	11	7	0	4	5	0	5	0	2	5	7	8
Scaled to 0,1,2,3 scale	3	2	3	2	0	1	1	0	1	0	1	1	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 704 A			CANCER BIOLOGY	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
2.5	0	0.5		3	0	0	3

Prerequisite: Cell biology molecular biology

Learning Objective:

Upon completion of this course, the students

- Would have learn about carcinogenesis.
- Would have learn about a comparative approach to understand the differences in mechanisms and signaling.

Course Outcomes	Domain	Level
After the completion of the course, students will be able to		
CO1: ***Outline*** the regulation and modulation of cell cycle in cancer by various signal switches	Cognitive	Understanding
CO2: ***Explain*** and ***compare*** various types of carcinogenesis and its metabolism	Cognitive	Understanding Analyzing
CO3: ***Illustrate*** the role of activation of kinases, ***identification*** of oncogenes, and ***conforms*** the role of telomere.	Cognitive Affective	Understanding Analyzing Responds to Phenomena
CO4: ***Explain*** metastasis and its significant clinical markers for invasion and metastasis	Cognitive	Understanding
CO5: ***Describe*** and ***compiles*** molecular tool for early diagnosis of cancer, different forms of cancer therapy.	Cognitive Affective	Understanding Responds to Phenomena

I- Cell Cycle and Cancer	**9**
Cancer: Causes, characteristics and types – Cell cycle phases, cyclins and CDKs, check points , modulation of cell cycle in cancer - Effects on receptor, signal switches, signaling pathways – Telomerase and its role in cancer – Apoptosis, Extrinsic and intrinsic pathways, apoptosome and caspases - mutations that leads to cancer.	
II- Carcinogenesis	**9**
Theory of carcinogenesis – Types: Physical, chemical and radiation carcinogenesis, Direct acting and indirect acting carcinogens, Metabolism of carcinogens, CYP450 reductase mechanism; Mechanism of radiation carcinogenesis, ionizing and non ionizing radiation, Retroviruses - RSV life cycle and its role in cancer, Identification of carcinogens, Long and short term bioassays.	
III- Molecular and Cell Biology of Cancer	**9**
Signal targets and cancer, activation of kinases – Oncogenes - types, c-Myc, Ras, Bcl-2 family - identification and detection of oncogenes, oncogenes and proto oncogene activity - Growth factors related to transformation - epidermal growth factor (EGF), platelet derived growth factor (PDGF), transforming growth factor (TGF), src and myc; RAS cycle – Tumor suppressor genes.	
IV- Invasion and Metastasis	**9**
Clinical significances and three step theory of Invasion, Metastasis – Introduction and cascade, heterogeneity of metastatic phenotype, Significance of proteases in basement membrane disruption, Epithelial- mesenchymal transition, stromal signals, Role of cadherin and integrin, metalloproteinases in cell invasion, Ras like GTPases.	

V- Diagnosis and Therapy	9
Diagnosis: Detection using biochemical assays, tumor markers - Molecular tools for early diagnosis of cancer, Disease staging - FISH, DNA microarrays, SNPs, CGH and imaging techniques. Treatment: Chemotherapy – Topoisomerase inhibitors – Radiotherapy – Gene therapy – Immuno therapy – Antigen specific and Adaptive therapy – Stem cell therapy - Use of signal targets towards therapy of cancer – New Genomic and proteomic technologies.	

Lecture	Tutorial	Practical	Total
45	0	0	45

Text Books:

1. Weinberg, R.A., The Biology of Cancer, Garland Science Taylor and Francis Group, New York, 1st Edition, 2007.
2. Kleinsmith. L.J., Principles of Cancer Biology, Pearson Education Inc., San Francisco, CA, 1st Edition, 2006.

References:

1. DeVita Jr, V.T., Lawrence, T.S., Rosenberg, S.A., DePinho, R.A. and Weinberg, R.A., DeVita, Hellman, and Rosenberg's Cancer: Principles and Practice of Oncology, Lippincott Williams & Wilkins Philadelphia, PA, 9th Edition, 2011.
2. Ian F.Tannock, Richard P. Hill, Robert G. Bristow and Lea Harrington., The Basic Sciences of Oncology, 4th Edition, The McGraw-Hill Companies, Inc. New Jersey,2005.
3. Pelengaris A.,and M. Khan (Eds)., The Molecular Biology of Cancer, Wiley - Blackwell Publishing, USA. 2006.
4. Gareth Thomas.,Medicinal Chemistry – An Introduction, 1st Edition, John Wiley and Sons, USA, 2004.
5. Benjamin Lewin., Genes VIII, International Edition, Pearson Prentice Hall, New Delhi. 2004.

E References:

1. www.nhri.org.tw/NHRI_ADM/userfiles/file/1010510.pdf

Mapping of Cos Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	2	1			2	2	2	2	3	2
CO 2	2	2	2	2	3	3	2	1				3	1	1
CO 3	3	3	2	2	2				1	1	2	2	2	3
CO 4	2			3	2							1	1	2
CO 5	3	3	2	3	2	2	2	1	2	2	1	1	1	1
	13	10	8	11	11	6	4	2	5	5	5	9	8	7

Mapping of Subject Vs POs

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2
Original value	13	10	8	11	11	6	4	2	5	5	5	9	8	7
Scaled to 0,1,2,3 scale	3	2	2	3	3	2	1	1	1	1	1	2	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 704 B			STEM CELL BIOTECHNOLOGY	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisite: - Cell biology, Immunology

Learning Objective:

Upon completion of this course, the students

- Would able to explain about various categories of stem cells.
- Would have learned the application of stem cell technology.

Course Outcomes	Domain	Level
On the successful completion of the course, students will be able to		
CO1: Able to r***ecall*** *and* ***interpret*** the biology of stem cells.	Cognitive	Remembering Understanding
CO2: ***Explain*** and **develop** the embryonic stem cell culturing.	Cognitive	Understanding Applying
CO3: ***Discuss*** and ***analyze*** the differentiation of stem cells	Cognitive	Understanding Analyzing
CO4: ***Explain*** *and* ***evaluate*** the various techniques involved in stem cell assay.	Cognitive	Understanding Evaluating
CO5: ***Discuss and apply*** the various applications of stem cells.	Cognitive	Understanding

I- Basics of Stem Cell	**9**
Unique properties of stem cells – embryonic stem cells , history and development, characteristics,- Adult stem cells ,Properies, types, clinical applications umbilical cord stem cells– Similarities and differences between embryonic and adult stem cells - Properties of stem cells – pluripotency – totipotency.	
II- Embryonic Stem Cells	**8**
In vitro fertilization –culturing of embryos-isolation of human embryonic stem cells – blastocyst – inner cell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of ES cells.	
III - Adult Stem Cells , iPSCs	**7**
Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells.	
IV- Stem Cell in Drug Discovery and Assay	**9**
Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection –Hematopoietic colony forming cell assay- stem cell in cellular assays for screening – stem cell based drug discovery, drug screening and toxicology.	
V- Applications of Stem Cells	**12**
Stem cell therapy for Mental disabilities, Diabetes Mellitus – Therapeutic applications – Parkinsondisease - Neurological disorder – limb amputation – heart disease - spinal cord injuries – diabetes –burns - HLA typing- Alzheimer's disease –tissue engineering application – production of complete organ - kidney – eyes - heart – brain.	

Lecture	Tutorial	Practical	Total
45	0	0	45

Text Books

1. Kursad and Turksen, Embryonic Stem Cells; Humana Press; 2002.
2. Dr. Logeswari Selvaraj, Stem Cells MJP Publishers,2015.

References

1. Mohan C. Vemuri, Stem Cell Assays, Springer International Edition; 2010.
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research. 2002.National Academic press.

E References

1. http://nptel.ac.in/courses/102103012/41

Mapping of COs Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	2	1			2	2	2	2	3	2
CO 2	2	2	2	2	3	3	2	1				3	1	1
CO3	3	3	2	2	2				1	1	2	2	2	3
CO4	2			3	2							1	1	2
CO5	3	3	2	3	2	2	2	1	2	2	1	1	1	1
	13	10	8	11	11	6	4	2	5	5	5	9	8	7

Mapping of Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original value	13	10	8	11	11	6	4	2	5	5	5	9	8	7
Scaled to 0,1,2,3 scale	3	2	2	3	3	2	0	0	0	0	0	2	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT 704 C			METABOLIC ENGINEERING	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
2.5	0	0.5		3	0	0	3

Prerequisite: Enzyme engineering, Biochemistry

Learning Objective:

Upon completion of this course, the students

- Would have learn about regulation of various metabolic processes.
- Would have learn about Metabolic Flux Analysis and Its Application.

Course Outcomes	Domain	Level
After the completion of the course, students will be able to		
CO1: ***State*** and ***understands*** the role of transport processes in metabolic pathways and material balance	Cognitive	Remembering Understanding
CO2: ***Analyze*** the regulation of enzymes involved in metabolic pathways	Cognitive	Analyzing
CO3: ***Build*** algorithms for biosynthesis pathways	Cognitive	Applying
CO4: ***Explain*** metabolic flux analysis and its role in manipulation of metabolite production.	Cognitive	Understanding
CO5: ***Explain*** and ***compiles*** various strategies to manipulate the production of industrially important Metabolites	Cognitive	Responds to Phenomena

I- Introduction **9**

Importance Of Metabolic Engineering – Overview Of Cellular Metabolism – Various Types Of Reactions – Stoichiometry Of Cellular Reactions – Dynamic Mass Balance – Yield Coefficient And Linear Rate Equation: Metabolic Model Of *Penicillium Chrysogenum* – Black Box Model – Elemental And Heat Balance Using Black Box Model.

Ii- Regulation of Metabolic Pathways **9**

Regulation of enzyme activity: Overview of enzyme kinetics and inhibition – Feed back inhibition and Activation: Feed back control architecture in aspartate pathway – Allosteric enzyme regulation - Regulation of enzyme concentration: Control of transcription and translation – Genetic regulatory network: cholesterol synthesis and elimination - Regulation of at the whole cell level - Regulation of metabolic networks – Regulation of eukaryotes versus prokaryotes.

III- Synthesis of Metabolic Pathways **9**

Metabolic pathway synthesis algorithm - Overview of the algorithm - Pathway for synthesis of alanine and serine - Case study: Lysine biosynthesis

IV- Metabolic Flux Analysis and Its Application **9**

Metabolic flux analysis - Overdetermined systems - Underdetermined systems; Linear Programming - Sensitivity analysis – Introduction to experimental determination of metabolic fluxes by isotope labeling: Distribution of TCA cycle Metabolite isotopomers from labeled pyruvate - Applications of metabolic flux analysis; Metabolic fluxes in mammalian cell culture – Determination, validation and application.

V- Applications of Metabolic Engineering **9**

Enhancement of Product yield and Productivity: Amino acids – Metabolic engineering of pentose metabolism for ethanol production – Extension of product spectrum by metabolic engineering : Antibiotics , vitamins, biopolymers – Improvement of cellular properties: Alteration of substrate

uptake and maintenance of genetic stability – Xenobiotic degradation			
Lecture	**Tutorial**	**Practical**	**Total**
45	**0**	**0**	**45**

Text Books:

1. Gregory N. Stephanopoulos, Aristos A. Aristidou., Metabolic engineering: Principles and Methodologies, Jens Nielsen Academic Press, 1st Edition, 1998.
2. Christina D. Smolke., The Metabolic Pathway Engineering Handbook: Fundamentals, CRC Press, New York, London, 1st Edition, 2010.

References:

1. Wang.D.I.C Cooney C.L., Demain A.L., Dunnil.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons, 1980.
2. Stanbury P.F and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
3. Cortassa S., Aon M.A., Iglesias A.A and Lioyd DAn Introduction to Metabolic and Cellular Engineering, World Scientific Publishing Co., Singapore, 1st Edition, 2002.

E References:

1. https://gcep.stanford.edu/pdfs/energy_workshops_04_04/biomass_shanmugam.pdf

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	2	2	1	2	1			2	2	2	2	3	2
CO 2	2	2	2	2	3	3	2	1				3	1	1
CO 3	3	3	2	2	2				1	1	2	2	2	3
CO 4	2			3	2							1	1	2
CO 5	3	3	2	3	2	2	2	1	2	2	1	1	1	1
Total	13	10	8	11	11	6	4	2	5	5	5	9	8	7

Mapping of Subject Vs POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO1**	**PSO2**
Original value	13	10	8	11	11	6	4	2	5	5	5	9	8	7
Scaled to 0,1,2,3 scale	3	2	2	3	3	2	1	1	1	1	1	2	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBT OE 1			INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0					
				3	0	0	3

Prerequiste : Nil

Learning Objectives:

Upon completion of this course, the students

- Would have understand the various types of IPR.
- Would have learn to search the database, drafting the patent and filing process.
- Would have understand about the IPR related disputes.

Course Outcomes		Domain	Level
CO1	***Understand*** the significance of IPR and ***identify*** various types of IPR.	Cognitive	Receiving Understanding
CO2	***Understand*** the process of *registration and* ***infer*** *the valuation of IP.*	Cognitive	Understanding Analysing
CO3	***Understand*** the legal framework and ***infer*** legislative process in India.	Cognitive	Receiving Analysing
CO4	***Understand*** the international commitment and ***imply*** suitable market for the registered IP.	Cognitive	Understanding
CO5	***Explain*** the specification and ***infer*** values for IP.	Cognitive	Understanding

I - Introduction to IPR **9**

Creativity, Invention, Innovations; Importance of Intellectual Property; Types of Intellectual Property; History and development of IPR in India – Initiatives by Indian Government towards IPR – advancement in S&T, traditional knowledge and biodiversity resources.

II- Types, Registration and Valuation of IPR (India/Pct) **9**

Patents – Copyrights and related rights – Trade Marks – Industrial Designs – Protection of Integrated Circuits and Layout Design – Geographical Indications of Goods – Biological Diversity – Plant Varieties and Farmers Rights – Trade Secrets / undisclosed information.

III- Legal and Legislation Framework in India **9**

IPR Laws – Owner's Rights – Negotiation of International Treaties – Traditional Knowledge Digital Library (TKDL) – Commercialization of IPR – Enforcement and Adjudication – Human Capital Development.

IV- International Conventions and Treaties **9**

WTO - International conventions – Establishment of WIPO – General Agreement on Trade and Tariff (GATT) – TRIPS – PCT.

V - IPR Management **9**

Drafting patent specification – Claims- IPR audit-IP asset management – IP Litigations – Transfer of Rights – IP training and education – IP valuation – Agreement Drafting.

Lecture	Tutorial	Practical	Total
45	0	0	45

Text Books

1. Subbaram N.R."Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

E-References

1 Neeraj Pandey, Khushdeep Dharni, Intellectual Property Rights, PHI Private Limited,

Delhi, 2014.

2 Intellectual Property Today : Volume 8, No. 5, May 2001, [www.iptoday.com].

3 Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000. [www.ipmatters.net/features/000707_gibbs.html.

E Resources

1. http://www.wipo.int/patentscope/en/
2. http://www.ipindia.nic.in/
3. http://www.uspto.gov/
4. https://www.epo.org/index.html
5. https://www.jpo.go.jp/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	0	0	1	0	0	0	0	0	1	0	1	3	0
CO 2	3	0	0	0	0	0	0	0	0	1	0	1	3	0
CO 3	3	2	0	1	0	0	0	0	1	1	0	2	3	2
CO 4	3	2	0	0	0	0	0	0	1	1	0	2	3	2
CO 5	3	2	0	1	1	0	0	0	1	1	0	2	3	2
Total	15	6	0	2	1	0	0	0	3	5	0	8	15	6

Mapping of Subject Vs POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
Original value	15	6	0	2	1	0	0	0	3	5	0	8	15	6
Scaled to 0,1,2,3 scale	3	2	0	0	0	0	0	0	0	0	0	2	3	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

XBTOE 2			INDUSTRIAL SAFETY AND RISK MANAGEMENT	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisites : Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn the importance of safety and risk management in industry.
- Would have learn to make strategies to avoid the industrial accidents.

Course Outcomes: At the end of this course, the students should be able to		**Domain**	**Level**
CO1	**State** the basic classification of safety measures and **explain** the fundamentals of Industrial Safety.	Cognitive	Remembering Understanding
CO2	**Interpret** a **analyze** the Hazard and Audit System	Cognitive	Remembering Understanding
CO3	**Know** the Risk Management and **estimate** the First Aid types and properties.	Cognitive	Remembering Understanding
CO4	**Analyze** and **evaluate** Safety Procedures	Cognitive	Remembering Understanding
CO5	**Knows** the safety handling and will **analyze** the related Chemicals Safety and Storages.	Cognitive	Remembering Understanding

I - Industrial Safety **9 hrs**

Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

II - Hazard Analysis **9 hrs**

Hazard identification and control – HAZOP, job safety analysis – Fault tree analysis – Event tree analysis – Failure modes and effect analysis and relative ranking techniques – Safety audit – Safety Survey – Plant inspection – Past accident analysis.

III- Risk Management **9 hrs**

Overall risk analysis – Chapains model, Eand FI model– Generation of meteorological data – Ignition data – Population data – Overall risk contours for different failure scenarios – Disastar management plan – Emergency planning – Onsiteand offsite emergency planning – Risk management – Gas processing complex, refinery – First Aids.

IV- Safety Procedures **9 hrs**

Safety in plant design and layout – Safety acts and regulations for industries.

V - Safety in Handling and Storage of Chemicals **9 hrs**

Safety measures in handling and storage of chemicals – Fire chemistry and its control – Personal protection.

Lecture	Tutorial	Practicals	Total
45	0	0	45

Text Books

4. Deshmukh, L.M., "Industrial Safety Management (Hazard identification and risk control)", TATA McGraw Hill, 2008.
5. Raghavan, K.V. and Khan, A.A., "Methodologies in Hazard Identification and Risk
6. Blake, R.P., "Industrial Safety", Prentice Hall, 1953.

References

1. A Guide to Hazard Operability Studies", Chemical Industry Safety Council, 1977.
2. Geoff Wells,"Hazard Identification and risk assessment", IIChE, UK.
3. Lees, F.P., "Loss Prevention in Process Industries", 2nd Edition, Butterworth Heinemann, 1996.

Mapping Of Cos and POs

	Program Outcomes													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO2	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO3	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO4	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO5	2	0	2	0	2	3	1	3	3	0	2	3	0	0
	10	0	10	0	10	15	5	15	15	0	10	15	0	0

Mapping of Subject Vs POs

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
Original value	10	0	10	0	10	15	5	15	15	0	10	15	0	0
Scaled to 0,1,2,3 scale	2	0	2	0	2	3	0	3	3	0	2	3	0	0

XBT OE 3			FOOD AND NUTRITION	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisite: Nil

Learning Objectives:

Upon completion of this course, the students

- Would be able to develop an understanding of food composition, principles of preservation
- Would be able to explain importance of different types of food in balanced diet and diet planning
- Would apply the knowledge of traditional methods for food preservation in developing a new food products
- Would able to understand the nutritional demands in various stages of life cycle and acquire skills in planning adequate menu in different stages of life cycle

Course Outcomes		Domain	Level
After the completion of the course, students will be able to			
CO1	***Outline*** the nutritional composition of foods and ***describe*** the calorific value of different food products	Cognitive	Analyzing Understanding
CO2	***Discuss*** the classification of foods and ***explain*** nutritional deficiency	Cognitive	Analyzing Understanding
CO3	***Outline*** different causes of food spoilage and its preservation methods	Cognitive	Analyzing Understanding
CO4	***Describe*** the recommended dietary allowances of nutrition according to different age groups	Cognitive	Analyzing Understanding
CO5	***Discuss*** the nutritional needs of people at different stages of their life	Cognitive	Analyzing Understanding

I- Food as a Source of Nutrients	**7**
Study of importance, composition and nutritive and calorific value of different foods (cereal grains, millets, pulses, nuts and oil seeds, fruits and vegetables), milk and milk products, meat, egg, poultry, fish, spices and condiments.	
II- Classification of Foods	**9**
Food classification on the basis of origin, functions and nutritional role of proteins, fats, carbohydrates, minerals, vitamins, water, and roughages. Antinutrients – Nutrition deficiency diseases: malnutrition	
III- Food Spoilage and Preservation	**9**
Food spoilage – Chemical, Thermal and Microbial causes – Microbial growth in foods, Foodborne diseases – Food preservation: Fermented Foods, Preservatives, Food additives.	
IV- Basic Concepts of Nutrition	**10**
Concept of balanced diet,– Basal metabolic rate (BMR): Definition, factors influencing BMR – Recommended dietary allowances (RDAs) for various age groups according to their physiological status for specific nutrients and energy. Diet Planning.	
V- Nutritional Needs	**10**
Nutrition during infancy, childhood, adolescence and adult, nutrition during pregnancy& lactation, nutrition in later maturity period, nutrition and infection, nutrition and immunity, nutrition & stress.	

Lecture	Tutorial	Practical	Total

45	0	0	45

Text Books:

1. Sunetra Roday, Food Science and Nutrition. 2nd edition, Oxford University Press. New Delhi, ISBN: 978-0198078869. 2012.
2. Vaclavik, Vickie, Christian, Elizabeth W - Essentials of Food Science. 2008
3. Srilakshmi B. Food Science, 5th ed. New Age Publishers. 2010

References:

1. Avantina Sharma Textbook of Food Science & Technology (Vol - I & II), International Book Distributing Company, 2nd ed. 2010.
2. Basic principles of Nutrition- Seema Yadav, First edition. 1997
3. Nutrition Trends in India -Vinodhini Reddy, Prahlad Rao, Govmth Sastry and Kashinath, NIN, Hyderabad. 1993.

E References:

1. https://nptel.ac.in/syllabus/126104004/

Mapping Of COs and POs

	Program Outcomes													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO2	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO3	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO4	2	0	2	0	2	3	1	3	3	0	2	3	0	0
CO5	2	0	2	0	2	3	1	3	3	0	2	3	0	0
	10	0	10	0	10	15	5	15	15	0	10	15	0	0

Mapping of Subject Vs POs

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
Original value	10	0	10	0	10	15	5	15	15	0	10	15	0	0
Scaled to 0,1,2,3 scale	2	0	2	0	2	3	0	3	3	0	2	3	0	0

XBTOE 4			INTRODUCTION TO MATLAB FOR ENGINEERS	L	T	P	C
				2	1	0	3
C	P	A		L	T	P	H
3	0	0		2	1	0	3

Prerequisite: Mathamatics

Learning Objectives:

Upon completion of this course, the students

- To introduce the MATLAB basic in engineering application aspects.
- Would have learn to perform technical programming in engineering applications.

Course Outcomes	Domain	Level
After the completion of the course, students will be able to		
CO1: ***State*** the basic of MATLAB and ***explain*** the fundamentals.	Cognitive	Understanding Apply
CO2: ***Interpret*** and ***apply*** the MATLAB functions.	Cognitive	Understanding Apply
CO3: ***Interpret*** the Matrix with MATLAB and ***estimate*** the Engineering properties.	Cognitive	Interpretation Apply
CO4: ***Apply*** and ***evaluate*** the MATLAB Array operations in linear equations.	Cognitive	Analyzing Evaluating
CO5: ***Knows*** the MATLAB applications and ***apply*** on engineering domain.	Cognitive	Interpretation Applying

I- Introduction	**6 + 3 hrs**
Basic features - creating MATLAB variables, Overwriting variable, Error messages and making corrections, controlling hierarchy of operations and floating point number, managing the work space, track of work session, Entering multiple statements per line, Miscellaneous commands – Exercise.	
II- Matlab Functions	**6 + 3 hrs**
Mathematical functions – Elementary functions, Predefined constant values – Basic plotting – creating simple plots, Adding titles, axis labels and annotations, Multiple data set in one plot, specifying line styles and colors - Exercises from engineering examples.	
III- Matrix in MATLAB	**6 + 3 hrs**
Matrix generations – Entering a vector, Matrix, Matrix indexing, Colon operator, Linear spacing, Creating a sub-matrix, Deleting row or column, Dimension, Continuation, Transposing a matrix, Concatenating matrices, Matrix generators, Special matrices – Exercises from engineering examples.	
IV- Array Operations and Linear Equations	**6 + 3 hrs**
Array operations – Matrix and Array arithmetic operations, matrix functions – Solving linear equations – Matrix inverse functions – Programming in MATLAB – M-File scripts and script side-effects – M-File functions – Anatomy, Input and output arguments, script files, commands - Exercises from engineering examples.	
V- Matlab Applications	**6 + 3 hrs**
Introduction – Linear algebra – solving a linear system, Gaussian elimination, Eigen values and Eigen vectors – Curve fitting and interpolation – Polynomial curve fitting, Least square curve fitting – Data analysis and statistics – Ordinary Differential Equations – First order linear - Exercises from engineering examples.	

Lecture	Tutorial	Practical	Total
30	15	0	45

Text Books:		
1. Rudra Pratap, "Getting started with MATLAB A quick introduction for scientists and engineers", Oxford University Press 2016 (Reprinted). 2. Bruce A Finlayson, "Introduction to chemical engineering computation", John & Wiley, Inc, 2006.		
References:		
1.R.K.Bansal, A.K.Goel, M.K.Sharma, "MATLAB and its applications in engineering" 2nd Edition, Pearson Delhi,2007. 2.DavidHoucqe, " Introduction to MATLAB for Engineering Students", North Western University Press, USA, AUG 2005.		
E-References: 1. https://nptel.ac.in/courses/103106074/ 2. https://in.mathworks.com/		

Mapping Of COs and POs

	PROGRAM OUTCOMES													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	2	2	0	0	0	3	3	0	1
CO2	3	3	2	2	2	2	2	0	0	0	3	3	0	1
CO3	3	3	2	2	2	2	2	0	0	0	3	3	0	1
CO4	3	3	2	2	2	2	2	0	0	0	3	3	0	1
CO5	3	3	2	2	2	2	2	0	0	0	3	3	0	1
	15	15	10	10	10	10	10	0	0	0	15	15	0	5

Mapping Of Subject and POs

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
Original value	15	15	10	10	10	10	10	0	0	0	15	15	0	5
Scaled to 0,1,2,3 scale	3	3	2	2	2	2	2	0	0	0	3	3	0	0

XBT OE5			PROJECT MANAGEMENT	L	T	P	C
				3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

Prerequisites: Nil

Learning Objectives:

Upon completion of this course, the students

- Would have learn to understand the basic fundamentals and principles of project management.
- Would have learn time management techniques and team build up.

Course Outcomes: At the end of this course, the students should be able to		**Domain**	**Level**
CO1	***Explain*** and ***understanding*** the basic principles of project and the management system	Cognitive	Remembering Understanding
CO2	***Analyze*** and ***understanding*** the risks in project execution.	Cognitive	Understanding Analysing
CO3	***List*** the project control system and ***interpret*** to the evaluation.	Cognitive	Understanding Analysing
CO4	***Discuss*** the salient features of team work and ***analyze*** the effective implementation.	Cognitive	Understanding Analysing
CO5	***Discuss*** the salient features of work environment and **analyze** the effective implementation.	Cognitive	Understanding Analysing

Unit-I An overview of project management	**9 hrs**
Project – Role of project manager – planning the project – Developing a vision, mission, goals and objectives of the project.	
Unit-II Project Risk plan	**9 hrs**
Project risk – Work break down structure – Scheduling project work – Producing a workable schedule.	
Unit-III Project control and evaluation	**9 hrs**
The change control process – Project time management – Project control using earned value analysis.	
Unit-IV Team work	**9 hrs**
Managing the project team – The project manager as leader – Effective ways of project management	
Unit-V Project work environment assessment	**9 hrs**
Assesment of politics of project – Identify goals – problem definition – Culture of stake holders – Culture of working organization – Effective relationship building.	

Lecture	Tutorial	Practicals	Total
45	0	0	45

Text Books

1. Joseph Heagney., "Fundamentals of project management", Fourth Edition, AMACOM, 2011.
2. Meri Williams, "The principles of project management", First Edition, Site Point publisher Private Limited, Australia, 2008.
3. Tonney Kennedy "Pharmaceutical Project Management" 2nd Edition (Vol 182), CRC press, Florida, 2008.

References

1. Harold Kerzner., "*Project Management"*, 11th Edition, Willey, Canada, 2013
2. Paul Roberts, "Guide to Project Management" 2nd Edition, Asian Books Pvt.ltd., 1998.

3. Kim Heldman, "*Project Management Jump Start"*, 3rd Edition, Willey, Canada, 2013.

Mapping Of Course Outcomes With Program Outcomes

	Program Outcomes													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	1	3	2	2	3	0	0	3	3	2	1	3	3	1
CO2	1	3	2	2	3	0	0	3	3	2	1	3	3	1
CO3	1	3	2	2	3	0	0	3	3	2	1	3	3	1
CO4	1	3	2	2	3	0	0	3	3	2	1	3	3	1
CO5	1	3	2	2	3	0	0	3	3	2	1	3	3	1
	5	15	10	10	15	0	0	15	15	10	5	15	15	5

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
Original value	5	15	10	10	15	0	0	15	15	10	5	15	15	5
Scaled to 0,1,2,3 scale	0	3	2	2	3	0	0	3	3	2	0	3	3	0

List of Skill Oriented Minor Courses

1. Plant Tissue Culture Training
2. Training on Instrumentation (GC-MS, HPLC, AFM, SEM, TEM, XRD)
3. MAT-lab for biological applications
4. Biofertilizer Technology
5. Bioenergy

List of Value Added Courses

1. Embryo Technology
2. Animal Handling Training
3. Biosimilars
4. Clone Development
5. Marine Biotechnology
6. Beverage Technology
7. Membrane Separation Technology
8. Food Processing Technology
9. Solid/Liquid waste management

Guidelines for UG Engineering & Technology Curriculum 2018-19

Curriculum Structure for B.Tech. (Full time) Degree Programmes offered by PMU

S. No.	Category	AICTE Recommendation %	PMU adoption %	PMU credits	Deviation %	Number of courses
1.	Humanities and Social Sciences (HS), including Management;	5 to 10	5.68 %	10	0	6
2.	Basic Sciences(BS) including Mathematics, Physics, Chemistry, Biology;	15 to 20	15.91 %	28	0	7
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	15 to 20	13.64 %	24	Actual = - 1.36 %	6
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required;)	30 to 40	39.20 %	69	0	17
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	10 to 15	10.23 %	18	0	6
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	5 to 10	5.11 %	9	0	3
7.	Project Work, Seminar and/or Internship in Industry or elsewhere	10 to 15	10.23 %	18	0	5
8.	Mandatory Courses (MC); Non-Credit 8 units (UGC Mandatory)*	-	-	-	-	3
10.	Non Credit Course – ELS	-	-	-	-	3
11.	NCC/NSS/YRC/RRC/Sports	-	-	-	-	1
			100%	**176**		**57**

SEMESTER I

Branch	C1	C2	C3	C4	C5	C6
Aero	MA-I	EM	BE-I	AP	SS	U-MAN-I
Bio	MA-I	CP	BE-I	AP	SS	U-MAN-I
Civil	MA-I	EM	BE-I	AP	SS	U-MAN-I
Chem	MA-I	CP	BE-I	AP	SS	U-MAN-I
ECE	MA-I	EM	BE-I	AP	SS	U-MAN-I
CSE	MA-I	CP	BE-II	AC	SS	U-MAN-I
EEE	MA-I	CP	BE-II	AC	SS	U-MAN-I
IT	MA-I	CP	BE-II	AC	SS	U-MAN-I
Mech	MA-I	CP	BE-II	AC	SS	U-MAN-I

S. No.	Description	Courses	Credits				Hours				
			L	T	P	Total	L	T	P	S.S.	Total
1.	MA-I	Algebra, Differential Calculus and their applications	3	1	0	4	3	2	0	0	5
2.	EM	Engineering Mechanics	3	1	0	4	3	2	0	0	5
	CP	Computer Programming	3	0	1		3	0	2		
3.	BE-I/BE-II	Electrical and Electronics Engineering Systems (BEE Lab included)	3	1	1	5	3	2	2	0	7
		Mechanical and Civil Engineering Systems (Workshop Practice included)	3	1	1		3	2	2		
4.	AP/AC	Applied Physics (Physics Lab included)	3	1	1	5	3	2	2	0	7
		Applied Chemistry (Chemistry Lab included)	3	1	1		3	2	2		
5.	SS	Study skills and Language Laboratory	1	0	0	1	1	0	2*	0	3
6.	U-MAN-I	Human Ethics, Values, Rights and Gender Equality	1	0	0	1	1	0	0	2*	3
		Total	**14**	**4/3**	**2/3**	**20**	**14**	**8/6**	**8/10**	**2**	**30**

* Non-credit

SEMESTER II

Branch	C1	C2	C3	C4	C5	C6
Aero	MA-II	CP	BE-II	AC	EG	SC
Bio	MA-II	BT	BE-II	AC	EG	SC
Civil	MA-II	CP	BE-II	AC	EG	SC
Chem	MA-II	EM	BE-II	AC	EG	SC
ECE	MA-II	CP	BE-II	AC	EG	SC
CSE	MA-II	EM	BE-I	AP	EG	SC
EEE	MA-II	EM	BE-I	AP	EG	SC
IT	MA-II	EM	BE-I	AP	EG	SC
Mech	MA-II	EM	BE-I	AP	EG	SC

S. No.	Description	Courses	Credits				Hours			
			L	T	P	Total	L	T	P	Total
1.	MA-II	Calculus and Laplace Transforms	3	1	0	4	3	2	0	5
2.	EM	Engineering Mechanics	3	1	0	4	3	2	0	5
	BT	Basic Thermodynamics	3	1	0		3	2	0	
	CP	Computer Programming	3	0	1		3	0	2	
3.	BE-I/BE-II	Electrical and Electronics Engineering Systems (BEE Lab included)	3	1	1	5	3	2	2	7
		Mechanical and Civil Engineering Systems (Workshop Practice included)	3	1	1		3	2	2	
4.	AP/AC	Applied Physics (Physics Lab included)	3	1	1	5	3	2	2	7
		Applied Chemistry (Chemistry Lab included)	3	1	1		3	2	2	
5.	EG	Engineering Graphics	2	0	1	3	2	0	2	4
6.	SC	Speech Communication	1	0	0	1	1	0	2*	3
		Total	**15**	**4/3**	**3/4**	**22**	**15**	**8/6**	**8/10**	**31**

* Non-credit

SEMESTER III

Branch	C1	C2	C3	C4	C5	C6	C7	C8
Aero	MA-III	CT	CP	CTP	MS/EM	MNGT-I	IPC	IPT-I
Bio	MA-III	CT	CP	CTP	MS	MNGT-I	IPC	IPT-I
Civil	MA-III	CT	CP	CTP	MS	MNGT-I	IPC	IPT-I
Chem	MA-III	CT	CP	CTP	MS/EM	MNGT-I	IPC	IPT-I
ECE	MA-III	CT	CP	CTP	MS	MNGT-I	IPC	IPT-I
CSE	MA-III	CT	CP	CTP	MS	MNGT-I	IPC	IPT-I
EEE	MA-III	CT	CP	CTP	MS	MNGT-I	IPC	IPT-I
IT	MA-III	CT	CP	CTP	MS	MNGT-I	IPC	IPT-I
Mech	MA-III	CT	CP	CTP	MS/EM	MNGT-I	IPC	IPT-I

S. No.	Description	Courses	Credits				Hours				
			L	T	P	Total	L	T	P	S.S.	Total
1.	MA-III	Transforms and Partial Differential Equations / Discrete Mathematics	3	1	0	4	3	2	0	0	5
2.	CT	Core with Tutorial	3	1	0	4	3	2	0	0	5
3.	CP	Core with PRACTICAL	3	0	1	4	3	0	2	0	5
4.	CTP	Core with Tutorial and PRACTICAL	3	1	1	5	3	2	2	0	7
5.	MS/EM	Material Science / Engineering Materials	3	0	0	3	3	0	0	0	3
6.	MNGT-I	Entrepreneurship Development	2	0	0	2	2	0	0	1*	3
7.	IPC	Interpersonal Communication (Non credit course)	0	0	0	0	0	0	2*	0	2
8.	IPT-I	In-plant Training - I	-	-	-	1	-	-	-		-
		Total	**17**	**3**	**2**	**23**	**17**	**6**	**6**	**1**	**30**

* Non-credit

SEMESTER IV

Branch	C1	C2	C3	C4	C5	C6	C7	C8
Aero	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
Bio	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
Civil	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
Chem	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
ECE	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
CSE	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
EEE	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
IT	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC
Mech	MA-IV	C	CP	CTP	CT	MNGT-II	TC	EC

S. No.	Description	Courses	Credits				Hours			
			L	T	P	Total	L	T	P	Total
1.	MA-IV	Probability and statistics / Probability and queuing theory / Random processes / Operations Research / Statistics and Operations Research	3	0	0	3	3	0	0	3
2.	C	Core	3	0	0	3	3	0	0	3
3.	CP	Core with PRACTICAL	3	0	1	4	3	0	2	5
4.	CTP	Core with Tutorial and PRACTICAL	3	1	1	5	3	2	2	7
5.	CT	Core with Tutorial	3	1	0	4	3	2	0	5
6.	MNGT-II	Economics for Engineers	3	0	0	3	3	0	0	3
7.	TC	Technical Communication	1	0	0	1	1	0	2*	3
8.	EC	Extracurricular activities - NCC/NSS/YRC/RRC/Sports	-	-	-	-	-	-	-	-
		Total	**19**	**2**	**2**	**23**	**19**	**4**	**6**	**29**

* Non-credit

SEMESTER V

Branch	C1	C2	C3	C4	C5	C6	C7	C8
Aero	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
Bio	C	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
Civil	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
Chem	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
ECE	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
CSE	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
EEE	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
IT	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II
Mech	MA-IV	CT	CP	CTP	PE-I	C-TQM	BC	IPT-II

S. No.	Description	Courses	Credits				Hours			
			L	T	P	Total	L	T	P	Total
1.	MA-V	Numerical Methods	**2**	**1**	**0**	**3**	**2**	**2**	**0**	**4**
	C	Core (Biotech)								
2.	CT	Core with Tutorial	**2**	**1**	**0**	**3**	**2**	**2**	**0**	**4**
3.	CP	Core with PRACTICAL	3	0	1	4	3	0	2	5
4.	CTP	Core with Tutorial and PRACTICAL	3	1	1	5	3	2	2	7
5.	PE-I	Professional Elective - I (with tutorial)	**2**	**1**	**0**	**3**	**2**	**2**	**0**	**4**
6.	C-TQM	Total Quality Management	3	0	0	3	3	0	0	3
7.	BC	Business Communication	1	0	0	1	1	0	2*	3
8.	IPT-II	In-plant Training - II	-	-	-	1	-	-	-	-
		Total	**16**	**4**	**2**	**23**	**16**	**8**	**6**	**30**

* Non-credit

SEMESTER VI

Branch	C1	C2	C3	C4	C5	C6	C7	C8
Aero	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
Bio	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
Civil	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
Chem	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
ECE	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
CSE	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
EEE	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
IT	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW
Mech	OE-I	C	CP	CTP	CT	PE-II	U-MAN-II	AW

S. No.	Description	Courses	Credits				Hours			
			L	T	P	Total	L	T	P	Total
1.	OE-I	Open Elective - I	3	0	0	3	3	0	0	3
2.	C	Core	3	0	0	3	3	0	0	3
3.	CP	Core with PRACTICAL	3	0	1	4	3	0	2	5
4.	CTP	Core with Tutorial and PRACTICAL	3	1	1	5	3	2	2	7
5.	CT	Core with Tutorial	3	1	0	4	3	2	0	5
6.	PE-II	Professional Elective - II	3	0	0	3	3	0	0	3
7.	U-MAN-II	Environmental Studies (Non credit course)	0	0	0	0	3*	0	0	3
8.	AW	Academic writing (Non credit course)	0	0	0	0	0	0	2*	2
		Total	**18**	**2**	**2**	**22**	**21**	**4**	**6**	**31**

* Non-credit

SEMESTER VII

Branch	C1	C2	C3	C4	C5	C6	C7	C8	C9
Aero	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Bio	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Civil	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Chem	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
ECE	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
CSE	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
EEE	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
IT	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Mech	OE-II	CP	CTP	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III

S. No.	Description	Courses	Credits				Hours			
			L	T	P	Total	L	T	P	Total
1.	OE-II	Open Elective - II	3	0	0	3	3	0	0	3
2.	CP	Core with practical	3	0	1	4	3	0	2	5
3.	CTP	Core with Tutorial and practical	3	1	1	5	3	2	2	7
4.	PE-III	Professional Elective - III	3	0	0	3	3	0	0	3
5.	PE-IV	Professional Elective - IV	3	0	0	3	3	0	0	3
6.	U-MAN-III	Cyber Security (Non Credit Course)	0	0	0	0	3*	0	0	3
7.	P-I	Project Phase - I	0	0	2	2	0	0	4	4
8.	CDS	Career Development Skills (Non credit course)	0	0	0	0	0	0	1*	1
9.	IPT-III	In-plant Training - III	-	-	-	2	-	-	-	-
		Total	**15**	**1**	**4**	**22**	**18**	**2**	**9**	**29**

* Non-credit

SEMESTER VIII

Branch	C1	C2	C3	C4
Aero	OE-III	PE-V	PE-VI	P-II
Bio	OE-III	PE-V	PE-VI	P-II
Civil	OE-III	PE-V	PE-VI	P-II
Chem	OE-III	PE-V	PE-VI	P-II
ECE	OE-III	PE-V	PE-VI	P-II
CSE	OE-III	PE-V	PE-VI	P-II
EEE	OE-III	PE-V	PE-VI	P-II
IT	OE-III	PE-V	PE-VI	P-II
Mech	OE-III	PE-V	PE-VI	P-II

S. No.	Description	Courses	Credits				Hours			
			L	T	P	Total	L	T	P	Total
1.	OE-III	Open Elective - III	3	0	0	3	3	0	0	3
2.	PE-V	Professional Elective - V	3	0	0	3	3	0	0	3
3.	PE-VI	Professional Elective - VI	3	0	0	3	3	0	0	3
4.	P-II	Project Phase - II	0	0	12	12	0	0	24	24
		Total	**9**	**0**	**12**	**21**	**9**	**0**	**24**	**33**

Summary of the credits and hours

Semester	Total Credits	Total Hours / Week	No. of courses
I	20	30	6
II	22	31	6
III	23	30	8
IV	23	29	8
V	23	30	8
VI	22	31	8
VII	22	29	9
VIII	21	33	4
I - VIII	**176 Credits**	-	57

The salient features of this curriculum are as follows.

1. For all B.Tech. programmes 176 credits is mandatory. In addition to 176 credits, students can register additional Audit courses choosing from professional electives or open electives.
   [Audit Courses: Students to be able to register for Courses outside the prescribed range of Credits for audit only, when interested to supplement their knowledge/skills; Optional for students to appear/pass in Continual Internal Examination(CIE), Semester End Examinations(SEE) of these courses and/or seek their inclusion in the Grade cards or Transcripts issued .

2. The average load per semester is about 22 credits.
3. The main Project is split up into 2 phases. 2 credits for phase I in the 7th Semester and 12 credits for phase II in the 8th Semester.
4. The credit distribution is followed as per the guidelines given by AICTE/UGC

Course type	Credits				Contact Hours			
	L	**T**	**P**	**Total**	**L**	**T**	**P**	**Total**
Lecture course	3	0	0	3	3	0	0	3
Lecture + practical course	3	0	1	4	3	0	2	5
Lecture + Tutorial course	3	1	0	4	3	2	0	5
	2	1	0	3	2	2	0	4
Lecture + Tutorial + practical course	3	1	1	5	3	2	2	7

Note:

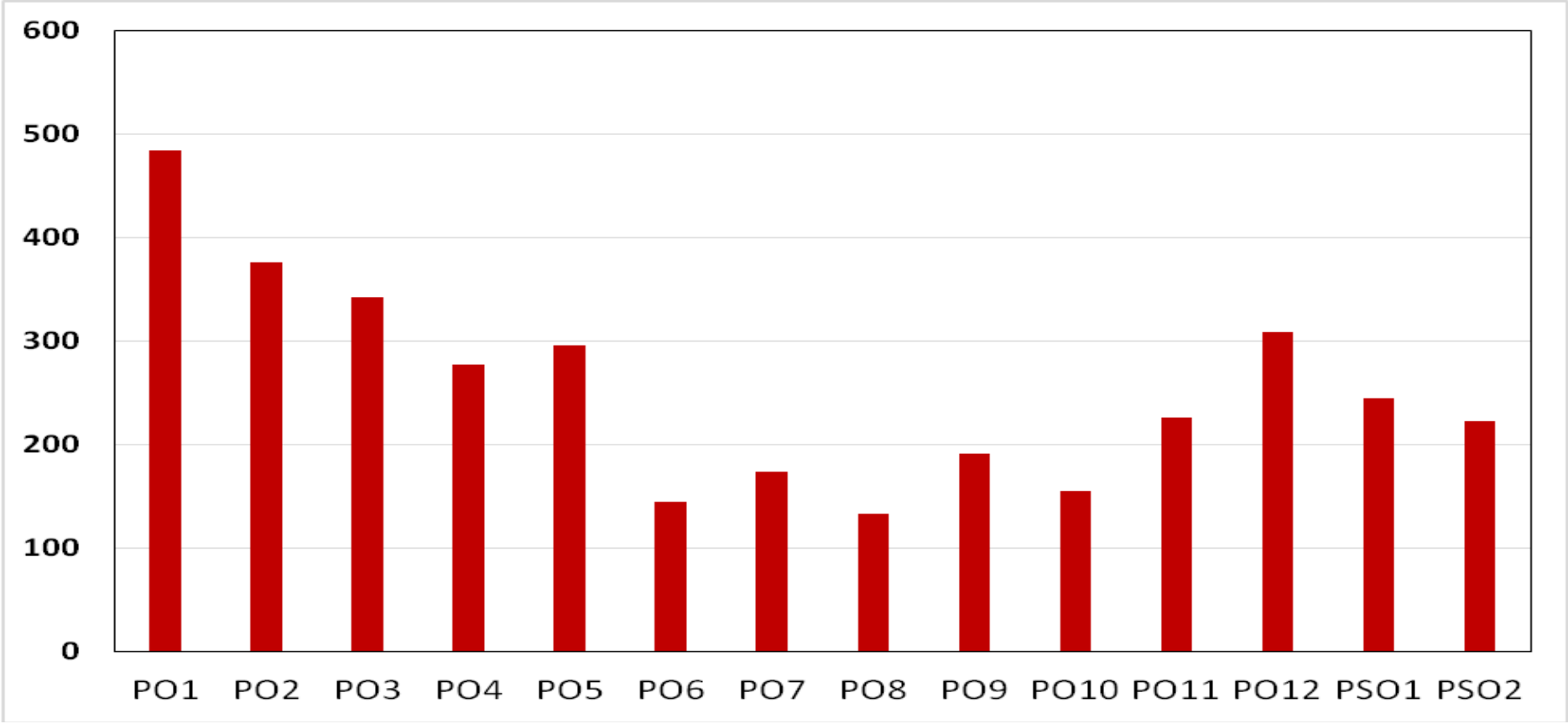
1. Evaluation and Assessment must be done for all non credit courses.
2. Apart from academic workload, the following academic sessions must be included in the time table to maintain 35 hours / week.
   Counseling – 1 hour, Academic mentor – 1 hour, Library – 1 hour.
3. The course teacher should maintain records for assessment of Self Study (SS).

Course articulation matrix

Course articulation matrix																		
	C	P	A	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	L:T:P: C
Core Subjects																		
XMA101	3	0.5	0.5	15	8	0	0	3	0	0	0	0	5	0	7	0	0	3:1:0:5
XES102	1.4	0.3	0.3	12	12	6	5	6	6	3	3	5	5	5	0	0	0	3:0:0:0
XBE103	3	1	0	15	15	15	6	15	6	15	5	5	6	11	3	3	0	2:1:2:5
XAP104	2.8	0.8	0.4	15	6	9	6	4	0	0	0	3	0	0	5	0	0	3:1:2:6
XEG105				15	15	15	6	15	6	15	5	5	6	11	3	3	0	0:0:3:3
XMA201	3	0.5	0.5	15	8	0	0	3	0	0	0	0	5	0	7	0	0	3:1:0:4
XCP202				12	10	3	4	11	0	0	1	0	2	10	12	10	0	3:0:2:5
XGS203	2.6	0.4	0	7	0	0	0	0	0	6	0	4	0	0	0	0	0	2:0:1:3
XAC 204	3.5	1	0.5	14	11	5	12	9	3	5	0	8	0	5	2	0	0	3:1:1:5
XWP205	1	3	0	10	5	10	10	5	0	0	5	5	0	5	10	0	0	1:0:2:3
XPS301	3.5	0.25	0.25	15	10	5	3	2	2	1	0	5	5	2	5	0	1	3:1:0:4
XBT302	1	0.5	0.5	15	15	10	15	10	0	10	0	0	0	0		10	10	2:1:0:3
XBT303	3	1.75	0.25	5	5	10	0	5	0	0	5	5	5	5	7	8	6	3:1:0:4
XBT304	2	0.5	0.5	15	12	8	8	5	6	8	2	5	4	5	5	4	2	3:0:2:4
XBT305	3	1	1	15	15	9	12	6	10	10	0	0	0	9	13	8	9	3:1:2:5
XUM306	1	0	0	0	0	0	0	0	0	0	15	15	15	0	0	0	0	2:1:0:0
XES401	3	0	0	6	7	8	2	0	0	0	0	1	0	1	6	5	5	3:0:0:3
XBT402	3	0	1	5	5	10	0	5	0	0	5	5	5	5	8	8	9	3:1:0:4
XBT403	2	0.5	0.5	15	4	0	3	5	3	0	0	3	3	4	4	0	0	3:1:2:5
XBT404	3	0.5	0.15	5	5	10	0	5	0	0	5	5	5	5	9	8	9	3:1:2:5

XBT405	**3**	**0**	**1**	**15**	**14**	**9**	**10**	**4**	**2**	**8**	**1**	**1**	**0**	**10**	**11**	**11**	**11**	**3:1:0:4**
XBT406	**3**	**0**	**0**	**10**	**2**	**0**	**5**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**0**	**0**	**3:0:0:0**
XMC407	**0.5**	**1**	**1.5**	**2**	**1**	**2**	**4**	**3**	**0**	**1**	**3**	**3**	**4**	**4**	**5**	**2**	**0**	**2:1:0:3**
XBT501	**1**	**0.5**	**0.5**	**14**	**12**	**11**	**7**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**5**	**3:0:2:4**
XBT502	**3**	**0**	**0**	**5**	**5**	**10**	**0**	**5**	**0**	**0**	**5**	**5**	**5**	**5**	**8**	**9**	**10**	**2:1:0:3**
XBT503	**1**	**0.5**	**0.5**	**8**	**11**	**8**	**7**	**2**	**0**	**2**	**0**	**4**	**0**	**5**	**5**	**6**	**6**	**3:1:2:5**
XBT504A	**2.5**	**0**	**0.5**	**13**	**8**	**11**	**8**	**14**	**9**	**5**	**4**	**8**	**7**	**5**	**13**	**10**	**10**	**2:1:0:3**
XBT504B	**3**	**0**	**0**	**10**	**3**	**12**	**9**	**12**	**9**	**0**	**0**	**0**	**0**	**5**	**13**	**10**	**10**	**3:0:0:3**
XBT504C	**3**	**0**	**0**	**6**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**11**	**5**	**5**	**2:1:0:3**
XEP506	**1.5**	**0.5**	**1**	**5**	**5**	**14**	**13**	**12**	**5**	**10**	**10**	**15**	**10**	**15**	**11**	**5**	**5**	**3:0:0:3**
XMC507	**1**	**0.5**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15**	**15**	**15**	**15**	**0**	**0**	**0**	**1:0:1:0**
XBT601	**1**	**0.5**	**0.5**	**6**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**9**	**8**	**6**	**3:1:2:5**
XBT602	**1.5**	**1**	**0.5**	**13**	**1**	**14**	**7**	**12**	**4**	**3**	**6**	**1**	**4**	**4**	**0**	**0**	**0**	**3:1:2:5**
XBT603	**1.5**	**1**	**0.5**	**14**	**8**	**7**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**3**	**9**	**9**	**3:0:0:3**
XBT604A	**2.5**	**0**	**0.5**	**15**	**8**	**10**	**9**	**12**	**5**	**4**	**5**	**6**	**9**	**8**	**12**	**8**	**9**	**3:0:0:3**
XBT604B	**2.5**	**0**	**0.5**	**8**	**12**	**7**	**5**	**12**	**10**	**7**	**2**			**5**	**12**	**8**	**9**	**3:0:0:3**
XBT604C	**3**	**0**	**0**	**14**	**13**	**5**	**11**	**8**	**5**	**8**	**5**	**5**	**0**	**8**	**11**	**11**	**11**	**3:0:0:3**
XMC605	**3**	**0**	**0**	**15**	**13**	**5**	**11**	**8**	**5**	**8**	**5**	**5**	**0**	**8**	**13**	**9**	**10**	**3:0:0:3**
XBT701A	**2.5**	**0**	**0.5**	**10**	**10**	**9**	**10**	**11**	**6**	**6**	**4**	**5**	**7**	**6**	**13**	**9**	**10**	**3:0:0:3**
XBT701B	**3**	**0**	**0**	**9**	**7**	**9**	**8**	**10**	**12**	**7**	**4**	**7**	**8**	**5**	**5**	**9**	**0**	**3:0:0:3**
XBT701C	**3**	**0**	**0**	**14**	**13**	**5**	**11**	**8**	**5**	**8**	**5**	**5**	**0**	**8**	**8**	**11**	**11**	**3:0:0:3**
XBT702	**1**	**0.5**	**0.5**	**2**	**9**	**10**	**3**	**13**	**0**	**0**	**0**	**2**	**0**	**5**	**4**	**7**	**5**	**3:0:1:4**
XBT703	**1**	**0.5**	**0.5**	**11**	**9**	**11**	**7**	**0**	**4**	**5**	**0**	**5**	**0**	**2**	**5**	**7**	**8**	**2:1:1:4**
XBT704A	**2.5**	**0**	**0.5**	**13**	**10**	**8**	**11**	**11**	**6**	**4**	**2**	**5**	**5**	**5**	**9**	**8**	**7**	**3:0:0:3**
XBT704B	**3**	**0**	**0**	**13**	**10**	**8**	**11**	**11**	**6**	**4**	**2**	**5**	**5**	**5**	**9**	**8**	**7**	**3:0:0:3**
XBT704C	**2.5**	**0**	**0.5**	**13**	**10**	**8**	**11**	**11**	**6**	**4**	**2**	**5**	**5**	**5**	**9**	**8**	**7**	**3:0:0:3**
Total				**484**	**376**	**342**	**277**	**296**	**144**	**174**	**133**	**191**	**155**	**226**	**309**	**245**	**222**	

Graph showing the cumulative POs for Eight semesters



Curriculum Structure for B.Tech. (Full time) Degree Programmes offered by PMIST

Semester I

Branch	C1	C2	C3	C4	C5	C6	Credit
Aero	Chemistry And lab	Calculus and Linear Algebra	Basic Electrical Eng	Eng Graphics and Design			17.5
Bio	Chemistry	Calculus and Linear Algebra	Physics	English with lab/communication skills	Eng Graphics and Design	Physics lab	19.5
Civil	Physics: Mechanics of Solid and Lab	Calculus and Linear Algebra	Basic Electrical Engineering	Eng Graphics and Design			17.5
ECE	Physics Introduction to Electromagnetic theory and lab	Calculus and Linear Algebra	Basic Electrical Engg	Eng Graphics and Design		Essence of Indian traditional Knowledge	17.5
CSE	Physics Semiconductor And lab	Calculus and Linear Algebra	Basic Electrical Engg	Eng Graphics and Design			17.5
EEE	Physics Semi conductor	Calculus and Differential Equation	Programming for problem solving using C	English with Lab			17.5
Mech	Physics Electromagnetism And lab	Calculus and Linear Algebra	Basic Electrical Engg	Eng Graphics and Design			17.5
Nano	Physics Semiconductor	Calculus and Linear Algebra	Basic Electrical Engg	Eng Graphics and Design		Indian traditional Knowledge	17.5

Semester II

Branch	C1	C2	C3	C4	C5	C6	C7	CREDITS

Aero	Differential equations	Physics I Electromagnetism	Computer programming	Basic Electronics Engineering	English with Lab		Constitution of India	21.5
Bio	Calculus ODE Complex variables	Basic Electrical and Electronics Engineering	Programming for problem solving	Thermodynamics -I	Introduction to biotech	Chemistry lab		23.5
Civil	Diff Equations	Chemistry 1 With lab	Programming for prob	Workshop/Manufacturing Practices	English with Lab			20.5
ECE	Calculus ODE and Complex variables	Chemistry 1 and lab	Programming for problem solving	Workshop/Manufacturing Practices	English with Lab		Constitution of India	20.5
CSE	Probability and Statistics	Chemistry 1 And Lab	Programming for problem solving	Workshop/Manufacturing Practices	English with Lab			20.5
EEE	Linear Algebra, transform, calculus and numerical methods	Chemistry 1	Basic Electrical Engg.	Workshop/Manufacturing Practices	Engineering graphics			20.5
Mech	ODE & Complex variables	Chemistry 1 And lab	Programming for problem solving	Workshop/Manufacturing Practices	English with Lab		Constitution of India	20.5
Nano	Calculus ODE Complex variables	Chemistry 1	Programming for prob	Workshop/Manufacturing Practices	English with Lab		Constitution of India	20.5

Semester III

Branch	C1	C2	C3	C4	C5	C6	C7	C8	C9	Credits
Aero	Physics 2: Optics and Waves	Maths III	Engineering Materials	Workshop practices	Eng Mechanics	Engineering thermodynamics				21
Bio	Material science	Chemistry 2	Cell biology	Biology	Princles of Chemical Engg	Eng workshop				23
Civil	Basic Electronics	Biology	CACD	Eng Mechanics	Energy Science and Engg	Life sciences	Maths 3 Trsnforms and discrete	Effective technical communication	Introduction to civil engg	22
ECE	Electronic devices	Electronic devices Lab	Digital systems design	Digital Sys Design Lab	Signals and Systems	Network theory	Slot for BS/ES/HS	Slot for MC		20
CSE	Analog Electronic circuits	Data structures and algorithms	Digital electronics	IT workshop (Scilab/ Matlab)	Differential calculus	Technical Communication with lab				23
EEE	Electric ciruit analysis	Analog Electronic c	Analog Electronc s Lab	Electric machines 1	Electrical machines Lab	Electromagnetic fields	Engineering Mechanics			20
Mech	Physics 2: Optics and Wav	Maths 3 PDE Prob and Sta	Biology for engg	Basic Electronics Engg	Engineering Mechanics	Thermodynamics				23
Nano	Physics 2: Optics and Wav	Transformadn PDE	Biology for engg	Material Sciences	Introduction to Nano Tech	Interpersonal Communication				20

Semester IV

Branch	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Credits
Aero	PC	PCC	PCC	PCC	PCC	Environ Studies (MC)					17.5
Bio	PCC	PCC	PCC	PCC	Maths 3	Environmental sciences (Mandatory)	Technical Communication skills				20
Civil	Mechanical Engg	PCC	PCC	PCC	PCC	PCC	PCC	PCC	Societal and Global Impact	Organization Behaviour	23
ECE	PCC	PCC Lab	PCC	PCC Lab	PCC	PCC Lab	SLOT FOR BS/HS/ES				20
CSE	PCC DISCRET MATHS	PCC	PCC	PCC	Organizational behavior/ Finance accounting	EnvSci (MC)					22
EEE	Prob Statistics	PCC	PCC	PCC	PCC	PCC	PCC	PCC	Biology	MC	22
Mech	PCC	PCC	PCC	PCC	Material Enginee	PCC	Environ Sci				19
Nano	Princip of chemical engg	PCC	Eng Mechanics	Fluid Mechanics	Random Process						19

Semester V

Branch	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Credits
Aero	PCC	PCC	PCC	PCC	OE 1	PCC L	Essence of Indian tradition				17
Bio	PCC	PCC	PEC	OE 1	Entrprenuership development	PCC	PCC	Constitution of India (MC)			21
Civil	PCC	PCC	PCC	PCC	PCC	PCC	PCC	Professional practice Law and Ethics	Constitution of India		23
ECE	PCC	PCC	PCC	PCC	PCC	PCC	PEC 1	OE 1			20
CSE	Signal and Systems	PCC	PCC	PCC	Entrepruership	PEC 1	Constitution of India				21
EEE	PCC	PCC	PCC	PCC	PCC	PCC	PEC1	OE1	Principles of Management		21
Mech	PCC	PCC	PCC	PCC	OE 1	PCC-lab	Essence of Indian	Proj 1			20.5
Nano	PCC	PCC	PCC	PEC 1	OE 1	Eng Thermodynamics	IPT 1				22

Semester VI

Branch	C1	C2	C3	C4	C5	C6	C7	C8		Credits
Aero	PCC	PCC	PEC 1	PEC 2`	OE 2	PCC Lab	PCC Lab			18
Bio	PCC	PCC	PCC	PCC	PEC2	Bio Ethics and IPR	OE 2			20
Civil	PCC	PCC	PEC 1	PEC 2	OE1	PEC3	PEC4			23
ECE	PCC	PCC	PCC	PCC	PEC 2	OE2	Slot BS/HS	MINI PROJ/ Electronic design workshop		20
CSE	PCC	PCC	PEC 2	PEC3	OE 1	PROJ 1				22
EEE	PCC	PCC	PCC	PCC	PEC 2	PEC3	OE2	SLOT FOR HS	SUMMER INTERNSHIP	22
Mech	PCC	PCC	PEC 1	PEC 2`	OE 2	PCC Lab	Proj-2			21.5
NANO	PCC	PCC	PEC 2	OE2	SURFACE ENGG	TQM	ACAD WRITI			22

Semester VII

Branch	C1	C2	C3	C4	C5	C6	C7	C8	Credits
Aero	PCC	PEC3	PEC4E	OE3	PCC LAB		PROJ 1		18.5
Bio	PCC	PCC	PEC 3	PEC 4	OE 3	OE 4	IPT		18
Civil	PEC 5	PEC 6	OE 2	PRJ 1					15
ECE	PEC 3	PEC 4	PEC 5	OE 3	Slot BS/HS		PROFJ 1		21
CSE	PEC 4	PEC 5	OE 2	Biology	PROJ 2				18
EEE	PEC 4	PEC 5	OE 3	OE4	PROJ 1	SLOT FOR HS			18
Mech	PCC	PEC 3	PEC 4	OE3	PCC LAB	PROJ 3			18.5
NANO	PCC	PCC	PEC 3	PEC 4	OE 3	ENTREPRENU	IPT	PROJ 1	23

SEMESTER VIII

Branch	C1	C2	C3	C4	C5	C6	CREDITS
Aero	PEC 5	PEC 6	OE 4	OE 5	PROJ 2		18
Bio	PROJ2						12
Civil	PEC 7	PEC 8	OE 3	OE 4	PROJ 2		16
ECE	PEC 6	PEC 7	OE 4	OE 5	PROJ 2		21
CSE	PEC 6	OE 3	OE 4	PROJ 3			15
EEE	PEC 6	OE 5	OE 6	PROJ 2			17
Mech	PEC 5	PEC 6	OE 4	OE 5	PROJ 4		18
NANO	PCC	PCC	PEC 5	OE 4	OE 5	PROJ 2	20

1.

Branch	C1	CREDITS
Nano – IX	**Proj 3**	**8**
Nano - X	**Proj 4**	**8**

ANNEXURE – I

Department Advisory Committee

AGENDA:

1. Programs to be organized for 2019-20 Academic year
2. Value added courses suggestion
3. Skillset development of students
4. Identification of the curriculum gap
5. Industrial Visits suggested
6. Regarding Discipline of the students
7. Student motivations
8. Quality Improvement
9. Students employability
10. Any other points for overall development of the Department

MINUTES:

Initially Dr. S.Kumaran, Head, Department of Biotechnology welcomed the members of the advisory committee and told about the purpose of the meeting to be conducted as it is required to have suggestions for the forthcoming semester and also a feedback on present curriculum and syllabus for the Board of studies meeting yet to be conducted before 30th April 2019.

Then the agenda points has been taken into consideration one by one and comments given by the members were noted as given below.

S.NO	Agenda	Member represented
1.	Programmes to be organized for 2019-20 Academic year	Dr. S.Kumaran detailed out the plan for the forthcoming year that one International conference jointly with other Engineering departments will be conducted in March 2020. Workshops on Bioinformatics and Bioprocess Engineering and Genomera 2019, National Students Level Technical symposium has been also suggested.

2.	Value added courses	Dr. S.Kumaran elaborated the list of value added courses to be conducted during the vacation period of the students. 16 VAC has been suggested such as Plant Tissue Culture Training, Animal Tissue Culturing (in vivo), Analytical Instruments (GC-MS and HPLC), MAT-lab for biological applications, AFM, Isolation and purification of proteins etc.
3.	Skillset development of students	It is suggested by Dr. S. Satheshkumar that individual opportunity to perform lab experiments Should be given. Ms. S. Rajasree told that there should be more Analytical calculations, Application based experiments and experiments current trends based experiments.
4.	Identification of the curriculum gap	The curriculum and syllabus copy of Regulation 2018-19 were circulated among the members**.** Dr. Nitin suggested that Biochemistry syllabus can be divided into two parts for effective learning, Dr. Kumaran agreed and told to make the syllabus according to GATE exam. Dr. Ashok suggested course on simulation techniques in Biotechnology and industrial safety and risk management. Dr. S. Satheshkumar suggested to divide the course of cell biology and microbiology into two separate subjects.
5.	Industrial Visits suggested	Ms. A. Afrin, IV year student requested to give more number of industrial visits to which Ms. Sangeetha assured that 5 industrial trips for each semester has been planned for coming sessions.
6.	Regarding Discipline of the students	Ms. Snehya. A.V, suggested for E-Sessions carrying laptops can be encouraged instead, book reading must be encouraged, Yoga and meditation sessions can be more frequent.
7.	Student motivations	Dr. S. Satheshkumar suggested that guest lectures regarding motivations, job, higher studies, competitive exams, Pshycological aspects, group discusions during class hours should be conducted often.
8.	Quality	Ms. Sangeetha and Ms. Snehya told book reading must be

	Improvement	encouraged. Dr. Ashok suggested to conduct quizzes (open book, MCQs) aftenly and Dr. Kumaran suggested there should be more session for discussing research papers. Dr. Nitin suggested to support students to attend more seminars and paper presentations.
9.	Enhancing the Relevance of Final Year Projects	Members suggested to add skill development course. Ms. S. Rajasree suggested to contact multi discplinary career advisory firms. Dr. Nitin suggested IPT in value generation from waste, mushroom and breweries industries.
10.	Students employability	Ms. S. Rajasree sugeested that giving more importance to Final year projects, value added courses, industrial visits will upgrade employability potential of the students.
11.	Any other points	DAC members came on conclusion that Staff strength should be maintained, P.G programs should be incorporated with sufficient funds to increase overall research learning experience. Board of studies will be conduicted incorporating all the sugeestions rendered by the members before 30th April 2019

Finally the meeting ended after Dr. Kumaran thanked all the members for their valuable contributions and suggestions provided on behalf of the Biotechnology Department.

ANNEXURE – II

BOARD OF STUDIES (REGULATION 2018)

AGENDA:

1. Reviewing Curriculum for B. Tech (Biotechnology) – Regulation 2018, Degree programme.

2. Developing Curriculum & Syllabus from IV -VIII semesters for B. Tech (Biotechnology) Degree programme.

3. Checking the course outcomes mapping with programme outcome.

MINUTES:

- Dr. S. Kumaran, Associate Professor and head of the department started with a welcome note and introduced the invited expertise and students.
- The curriculum and syllabus of (III –VIII) for B. Tech Biotechnology for Regulation 2018, Revision-I, was reviewed and finalised.
- The major changes put forward by the academic expert is as follows
    1. The basic analytical skills are lacking in the undergraduate students. So it was advised to give special attention to solve the analytical problems. This will enhance the quality of research experiments.
    2. Incorporation of biological techniques in XBT 403 Analytical Techniques, such as MALDI TOF, Bio imaging, Sequencing Techniques etc and changing the course name into "XBT 501 Bioinstrumentation".
    3. It was recommended to revise the syllabus and suggested to have the title "XBT 601 Bioreactor Design and Analysis" instead of "XBT 601 Biochemical Engineering".
    4. In XBT 404 Biochemistry II has been changed as "XBT 404 Bioenergetics and Metabolism". In that metabolic disorders topic was added.
    5. It was suggested to split XBT 305 Cell Biology and Microbiology, in to Cell Biology and Microbiology separately. It was also advised to incorporate the topics such as mutalism, paracytism, Amansalism, symbiosism and to include Industrial Microbiology relevant topics such as Environmental aspects, biofuel, bioremediation, microbial fuel cells in the Microbiology course. Thus necessary changes have been made in the XBT 304 Microbiology and XBT403 Cell Biology courses.
    6. Special lectures for GATE have to be arranged for coaching the students.
- The suggestions given by industrial expert:

1. As far as industry is concerned, a technologist should be able to do the trouble shooting in process units. So it has been included in Unit Operations, Bioprocess Engineering, Bioreactor Design and Downstream Processing.
2. In general, the undergraduate students are lacking with basic calculations/problem solving skills while doing their In-plant training, hereby it is suggested to practise all necessary basics such as Mass and energy balance, etc. during the lab hours itself.
3. In order to emphasize the current scenario, the Biosimilars is suggested by members to be included. Hence it is incorporated in skill oriented course list.
4. It was recommended to include topics related to clinical trials, drug designing in the elective subjects. Hence it is included in the core elective, Pharmaceutical Biotechnology course.
5. The production of Biofuels, Biopolymers, Industrial enzyme process are suggested to be incorporated in the curriculum. Thus, it is included in the Microbiology course.

- Suggestions given by alumnus:
  1. As per suggestion in feedback of alumni chemical engineering based subjects such as Mass transfer and Heat transfer are included in the curriculum.

- Suggestions given by parents:
  1. Parents emphasize to reduce the CA3 components to minimum number but effectively.

ANNEXURE – III

FEEDBACKS

DEPARTMENT OF BIOTECHNOLOGY
Periyar Nagar, Vallam, Thanjavur - 613 403, Tamil Nadu, India
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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

CONSOLIDATED REPORT ON STUDENT FEEDBACK ON CURRICULAR ASPECTS

PROGRAMME: B.Tech Biotechnology

Academic 2018-2019(Even Semester)

Use √ mark in the blank cells where 5 - Excellent, 4 – Very Good, 3 – Good, 2- Fair, 1- Average and 0 - Poor

S.No	Criterion	5	4	3	2	1	0
1	The sequences of the Courses are properly arranged	28.5	71.42	-	-	-	-
2	Distribution of the contact hours enables to cope up with the syllabus	14.2	28.5	28.5	14.2	14.2	-
3	Offered Core/Professional Electives covers the breadth and depth of the branch chosen	28.5	52.14	14.2	-	-	-
4	Text Books and reference books are up to date and easily available	52.14	28.5	14.2	-	-	-
5	Timeline is realistic to complete the syllabus	28.5	71.42	-	-	-	-
6	The syllabus covers Science, Humanities, Discipline core, Discipline Elective, Open Elective, Project etc.	28.5	52.14	14.2	-	-	-
7	LAB components are adequate and address all skills needed.	42.8	28.5	14.2	14.2	-	-
8	Outcomes are properly defined and questions are aligned	28.5	42.8	28.5	-	-	-
9	Research motives are found in the curriculum	57.14	42.8	-	-	-	-
10	Latest trends and developments in the field are covered.	28.5	57.14	-	14.2	-	-
11	Syllabus enables lifelong learning	-	100	-	-	-	-
12	Open Electives offered are interesting and engages horizontal movement	71.42	-	28.5	-	-	-

General Comments and Suggestions:

S. Kumaran 19/9/19

HOD BIOTECHNOLOGY
(Dr.S.Kumaran)

DEPARTMENT OF BIOTECHNOLOGY

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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

CONSOLIDATED REPORT ON TEACHER FEEDBACK ON CURRICULAR ASPECTS

PROGRAMME: B.Tech Biotechnology
Academic 2018-2019(Even Semester)

Use √ mark in the blank cells where 5 - Excellent, 4 – Very Good, 3 – Good, 2- Fair, 1- Average and 0 - Poor

S.No	Criterion	5	4	3	2	1	0
1	The syllabus is on-par with well-known national and international Universities	66.6	16.6	16.6	-	-	-
2	The syllabus is in line with Indian statutory bodies/Councils.	83.3	16.6	-	-	-	-
3	The curriculum and syllabus scrupulously follow the Outcome Based Education	83.3	16.6	-	-	-	-
4	The curriculum and syllabus suffice the employment requirement of the students	16.6	50	16.6	16.6	-	-
5	The syllabus can be well taught in stipulated time and the course outcomes can be attained.	-	83.3	16.6	-	-	-
6	Latest trends in the programme are covered.	16.6	3	33.3	-	-	-
7	Local needs, national needs and international needs are addressed in the curriculum and syllabus	50	16.6	16.6	16.6	-	-

General Comments and Suggestions:

S Kumaran 28/6/19

HOD BIOTECHNOLOGY

(Dr.S.Kumaran)

DEPARTMENT OF BIOTECHNOLOGY
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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

CONSOLIDATED REPORT ON PARENTS/ EMPLOYERS / INDUSTRY EXPERT FEEDBACK ON CURRICULAR ASPECTS

PROGRAMME: B.Tech Biotechnology

Academic 2018-2019(Even Semester)

Use √ mark in the blank cells where 5 - Excellent, 4 – Very Good, 3 – Good, 2- Fair, 1- Average and 0 - Poor

S.No	Criterion	5	4	3	2	1	0
1	Sequence of course arrangement	20	80	-	-	-	-
2	Electives offered covers the breadth and depth of the branch chosen	-	40	40	20	-	-
3	Courses introduced fulfill the contemporary requirements and expectations which helps to perform well in the work environment	20	80	-	-	-	-
4	Emphasis given more on fundamentals	-	80	-	20	-	-
5	Science, Humanities, Open Elective and Project provides basic knowledge and understanding.	-	80	20	-	-	-
6	LAB components are adequate and address all entry-level knowledge and/or skill development in the field (Applicability/relevance to real life situations)	60	20	-	20	-	-
7	Balance between theory (i.e., classroom) and practice (i.e.lab/shop/fieldwork) is satisfactory	60	20	20	-	-	-
8	The curriculum and syllabus have research components	-	80	20	-	-	-
9	Latest trends and developments in the field are covered. (Coverage of modern/advanced topics)	20	20	40	20	-	-
10	Syllabus enables lifelong learning	20	60	20	-	-	-
11	Gives Better Employment Opportunity	-	60	40	-	-	-

General Comments and Suggestions:

S.Kumaran 28/09/19

HOD BIOTECHNOLOGY

(Dr.S.Kumaran)

ANNEXURE – IV

COMMUNICATIONS

Department Advisory Committee - Industrial Expert - Meeting on 20th April at 10.30 A.M
Inbox x

HOD BIOTECH <headbio@pmu.edu> Tue, Apr 16, 1:01 PM

to drsatheshkumar6, Snehya, Dr, K, Nitin, sangmechii

Dear Professor Dr. Satheeshkumar,

Warm greetings from PMIST!

In continuation of the phone conversation with you, you have been selected as Academic Expert for Department Advisory Board for biotechnology by competent authority. In this connection, we plan to conduct meeting on 20th April, 10.30 A.M at PMIST (Marie Curie Hall).

I request you to confirm your presence through email.
Looking forward to hear form you.

Best regards,
Kumaran

DR S SATHESHKUMAR <drsatheshkumar6@rediffmail.com> Tue, Apr 16, 4:08 PM

to me

Dear Dr Kumaran
Received your mail. I hereby accept your invitation and I will attend the meeting as scheduled.
Best regards

DR. S. SATHESHKUMAR, M.V.Sc., Ph.D.,
Professor and Head
Dept. of Veterinary Gynaecology and Obstetrics
Tamilnadu Veterinary and Animal Sciences University
Veterinary College and Research Institute
Tirunelveli, Tamil nadu

Department Advisory Committee - Industrial Expert - Meeting on 20th April at 10.30 A.M
Inbox x

HOD BIOTECH <headbio@pmu.edu> Tue, Apr 16, 1:02 PM

to Rajasree, Snehya, Dr, K, Nitin, sangmechii

Dear Ms. S. Rajashree

Warm greetings from PMIST!

In continuation of the phone conversation with you, you have been selected as Industrial Expert for Department Advisory Board for biotechnology by competent authority. In this connection, we plan to conduct meeting on 20th April, 10.30 A.M at PMIST (Marie Curie Hall).

I request you to confirm your presence through email.

Looking forward to hear form you.

Best regards,

Kumaran

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www.pmu.edu/web/biotech.html

Google scholar citations

https://scholar.google.com/citations?user=oGMRaWUAAAAJ

Rajasree Shanmuganathan <rajasreeshanmuganathan@gmail.com> Tue, Apr 16, 1:04 PM

to me, sangmechii, Nitin, K, Dr, Snehya

Thanks sir, I will be there.

Department of Biotechnology
Periyar Nagar, Vallam, Thanjavur - 613 403,
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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

Office Note No: 1117 /Biotech /PMIST/Dated: 15.04.2019
Sub: Recommendation and Approval for Department Advisory Committee - reg

Recommendation of External members for Department Advisory Committee (DAC) has been sought for a discussion to develop the department activities in academics, research, placements and other developmental aspects. The members list is submitted for your kind perusal and approval.

Sl.No	External Member	Category
1.	Dr.S.Sathesh Kumar, Professor and Head, Dept. of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute, Ramayanpatti, Tirunelveli – 627 358. T: +91-462-2336344 / 2336345 / 2336347; Email: drsatheshkumar6@rediffmail.com	Academic Expert
2.	Dr. Manickam Matheswaran Associate Professor, Department of Chemical Engineering National Institute of Technology, Tiruchirappalli - 620015, Tamil Nadu, INDIA. E-mail: math_chem95@rediffmail.com; Mobile: +91 98945 24804	Academic Expert
3.	Dr. M. Rajasimman, Professor, Department of Chemical Engineering, Faculty of Technology, Annamalai University, Annamalainagar – 608002. Mobile: 9842565098; Email: simms@rediffmail.com	Academic Expert
4.	Ms.S.Rajasree, CEO, CoRx Life Science and Pharmaceutical Pvt.Ltd. Trichy. Mobile: 8760706950; Email:rajashree9550@gmail.com	Industrial Expert
5.	Mr.S.Prabakaran CEO, Biocline Pvt.Ltd, 212, Periyar Technology Business Incubator Thanjavur – 613403 Mobile: 9524666976.	Industrial Expert
6.	Dr. C. Tamilselvan, Managing Director, Test Facility Management, Bioscience Research Foundation, Chennai Mobile : +91 98400 33458, E-mail : brfchennai@gmail.com; E-mail : drselvan@brfchennai.com	Industrial Expert

S.Kumaran 15/4/19
Dr.S.Kumaran,
HOD/Biotechnology

Remarks: Recommended for opting Resource person for DAC

R. Arumugam 15/4/19
Dean/FET

Remarks: Sl No (1) and (4) may be approved Recommended and forwarded

Dean Academic

Remarks:

VC for Recommendation
Sl. No. 1 for Academic expert category and
Sl. No. 4 for Industrial expert category are approved.
S. Vaidhyasubramaniam 15/4/19

DEPARTMENT OF BIOTECHNOLOGY

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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

Department Advisory Committee

Date : 20.04.2019 **Time:** 10:30 AM **Venue**: Dean Research Office

MEMBERS PRESENT

S.No	Name	Designation	Membership Details	Signature
1.	Dr. S. Kumaran	Associate professor, Head of the Department, Biotechnology and Dean Research (IC)	Chairperson	20/04/19
2.	Dr. S. Satheshkumar	Professor and Head Dept. of Veterinary Gynaecology and Obstetrics, TANUVAS, Tirunelveli, Tamil nadu	Academic Expert Member	20/4/19
3.	Ms. S. Rajasree	CEO, CoRx Life Science and Pharmaceutical Pvt. Ltd. Trichy	Industrial Expert Member	20/4/19
4.	Dr. A. AshokKumar	Assistant professor	Internal Member	20/4/2019
5.	Dr. Nitin Kumar	Assistant professor	Internal Member	20/4/19
6.	Ms. S. Snehya	Assistant professor	Internal Member	20/4/19
7.	Ms. A. Sangeetha	Assistant professor	Internal Member	
8.	Mr. R. Prasanna Srinivasan	Research Assistant, TanBio R&D Solution (2014-18)	Alumini	
9.	Mr. A. Rajagopal & R. Umakantham	Bank Manager, Jagdeesan Nagar, Thanajavur	Parent	Absent
10.	Ms. A. Afrin	Student representative	IV year student	
11.	Ms. E. Akshaya	Student representative	IV year student	
12.	Mr. G. Pradeep	Student representative	III year student	
13.	Mr. S. Kilurudeen	Student representative	III year student	20/4/19
14.	Mr. R. Shankar	Student representative	II year student	
15.	Ms. T. Pavithra	Student representative	II year student	

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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

Office Note No: 1118 /Biotech /PMU/Dated: 20.4.2019
Ref: 1117 /Biotech /PMU/Dated :15.4.2019
Sub: Approval for Remuneration- Department Advisory Committee

Respected Sir,

It is planned to conduct department advisory committee the for academic year 2018-2019 on 20.4.2019. The remuneration details for the external members are submitted for your kind perusal and approval.

Sl.no	External auditee member	Category	Honorarium	Travel Allowance	Total Amount(Rs)
1.	Dr.S.Sathesh Kumar, Professor and Head, Dept. of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute, Ramayanpatti, Tirunelveli – 627 358. T: +91-462-2336344 / 2336345 / 2336347 Email: drsatheshkumar6@rediffmail.com	Academic - Expert	2000	500	2500
2.	Ms.S.Rajasree, CEO, CoRx Life Science and Pharmaceutical Pvt.Ltd. Trichy. Mobile: 8760706950. Email:rajashree9550@gmail.com	Industrial Expert	2000	750	2750
				TOTAL	5,250

I request you to sanction, money can be transfered through online.

S.Kumaran 20/Apr/19

Dr.S.Kumaran, Asso Professor & HOD/Biotech and Chemical Engg.

Remarks: Recommended & submitted for approval

R. Jayanthi 20/4/19

Dean/FET

Remarks: Recommend and forward

Dean Academic

Remarks:

Registrar

20/4/19

Request to accept our invitation - BoS-Department of Biotechnology, PMIST

HOD BIOTECH <headbio@pmu.edu> Apr 24, 2019, 6:55 PM

to deanautvl, sureshbiotech2003

Dear Dr. Sureshkumar,

Professor of Biotechnology & Dean, Anna University Regional Campus,Tirunelveli

On behalf of Department of Biotechnology, PMIST. I am requesting you to accept our invitation for board of studies (Academic Expert). You will be our Academic expert in this BoS. We have decided to conduct the meeting on 29th April 2019 at 10 A.M in Marie Curie Hall.

Please feel free to contact us.
Looking forward to hearing from you.

Best regards
Dr. S. Kumaran
Head, Department of Biotechnology
Periyar Maniammai Institute of Science and Technology
Vallam, Thanjavur - 613 403
Tamilnadu, India

HOD BIOTECH <headbio@pmu.edu> Apr 25, 2019, 6:47 PM

to Sathyanarayana

Dear Dr. Sathyanaryana Gummadi,
Professor of Biotechnology, IIT-M

Warm greetings!
On behalf of Department of Biotechnology, PMIST. I am requesting you to accept our invitation for board of studies (Academic Expert-Special Invitee). You will be our Academic expert in this BoS. We have decided to conduct the meeting on 29th April 2019 at 10 A.M in Marie Curie Hall.

Please feel free to contact us.
Looking forward to hearing from you.

Best regards
Dr. S. Kumaran

Request you to accept our invitation - BoS

Inbox x

HOD BIOTECH <headbio@pmu.edu> Tue, Apr 23, 7:35 PM

to Sundar, Snehya, Dr, K, sangmechii, Nitin

Dear Mr. Sundar,

Warm greetings!

On behalf of department of biotechnology, PMIST. I am requesting you to accept our invitation for board of studies (Industrial Expert). You will be our Industrial expert in this BoS. We have decided to conduct meeting on 29th April 2019 in our campus.

Please feel free to contact us.

Looking forward to hearing from you.

Best regards

Kumaran

sundar@labmateasia.com Wed, Apr 24, 9:44 AM

to me

Dear Dr. Kumaran

Thanks for the invite. Yes confirmed I will reach on 29th April at 10 am for the meeting.

Regards,

Sundar

From: HOD BIOTECH
Sent: Tuesday, April 23, 2019 7:35 PM
To: Sundar
Cc: Snehya AV ; Dr A Ashokkumar AP/Chem Eng ; K Anbarasu Bio Tech ; sangmechii arumugam ; Nitin Kumar AP / Bio-Technology
Subject: Request you to accept our invitation - BoS

Dear Mr. Sundar,

Warm greetings!

On behalf of department of biotechnology, PMIST. I am requesting you to accept our invitation for board of studies (Industrial Expert). You will be our Industrial expert in this BoS. We have decided to conduct meeting on 29th April 2019 in our campus.

Please feel free to contact us.

Looking forward to hearing from you.

Best regards

Kumaran

HOD BIOTECH <**headbio@pmu.edu**> Wed, Apr 24, 11:05 AM

to asangeetha, Dr, K, KUMARAN, Nitin, Snehya

Dr. S. Kumaran

KUMARAN S Wed, Apr 24, 11:26 AM

to me

Dear Sundar,

Thank you very much.

best regards,

Kumaran

Kumaran Shanmugam, M.Sc., Ph.D., (Anna Univ.), Ph.D., (Charles Univ.)
Postdoctoral Training (Osaka Univ.)
Endeavour Executive Fellow (Flinders Univ.)

Associate Professor
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PERIYAR MANIAMMAI UNIVERSITY
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Office note order No: 1004Biotech /Dated:24/05/2018

Submitted to the Administrative Committee:

Sub: Permission sought for the nomination of Board of Studies Member for B. Tech Biotechnology Regulation 2018.

The BOS member from the industry has to be reconstituted and nominated for the review of the curriculum and syllabus of B. Tech Biotechnology Programme. Regulation 2018. The following expert members are submitted for your kind perusal and nomination.

Sl No	Expert Member	
1.	Mr.S.Sundarajan, National Head, Pharma & Food, Labmate Asia Pvt. Ltd., Chennai. Mail: sundar@labmateasia.com Mob: 97856 73234	Industry Experts
2.	Mr. Abdul.waheed Deputy Manager, MSAT, Biocon, Banglore. E.mail:abdul.waheed@bicon.com Phone No:953806221	
3.	Dr. Ankur Bhat nagar Chief Scientific Manager & Head of Upstream Process Development, Biocon, Bangalore. E.mail:ankur.bhatnagar@biocon.com	

It is requested to nominate one expert member from the above list.

24/5/18
Dr.S.Chittibabu
Head/Biotechnology

Recommended for nominating industry expert for BOS/Biotech.

R. Annamalai 25/5/18
Dean(FET)

Recommended and forwarded Sl No 1 may be approved

25/5/18
Dean (Academics)

Registrar
25/5/18

Faculty of Engineering and Technology
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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

Submitted to the Registrar

Offices note No: BT/1120/ Dated: 07-02-2018 /Biotechnology

Sub: **Regarding Special Invitee -BoS Biotechnology**

Department of Biotechnology BoS meeting has been scheduled on 29/4/19, regarding this we hereby proposing to have a special invitee Professor Sathyanarayana N Gummadi, Department of Biotechnology, IIT Madras. Prof. Gummadi has more than 20 years of experience in the field of Biotechnology and it will be very productive if we can get his presence for the BoS meeting. We can provide him only DA and no TA.

BOs i/c 25/4/19
Dr. Nitin Kumar

Honarium: 8000/- only for the time

DA :

S Kumaran 25/Apl/19
Dr. S. Kumaran
(Head, Biotech)

Date:

Remarks

TA+DA = Rs. 8920
2000
Total :-Rs. 10920/-

Recommended & Submitted

R. Jayavelu 25/4/19
Dean (FET)

Date:

Recommended and forwarded

Dean (Academics)

Date:

Registrar
25/4/19

DEPARTMENT OF BIOTECHNOLOGY
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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

MINUTES OF THE BOARD OF STUDIES

(Regulations 2018)

Date: 29-04-2019

Time: 10:00 AM – 2:00 PM

Venue: Dean Research Office

Agenda:

1. Reviewing Curriculum for B.Tech (Biotechnology) –Regulation 2018, Degree programme.
2. Developing Curriculum & Syllabus from IV – VIII semesters for B.Tech (Biotechnology) Degree programme.
3. Checking the course outcomes mapping with program outcome.

Members present:

S.No	Name	Designation	Representing	Signature
1.	Dr. S. Kumaran	Associate Professor & Head	Chair person	
2.	Dr. P. Suresh Kumar	Professor and Dean Anna University, Regional Campus, Tirunelveli	External Member (Academic)	
3.	Mr. S. Sundarajan	National Head Pharma and Food (Labmate Asia Pvt. Ltd.)	External Member (Industry)	
4.	Dr. Sathyanarayana. N. Gumadi,	Professor, Department of Biotechnology, IIT-M, Chennai	Special invitee from Academic	
5.	Dr.A. Ashok Kumar	Assistant Professor/Chemical Engineering	Member	
6.	Mrs.A.V Snehya	Assistant Professor/Biotechnology	Member	

7.	Ms. A. Sangeetha	Assistant Professor/Chemical Engineering	Member	
8.	Dr. K. Anbarasu	Assistant Professor/Biotechnology	Member	
9.	Mr. Nitin Kumar	Assistant Professor/Biotechnology	Member	
10.	Mr.R Prasanna Srinivasan	Research Assistant, TAN Bio R & D Solutions,Periyar Technology Business Incubator	Alumnus	
11.	Ms. R. Umakantham	28, Jagadesan Nagar,Sungathidal Road, Opp kodiamman Kovil, Thanjavur.	Parent invitee	
12.	Ms.R.Harivardhinie	Fourth year, B.Tech Biotechnology ,PMIST	Student member	
13.	Ms.R.Bhuvaneshwari		Student member	
14.	Mr.G.Pradeep	Third year, B.Tech Biotechnology,PMIST	Student invitee	
15.	Mr.S.Kilurudeen		Student invitee	
16.	Ms.S.Gayathri	Second year, B.Tech Biotechnology,PMIST	Student invitee	
17.	Ms.S.Nandhini		Student invitee	
18.	Ms.KPriyanka	First year B.Tech Biotechnology,PMIST	Student invitee	

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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY
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Office Note No: 1121/BOS/Biotech/Dated: 25.4.2019

Ref: 1004 /Biotech/Dated: 24.05.2018
BT/806/Dated: 09.09.2018

Sub: Approval for Remuneration- BOS – Regulation 2018 -Reg

Respected Sir,

It is planned to conduct the BOS Meeting for B.Tech Biotechnology Programme on 29/04/2019 (FN). The remuneration details for the BOS members are submitted for your kind perusal and approval.

Sl.no	External BOS members	Category	Honorarium	Travel Allowance	Total Amount (Rs)
1.	Dr. P. Sureshkumar Professor and Dean Anna University, Tirunelveli	Academic Expert	2000	From Trichy (Home) 120 km (both sides) -- car@Rs.6 per km = 720/-	2720/-
2.	Mr. S. Sundarajan, National Head Pharma and Food Labmate Asia Pvt.Ltd Chennai	Industrial Expert	2000	700 km (both sides) – car@Rs.6 per km = 4200/-	6200/-
				TOTAL	**8,920/-**

BOS i/c
Dr. Nitin Kumar 25/4/19

S. Kumaran 25/4/19
Dr.S.Kumaran, Asso Professor &
HOD/Biotech and Chemical Engg.

Remarks: Recommended & submitted

R. Jayanthi 25/4/19
Dean/FET

Remarks: Recommended and forwarded

Dean Academic

Remarks:

Registrar
25/4/19