DEPARTMENT OF BIOTECHNOLOGY





CURRICULUM & SYLLABUS

FOR

B.Tech – BIOTECHNOLOGY

(Based on Outcome Based Education)

(I - VIII Semester)

REGULATIONS

2015

TABLE OF CONTENTS

S.No	Contents	P.No
1.	Institute Vision and Mission	
2.	Department Vision and Mission	
3.	Members of Board of studies	
4.	Department Vision and Mission Definition Process	
5.	Programme Educational Objectives (PEO)	
6.	PEO Process Establishment	
7.	Mapping of Institute Mission to PEO	
8.	Mapping of Department Mission to PEO	
9.	Programme Outcome (PO)	
10.	PO Process Establishment	
11	Correlation between the POs and the PEOs	
12	Curriculum development process	
13.	Faculty allotted for course development	
14	Pre-requisite Course Chart	
15	B. Tech. (BIOTECHNOLOGY) – Curriculum	
16	B. Tech. (BIOTECHNOLOGY) – Syllabus	
17	Overall course mapping with POS	
18.	Guidelines – UG Engg.& Tech Curriculum 2015-16	

PERIYAR MANIAMMAI UNIVERSITY

Our University 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 ensurin	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				
•	Feam 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.			

MEMBERS OF THE BOARD OF STUDIES Venue: Marie Curie Hall

Sl.No.	Name	Designation	Membership	
1.	Dr. K. Rajendran	Associate Professor & Head, Dept. of Biotechnology, PMU	Chairperson	
2	Dr. Muniasamy	Director, Protein Technology	External Member	
2.	Neerthalingam	Group, C-CAMP, Bangalore	(Academic Expert)	
3	Dr. Tulin Nuwal	Manager, Business,	External Member	
5.		Dr. Reddy's Laboratory	Representing industry	
4	Mc S Pajasroo	CoRx Life Science and	External Member	
т.	MS. S. Rajasiee	Pharmaceutical Pvt Ltd, Trichy	(Alumni)	
		CEO, Biocline, Periyar	External Member	
5.	Mr. K. Prabaharan	Technology Business Incubator,	(Alumni)	
		PMU campus	(Alulinii)	
6	Ms. K. Rajarathi	CEO Mullai Via Bio Thaniavar	External Member	
0.			(Alumni)	
7	Ms A V Snehva	Assistant Professor, Dept. of	Convener	
/.	NIS. M. V. Shenya	Biotechnology, PMU	Gonvener	
8	Ms. M. Shanthi	Assistant Professor, Dept. of	Convener	
0.		Biotechnology, PMU		
9	Dr S Kumaran	Assistant Professor (SG), Dept.	Member	
).		of Biotechnology, PMU		
10	Dr R Kumaresan	Assistant Professor, Dept. of	Member	
10.	DI. R. Rumaresan	Biotechnology, PMU		
11.	Dr T Muthukumaran	Assistant Professor, Dept. of	Member	
	D1. 1. Muthukumaran	Biotechnology, PMU		
12.	Mr K Kathikevan	Assistant Professor, Dept. of	Member	
	Mirit Rathikeyan	Biotechnology, PMU	Member	
13	Mr B John	Final year student, Dept. of	Student Member	
13.		Biotechnology, PMU	Student Member	

The current Bachelor of Technology (B.Tech) Curriculum is undergoing its Fifth Board of studies on 06.10.2015 to tune the syllabus towards Outcome Based Education to meet the UGC requirements and the suggestions provided will be implemented in Regulations 2015.

Biotechnologists should have deep knowledge in biology and engineering, the curriculum and syllabus should be designed in such a way to meet the academic and industrial needs. Department of Biotechnology's vision and mission have been well-structured with the inputs of stakeholders.

Department Vision and Mission Definition Process

The development of vision and mission of the department is carried out as per the following steps.

Step: I	Feedback mechanism at different levels			
	First level – Discussion with inter department faculty by the HOD			
	Second level – Discussion with Current students by the faculty			
	Third level - Employers, alumni and academia and industry experts			
Step: II	Framing the Vision and Mission to benchmark with other Universities			
Step: III	Validation by the Board of studies and approval by Academic Council			
Step: IV	Displayed to imprint the vision and mission			

The University Vision is split up into small elements and verifies its compliance with Department Vision

UNIVERSITY VISION	DEPARTMENT VISION			
global dynamism	State of art department fostering biotechnology education			
excellence in knowledge and innovation	Research to produce technologist			
ensuring social responsibility Creating an egalitarian society.	Scientist and entrepreneurs for the benefit of society and environment.			

To accomplish the vision stated, well-structured mission is established with consultation with administrators, faculty members and other officials.

UNIVERSITY MISSION	DEPARTEMNT MISSION		
Well balanced programmes with scholarly	With state of art infrastructure, learning and impart		
faculty	training in biotechnology		
To impart high level of knowledge	Graduates of highly skilled		
Student - centered education and foster their	With entrepreneurial, professional, ethical and		
growth in critical thinking, creativity,	socially responsibility to work in or create various		
entrepreneurship, problem solving and	biotechnology industries		
collaborative work.			
Progressive and meaningful research	To pursue research as well as collaborate with		
	biotechnology		
Sustainable development.	In the area of food and pharmaceutical industries,		
Skills for global competencies.	Academic and R&D institutions whenever		
	necessity arises.		
	Bio technological intervention utilizing rural		
	knowledge in health, food processing and		
	agriculture practices		
Inculcating Universal values, Self respect,	To contribute socio-economic developments		
Gender equality, Dignity and Ethics.			

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	UM 1	UM 2	UM 3	UM 4	UM 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	6	6

1-Low	2- Medium	3 – High
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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.

Programme Educational Objectives (PEO) PROCESS ESTABLISHMENT

The department of biotechnology faculty and staff discussed in various occasions and formulated Programme Educational Objectives. The Department PEOs will be assessed through the graduates five years after the graduation and revision will be carried out.



The framework for the review and revision of the PEOs at the departmental level involving all the faculty members comprised the following broad stages.

- 1. Using the key words and phrases extracted from the Mission Statement of the institution and department to identify attributes to gauge graduates.
- 2. Capturing the distinction between the educational objective and the student outcomes.
- 3. Formulating each objective to be measurable.

The program educational objectives for the biotechnology program describe accomplishments that graduates are expected to attain within five years after graduation. Graduates will have applied their expertise to contemporary problem solving, be engaged professionally, and have continued to learn and adapt, and have contributed to their organizations through leadership and teamwork.

Mapping of Pr	ogram Edu	cational O	bjectives (I	PEOs) with Depa	rtment Missi	on (DM)
			_			1

	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	R-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

SUMMARY OF THE FEED BACK OBTAINED

Feedback on subject, curriculum, faculty, alumni, employers and university were collected. In that, the following important observations were made,

- 1. Experiments in practical classes chemicals can be used instead of readymade kits available in the market.
- 2. Coaching for GATE exams while taking core subjects
- 3. Guidance for applying summer scholarships to carry out work in national lab and international lab
- 4. Guidance to work in private industries

The above inputs have taken care while framing the PEO statements.

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	Soft-skills through classroom seminars, institutional and industry interactions, use of modern technique and ICT tools.							
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							
1011	working in a need-based and problem solving projects.							
	PROGRAM SPECIFIC OUTCOME							
PS01	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. Project 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)

P0 →	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO 2
PEO 1	2	0	2	1	0	0	0	0	0	0	1	0	2
PEO 2	0	2	2	2	1	0	0	0	0	1	1	1	2
PEO 3	1	0	0	0	2	0	0	0	1	1	1	1	1
PEO 4	1	1	0	0	1	0	0	1	1	2	1	0	1
PEO5	0	0	0	0	0	2	2	1	1	1	1	1	1
1 - Low				2 – Medium			1	3 - High					



	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11
P01	3	1	0	1	1	1	0	1	0	0	1
P02	1	3	1	1	1	0	1	0	1	0	1
PO3	1	1	3	1	1	0	0	0	1	0	0
PO4	0	0	2	3	0	0	0	0	0	0	0
P05	0	0	0	1	3	0	0	0	0	2	0
P06	1	0	0	0	0	3	0	1	0	1	0
P07	0	0	0	0	0	0	3	1	1	0	0
P08	0	0	0	0	0	1	1	3	0	0	1
PO 9	0	0	0	0	0	1	1	1	3	1	0
P010	0	0	0	0	1	0	0	0	1	3	0
P011	0	0	0	0	1	1	1	1	1	2	3
PSO1	0	0	0	1	1	1	1	1	1	1	1
PSO2	0	0	2	0	0	0	0	0	1	1	1

1- Slightly 2 – Supportive

3 - Highly related

PO PROCESS ESTABILSHMENT



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.

Faculty members assigned for course development

S.No	Course Name	Staff Incharge
1.	Introduction to Biotechnology	Dr. K.Rajendran
2.	Principles of Chemical Engineering	Dr.S.Chittibabu
3.	Instrumental methods for analysis	Mr. M.Karthikeyan
4.	Cell biology& Microbiology	Ms.Snehya.A.V
5.	Genetics and Molecular Biology	Ms.M. Shanthi
6.	Basic Industrial Biotechnology	Ms.M. Shanthi
7.	Biochemistry	Dr. R. Kumaresan
8.	Chemical Engineering Thermodynamics	Dr.S.Chittibabu
9.	Process economics and industrial management.	Dr.S.Chittibabu
10	Plant Biotechnology	Mr. M.Karthikeyan
11	Chemical Reaction Engineering	Dr.S.Chittibabu
12	Recombinant DNA Technology	Ms.M. Shanthi
13	Bioprocess Engineering	Ms.Snehya.A.V
14	Animal Biotechnology	Mr. M.Karthikeyan
15	Immunology	Dr. R. Kumaresan
16	Biochemical Engineering	Ms.Snehya.A.V
17	Protein Engineering	Dr.S. Kumaran
18	Bioinformatics and computational biology	Mr. M.Karthikeyan
19	Downstream Processing	Ms.Snehya.A.V
20	Plant Breeding and Agricultural Products	Ms.M. Shanthi
21	Food biotechnology	Ms.M. Shanthi
22	Biosafety, bioethics and IPR	Dr.S. Kumaran
23	Drug discovery and development	Mr. M.Karthikeyan
24	Pharmaceutical Biotechnology	Mr. M.Karthikeyan
25.	Clinical trials and regulatory affairs	Dr. R. Kumaresan
26	Cancer Biology	Dr.S. Kumaran
27.	Metabolic engineering	Ms.M. Shanthi
28	Stem cell biology	Dr. R. Kumaresan
29.	Molecular pathogenesis of Infectious diseases	Dr. R. Kumaresan
30	Industrial waste water management	Ms.Snehya.A.V
31.	Bioresource Technology	Ms.Snehya.A.V
32.	Advanced Microbiology	Mr. M.Karthikeyan

33.	Insect Biotechnology	Mr. M.Karthikeyan
34	Genomics and proteomics	Dr. R. Kumaresan
35.	Tissue engineering	Dr. K.Rajendran
36	Marine biotechnology	Ms.M. Shanthi
37	Nanobiotechnology	Dr.S. Kumaran

Faculty members allotted to Common courses

S.No	Course Name	Responsible Staff
1	Human ethics, Values, Rights and Gender equality	Dr.P.Palani Arangasami, Director / Centre for Periyar Thought Dr.S.Kumaran,AP (SG) / Biotechnology
2	Entrepreneurial Development Management	Dr.A.P.Aruna,Chief Executive Officer /Periyar Technology Business Incubator
		Mr.B.Mahendramohan,HoD/ MBA
3	Total Quality Management	Dr.T.P.Mani,Dean (SET)
		Dr.K.V.R.Rajandran,Asso.Prof / MBA
4	Basic Engineering I	Ms.V.Violet Juli,HoD /ECE
	(Electrical and Electronics Engineering)	Dr.N.Muruganatham,HoD /EEE
5	Basic Engineering II	Dr.P.K.Srividya,Professor/Mech
	(Civil, Mechanical, Bio-technology, Chemical)	Ms.D.ThaiyalnayakiAP / Civil
6	Social Engineering	Dr.P.Sabapathi,Director /KKCPS
		Dr.M.Gabriel,AP/MSW
7	Computer Programming	Prof.G.Thiruchelvi, HoD/CSE
		Ms.R.Vanitha,AP /IT
8	Engineering Graphics	Mr.P.Pandiyaraj,HoD/Mech
		Mr.K.Srinivasan,AP/Civil
9	Engineering Mechanics	Dr.R.Jayanthi,HoD / Civil
		Mr.A.Pugazhenthi, AP/Mech
10	Object oriented programming	
11	Object oriented programming Lab	
12	Operating System (Same Syllabus for all undergraduate program	
13	Operating System (Same Syllabus for all Post Graduate program)	

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.

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;	РС
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)	МС
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	2	1	2	4	4				13	14
BS	9	9	4	3					25	30
ES	9	12	3						24	30
РС			13	16	15	16	9		69	50
PE					3	3	6	6	18	20
OE						3	3	3	9	12
PW/PI			1		1		4	12	18	20
МС										
Total	20	22	23	23	23	22	22	21	176	176

* flexibility of +/- 20%

PRE-REQUISITE MAPPING



XMA 101 - Algebra, Differential calculus and their applications
XMA 102 - Computer Programming
XBE 103 - Electrical and Electronic Engineering System
XAP 104 - Applied Physics
XUM 106 – Human Ethics, Values, Rights and Gender Equality
XMA 201 - Calculus and Laplace Transforms
XEM 202 - Engineering Mechanics
XBW 203 - Mechanical and Civil Engineering Systems
XAC 204 - Applied Chemistry
XBT 207 - Introduction to Biotechnology
XBT 301 - Transforms and Partial Differential Equations
XBT 302 - Principles of Chemical Engineering
XBT 303 - Instrumental Methods for Analysis
XBT 304 - Cell Biology and Microbiology
XBT 305 - Engineering Materials
XPS 401 - Probability and Statistics
XBT 402 - Genetics and Molecular Biology
XBT 403 - Basic Industrial Biotechnology
XBT 404 - Biochemistry
XBT 405 - Chemical Engineering Thermodynamics
XBT 501 - Plant Biotechnology
XBT 502 - Chemical Reaction Engineering
XBT 503 - Recombinant DNA Technology
XBT 504 - Bioprocess Engineering
XBT 505A - Plant Breeding and Agricultural Products
XBT 505B - Food Biotechnology
XBT 505C - Biosafety, Bioethics and IPR
XBT 602 - Animal Biotechnology
XBT 603 - Immunology
XBT 604 - Biochemical Engineering
XBT 605 - Protein Engineering
XBT 606A - Drug Discovery and Development
XBT 606B - Pharmaceutical Biotechnology
XBT 606C - Clinical Trials and Regulatory Affairs
XBT 702 - Bioinformatics and Computational Biology
XBT 703 - Downstream Processing
XBT 704A - Cancer Biology
XBT 704B - Metabolic Engineering
XBT 704C - Stem cell biology
XBT 705A - Molecular pathogenesis of Infectious Diseases
XBT 705B - Industrial Waste Water Management
XBT 705C - Bioresource Technology
XBT 802A - Advanced Microbiology
XBT 802B - Insect Biotechnology
XBT 802C - Genomics and Proteomics
XBT 803A - Tissue Engineering
XBT 803B - Marine Biotechnology
XBT 803C - Nan Biotechnology
ALL OVER - Mano Diotechnology

Department of Biotechnology

University Vision:

To be a University of global dynamism with excellence in knowledge and innovation, ensuring social responsibility for creating an egalitarian society.

University 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.

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.

	DM1	DM2	DM3	DM4	Total
UM1	3	1	2	0	6
UM2	1	3	2	1	7
UM3	0	1	3	2	6
UM4	2	3	2	1	6
UM5	0	3	1	2	6

Mapping of Department Mission with University Mission:

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

Program Educational Objectives (PEO):

The Four year B.Tech Biotechnology programme is dedicated to produce graduates who have

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.

BTech	PEO1	PEO2	PEO3	PEO4	PEO5	Total
DM1	2	2	2	1	1	8
DM2	2	3	2	1	2	10
DM3	2	2	1	3	2	10
DM4	1	1	1	2	3	8
Total	7	8	6	7	8	

Mapping of Programme Educational Objectives (PEO) with Department Mission:

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

Program Outcomes:

Graduates of the Four Year B.Tech Biotechnology programme will have attained,

PO1: The fundamental concepts of both engineering and life sciences and apply it to a wide range of interdisciplinary work.

PO2: An ability to analyze complex engineering problems, conduct experiments in biotechnology and apply in the field by generating innovative, economical and feasible solutions.

PO3: An experience to develop a process that meets the specific needs of societal and environmental problems to draw meaningful conclusions.

PO4: To draw conclusion in research based methods for value addition to existing products.

PO5: Soft-skills through classroom seminars, institutional and industry interactions, use of modern technique and ICT tools.

PO6: An ability to apply contextual knowledge to assess the issues in public health, society and environment.

PO7: An ability to update the modern techniques in biotechnological essential for protecting the environment and sustainable development.

PO8: An ability to demonstrate themselves as morally responsible citizens by being aware of his/her roles, duties, professional and ethical responsibilities and rights.

PO9: A Positive attitude and interpersonal skills to function in multidisciplinary teams and setups.

PO10: An ability to communicate, comprehend and write effective reports.

PO11: An enthusiasm for life-long learning and urge to contribute to technology and society by working in a need-based and problem solving projects.

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, analyze 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. Life-long learners: Update the technical needs in a challenging world in equipping themselves to maintain their competence.

			B. 1	ech Bi	iotech	nology	7								
SI.No	Graduate Attributes					I	?0						PSO		
		1	2	3	4	5	6	7	8	9	10	11	1	2	
GA 1	Engineering Knowledge	3	1	1	0	0	1	0	0	0	0	0	0	0	
GA 2	Problem analysis	1	3	1	0	0	0	0	0	0	0	0	0	0	
GA 3	Design/Development of solutions	0	1	3	2	0	0	0	0	0	0	0	0	2	
GA 4	Conduct investigations of complex problems	1	1	1	3	1	0	0	0	0	0	0	1	0	
GA 5	Modern tool usage	1	1	1	0	3	0	0	0	0	1	1	1	0	
GA 6	Engineer and Society	1	0	0	0	0	3	0	1	1	0	1	1	0	
GA 7	Environment and Sustainability	0	1	0	0	0	0	3	1	1	0	1	1	3	
GA 8	Ethics	1	0	0	0	0	1	1	3	1	0	1	1	1	
GA 9	Individual and Team Work	0	1	1	0	0	0	1	0	3	1	1	1	1	
GA 10	Communication	0	0	0	0	2	1	0	0	1	3	2	1	1	
GA 11	Life Long Learning	1	1	0	0	0	0	0	1	0	0	3	1	1	

Mapping of Programme Outcomes (PO) with Graduate Attributes:

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

B.Tech						РО						PS	50
	1	2	3	4	5	6	7	8	9	10	11	1	2
PEO1	2	0	2	1	0	0	0	0	0	0	1	0	1
PEO2	0	2	2	2	1	0	0	0	0	1	1	1	2
PEO3	1	0	0	0	2	0	0	0	1	1	1	1	1
PEO4	1	1	0	0	1	0	0	1	1	2	1	0	1
PEO5	0	0	0	0	0	2	2	1	1	1	1	1	1

Mapping of Programme Outcomes (PO) with PEO:

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

SEMESTER – I

S. No.	Course	Name of The Course	(Cre	dits			Cor	ntact Hours		
5. NU	Code	Name of The Course	L	Т	Р	С	L	Т	Р	SS	Total
1	XMA 101	Algebra, Differential calculus and their applications	3	1	0	4	3	2	0	0	5
2	XCP 102	Computer Programming	3	0	1	4	3	0	2	0	5
3	XBE 103	Electrical and Electronic Engineering System	3	1	1	5	3	2	2	0	7
4	XAP 104	Applied Physics	3	1	1	5	3	2	2	0	7
5	XGS 105	Study skills and language lab	1	0	0	1	1	0	0	2	3
6	XUM 106	Human Ethics, Values, Rights and Gender Equality	1	0	0	1	1	0	0	2	3
ТОТА	L		14	3	3	20	14	6	8	2	30

SEMESTER – II

C No	Course	Nome of The Course		Cred	lits			Co	ntac	t Hou	rs
5. NU	Code	Name of The Course	L	Т	Р	C	L	Т	Р	SS	Total
1	XMA201	Calculus and Laplace Transforms	3	1	0	4	3	2	0	0	5
2	XEM202	Engineering Mechanics	3	1	0	4	3	2	0	0	5
3	XBW 203	Mechanical and Civil Engineering Systems	3	1	1	5	3	2	2	0	7
4	XAC204	Applied chemistry	3	1	1	5	3	2	2	0	7
5	XEG205	Engineering Graphics	2	1	0	3	2	2	0	0	4
6	XGS 206	Speech communication	1	0	0	1	1	0	0	2*	3
7	XBT 207	Introduction to Biotechnology	0	0	0	0	1*	0	0	2*	3
TOT	TOTAL		15	5	2	22	16	10	4	4	34

*Non-credit hours

SEMESTER – III

S. No Course Name of the course Credits	s Contact Hours
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	Code		L	Т	Р	С	L	Т	Р	SS	Total
1	XMA301	Transforms and Partial Differential equations	3	1	0	4	3	2	0	0	5
2	XBT 302	Principles of Chemical Engineering	3	1	0	4	3	2	0	0	5
3	XBT 303	Instrumental methods for analysis	3	0	1	4	3	0	2	0	5
4	XBT 304	Cell biology& Microbiology	3	1	1	5	3	2	2	0	7
5	XES 305	Engineering Materials	3	0	0	3	3	0	0	0	3
6	XEP 306	Entrepreneurship Development	2	0	0	2	2	0	0	1*	3
7	XGS 307	Interpersonal communication	0	0	0	0	0	0	0	2*	2
8	XBT 308	In plant training – 1	-	-	-	1	_	-	-	_	_
ТОТА	L		17	3	2	23	17	6	4	3	30

SEMESTER -IV

C. No.	Course			Cred	its			Со	ntact	t Hou	rs
5. NO	Code		L	Т	Р	С	L	Т	Р	SS	Total
1	XPS 401	Probability and Statistics	3	0	0	3	3	0	0	0	3
2	XBT 402	Genetics and Molecular Biology	3	0	0	3	4	0	0	0	4
3	XBT 403	Basic Industrial Biotechnology	3	0	1	4	3	0	2	0	5
4	XBT 404	Biochemistry	3	1	1	5	3	2	2	0	7
5	XBT 405	Chemical Engineering Thermodynamics	3	1	0	4	3	2	0	0	5
6	XBT 406	Process economics and industrial management.	3	0	0	3	3	0	0	0	3
7	XGS 407	Technical communication	1	0	0	1	1	0	0	2*	3
8	XEC 408	Extracurricular activities - NCC/NSS/YRC/RRC/Sports	-	-	_	_	_	_	-	_	-
			19	2	2	23	20	4	6	2	30

- *Non-credit hours

SEMESTER -V

	Course			Cre		Contact Hours					
S. No	Code	Name of the course	L	Т	Р	С	L	Т	Р	S S	Total
1	XBT 501	Plant Biotechnology	2	1	0	3	2	2	0	0	4
2	XBT 502	Chemical Reaction Engineering	2	1	0	3	2	2	0	0	4

3	XBT 503	Recombinant DNA Technology	3	0	1	4	3	0	2	0	5
4	XBT 504	Bioprocess Engineering	3	1	1	5	3	2	2	0	7
5	XBT 505	Professional electives - 1	3	0	0	3	3	0	0	0	3
6	XTQ506	Total Quality Management	3	0	0	3	3	0	0	0	3
7	XGS 507	Business communication	1	0	0	1	1	0	2*	0	3
8	XBT 508	In-plant Training - II	-	-	-	1	-	-	-	-	-
ТОТА	L		17	3	2	23	16	8	6	0	30

SEMESTER -VI

	Course			Cre	dits		Contact Hours					
S. No	Code	Name of the course	L	Т	Р	С	L	Т	Р	S S	Total	
1	XOE 601	Open elective – 1	3	0	0	3	3	0	0	0	3	
2	XBT 602	Animal Biotechnology	3	0	0	3	3	0	0	0	3	
3	XBT 603	Immunology	3	0	1	4	3	0	2	0	5	
4	XBT604	Biochemical Engineering	3	1	1	5	3	2	2	0	7	
5	XBT 605	Protein Engineering	3	1	0	4	3	2	0	0	5	
6	XBT 606	Professional Elective - 2	3	0	0	3	3	0	0	0	3	
7	XUM 607	Environmental Studies	0	0	0	0	3*	0	0	0	3	
8	XGS 608	Academic Writing	0	0	0	0	0	0	2*	0	2	
TOTAI			18	2	2	22	21	4	6	0	31	

*Non-credit

hours

SEMESTER –VII

S. No	Course	Name of the course		Cre	edits		Co				
5. NU	Code	Iname of the course	L	Т	Р	С	L	Т	Р	SS	Total
1	XOE 701	Open elective – 2	3	0	0	3	3	0	0	0	3
2	XBT 702	Bioinformatics and computational biology	3	0	1	4	3	0	2	0	5

3	XBT 703	Downstream Processing	3	1	1	5	3	2	2	0	7
4	XBT 704	Professional Elective - 3	3	0	0	3	3	0	0	0	3
5	XBT 705	Professional Elective - 4	3	0	0	3	3	0	0	0	3
6	XUM 706	Cyber Security	0	0	0	0	3*	0	0	0	3
7	XBT 707	Project Phase - 1	0	0	2	2	0	0	2	0	2
8	XGS 708	Career Development Skills	0	0	0	0	0	0	1*	0	1
9	XBT 709	Inplant Training - III	-	-	-	2	-	I	I	-	-
			15	1	4	22	18	2	7	0	27

SEMESTER -VIII

S. No.	Course	Name of the course	Credits				Contact Hours				
5. NU	Code		L	Т	Р	С	L	Т	Р	SS	Total
1	XOE 801	Open elective - 3	3	0	0	3	3	0	0	0	3
2	XBT 802	Professional Elective – 5	3	0	0	3	3	0	0	0	3
3	XBT 803	Professional Elective - 6	3	0	0	3	3	0	0	0	3
4	XBT804	Project Phase - 2	0	0	12	12	0	0	24	0	24
			9	0	12	21	9	0	24	0	33

*Non-credit hours

LIST OF PROFESSIONAL ELECTIVES

Subject code	Name of the subjects	L	Т	Р	C
	Professional Electives - 1				
	A – Plant Breeding and Agricultural Products	3	0	0	3
XBT 505	B - Food biotechnology		Ū	Ŭ	5
	C - Biosafety, bioethics and IPR				
	Professional Electives - 2				

	A - Drug discovery and development				
	B - Pharmaceutical Biotechnology	3	0	0	3
XB1 606	C - Clinical trials and regulatory affairs				
	Professional Electives - 3				
	A - Cancer Biology	3	0	0	3
XBT 704	B - Metabolic engineering	5	Ũ	Ũ	5
	C - Stem cell biology				
	Professional Electives - 4				
	A - Molecular pathogenesis of Infectious diseases	3	0	0	3
XBT 705	B - Industrial waste water management				
	C - Bioresource Technology				
	Professional Electives - 5				
	A - Advanced Microbiology		0	0	3
XBT 802	B - Insect Biotechnology	5	0	Ŭ	5
	C - Genomics and proteomics				
	Professional Electives - 6				
	A - Tissue engineering	2	0	0	2
XBT 803	B - Marine biotechnologyC - Nanobiotechnology		0	0	5

ALGEBRA, DIFFERENTIAL CALCULUS AND L T P											
XMA 101	THEIR APPLICATION		3	1	0	4					
C P A			L	Τ	Р	Η					
3 0 0			3	2	0	5					
PREREQUISI	PREREQUISITE: Basic concepts of Matrices, Numbers, Differentiation and Integration										
COURSE OUT	COMES:	[
Course Outcomes Domain Level											
CO1: Explain t	he Properties of eigen values and eigen vectors	Cog	1	Unders	stand	ing					
of the matrice	s, <i>Make Use of</i> orthogonal and similarity		1	Apply							
transformation a	nd Construct the quadratic form to Canonical										
form.		C		D	1 .						
CO2: Define a	nd Find the radius and circle of curvature in	Cog	1	Remer	nberi	ng					
cartesian and p	olar coordinate and to <i>Explain</i> evolutes and		'	Unders	stand	ing					
CO3: Emplain	the convergence of coming of positive terms	Coa		Indon	tond	ina					
olternating serie	and nower series using tests of convergence	Cog	'	Under	stand	mg					
CO4: Find t	s, and power series using tests of convergence	Cog		Domor	nhari	na					
expansions of t	functions and the extremum of functions and	Cug	1	Kenner	noen	ng					
their application	s										
CO5. Solve the	inear equations of second and higher order	Cog		Annly							
with constant an	d variable coefficients and simultaneous first	005	1	• PP • J							
order differentia	equations and to <i>Apply</i> Method of variation of										
parameters to Sa	<i>lve</i> the differential equation.										
UNIT I MAT	RICES					15					
Eigen values an	l Eigenvectors of a real matrix –Properties of Eig	gen value	es and	l Eiger	n vec	tors					
– Cayley-Hamil	ton theorem (excluding proof) - Similarity trans	formatio	on (Co	oncept	only	y) —					
Orthogonal mat	rix - Orthogonal transformation of a symmetric	matrix	to di	agonal	for	n –					
Reduction of qu	adratic form to Canonical form by Orthogonal tra	nsforma	tion.								
UNIT II GEO	METRICAL APPLICATIONS OF DIFFERE	NTIAL	CAL	CUL	U S	15					
Curvature – Ca	tesian and polar co-ordinates - Centre and radi	ius of cu	ırvatu	ıre – (Circle	e of					
curvature – Invo	lutes and evolutes - Envelopes - Properties of en	velopes	and e	volute	s.						
UNIT III INF	INITE SERIES					15					
Sequences – Co	nvergence of series – General properties – Series	of posit	ive te	erms –	Test	s of					
convergence (C	omparison test, Integral test, Comparison of ratios	and D'	Aleml	bert's	ratio	test					
– Statement of	theorems and problems only) - Alternating series	ies – Se	ries o	of posi	tive	and					
negative terms	- Absolute and conditional convergence - Pow	er Serie	s – C	onverg	gence	e of					
exponential, log	arithmic and Binomial Series (Simple problems o	nly)									
UNIT IV FUN	CTIONS OF SEVERAL VARIABLES					15					
Functions of two	variables – Partial derivatives – Total differentia	ation – T	aylor	's exp	ansic	on –					
Maxima and M	nima – Constrained maxima and minima – Lag	range's]	Multi	plier n	netho	od –					
Jacobian Detern	inants.										

UNIT V ORDINARY DIFFERENTIAL EQUATIONS AND APPLICATIONS

Linear equations of second and higher order with constant and variable coefficients (Euler's and Legendre's equations) – Simultaneous first order linear equations with constant

15

coefficients – Method of variation of parameters - A	Applications to	electrical circuit	problems.
	LECTURE	TUTORIAL	TOTAL
	45	30	75
TEXT			
1. Grewal, B.S. Higher Engineering Mathemat	tics, 40 th Edit	ion, Khanna	
Publication, Delhi, 2007.			
2. Kreyszig, E, Advanced Engineering Mather	natics, Eighth H	Edition, John Wi	ley and
Son(Asia) Ltd, Singapore, 2001.	_		-
REFERENCES			
1. Bali N.P and Narayana lyengar, Engineering	g Mathematics,	Laxmi Publicati	ions
(P) Ltd, New Delhi, 2003.			
2. Veerarajan T, Engineering Mathematics For	urth Edition, Ta	nta – McGraw H	ill
Publishing Company Ltd, New Delhi, 2005			
3. Kandasamy P., Thilagavathy K, and Gunava	athy K, Engine	ering Mathemati	CS
Volume I, II and III, S. Chand & Co, New I	Delhi, 2005.		
4. Venkataraman M. K, Engineering Mathema	tics, Volume I	and II Revised e	nlarge
Fourth Edition, The National Publishing Co	mpany, Chenna	ai, 2004.	
E REFERENCES			
1. <u>www.nptel.ac.in</u>			
Advanced Engineering Mathematics Prof. F	Pratima Panigra	hi	
Department of Mathematics Indian Institute	of Technology	, Kharagpur.	

	PO1	PO2	PO5	PO6	PO8	PO10	PO11	PO12
CO 1	3					1		1
CO 2	3					1		1
CO 3	3	2				1	1	2
CO 4	3	2	1			1	1	1
CO 5	3	2	1			1	1	1
	15	6	2	0	0	5	3	6

1 - Low , 2 – Medium , 3- high

XCP102 COMPUTER PROGRAMMING							P	С		
					3	0	1	4		
С	Р	Α			L	Т	P	Η		
3	1	0			3	0	2	5		
	Leve	l								
CO1	Defi prog	<i>ne</i> pr rams ι	ogramming fundamentals and <i>Solve</i> simple using I/O statements.	Cog Psy	Reme Guide Respo	emember Juided Lesponse				
CO2Define syntax and write simple programs using control structures and arraysCog PsyRe Gu Re							Remember Juided Response			
CO3Explain and write simple programs using functions and pointersCog PsyUr Gu Re							d			
CO4	CO4Explain and write simple programs using structures and unionsCog PsyUn Gu 									
CO5	CO5Explain and write simple programs using files and Build simple projectsCog PsyU G R									
Ι		PROC STAT	GRAMMING FUNDAMENTALS AND INPU YEMENTS	T /OUTPUT	9) + 6				
Theor Progra Token Data 7 Practi 1. 2. 3. 4.	y am – s: Ide Fypes ical Prog Prog Prog	Flowcl ntifiers - Outp ram to ram to ram to <u>ram to</u>	hart – Pseudo code – Software – Introduction s, Keywords, Constants, and Operators – sample out statements – Input statements. display a simple picture using dots. or addition of two numbers swap two numbers o solve any mathematical formula.	to C language	– Cha are -H	eade:	er se r file	xt − ≥s −		
II		CON	FROL STRUCTURE AND ARRAYS		9) + 6				
II CONTROL STRUCTORE AND ARRAYS 9+6 Theory Control Structures – Conditional Control statements: Branching, Looping - Unconditional constructures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declarate – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional array Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings. Practical 1. Program to find greatest of 3 numbers using Branching Statements 2. Program to display divisible numbers between n1 and n2 using Looping Statement 3. Program to remove duplicate element in an array. 4. Program to perform string operations.								trol tion /s - n —		

III	FUNCTIONS AND POINTERS	9+6
Theory		
Functions:	Built in functions - User Defined Functions - Parameter passing meth	ods - 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 - Pointers and structures - Pointers on pointer.

Practical

1. Program to find factorial of a given number using four function types.

- 2. Programs using Recursion
- 3. Programs using Pointers

5. 110	Bruins using <u>romeers</u>	
IV	STRUCTURES AND UNIONS	9 + 6
Theory		

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.

Practical

- 1. Program to read and display student mark sheet Structures with variables
- 2. Program to read and display student marks of a class using Structures with arrays
- 3. Program to create linked list using Structures with pointers

V	FILES	

9+6

Theory

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 for copying contents of one file to another file.
- 2 Program using files using structure with pointer

LECTURE	PRACTICAL	TOTAL
45	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

REFERENCES

Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson 1. Education Inc. (2005).

2. Behrouz A. Forouzan and Richard. F. Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks–Cole Thomson Learning Publications, 2001.

- 3. Johnsonbaugh R. and Kalin M., "Applications Programming in ANSI C", III Edition, Pearson Education India, 2003.
- 4. https://iitbombayx.in/courses/IITBombayX/BMWCS101.1x/2015_T1/courseware

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2							2
CO2	3	2			2					2		
-----	---	---	---	---	---	--	---	--	---	---		
CO3	3	2	1	2	2					2		
CO4	3	2	1	2	2					2		
CO5	3	2	1		2		1		2	2		

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Original	15	10	3	4	10			1			2	10
Scaled to 0,1,2,3 scale	3	2	1	1	2			1			1	2

					L	Т	Р	С					
XI	BE 10	3	ELECTRICAL AND ELECTRONICS ENGINEE	RING	3	1	1	5					
			SYSTEMS										
С	Р	Α			L	Τ	Р	Η					
3	1	0			3	2	2	7					
PREREQUISITE: Nil													
COL	JRSE	OU	rcomes:										
			Course Outcomes	Domain			Leve	1					
After	the c	compl	letion of the course, students will be able to										
CO1	: Des	I	ring										
Cons	struct	Psy	I	Mech	anisr	n, Set							
CO2	Cog	J	Jnde	rstan	ding								
CO3	CO3 : Describe semiconductor devices and show the input output Cog												
chara	acteris	stics of	of basic semiconductor devices	Psy	S	Set							
CO4	: <i>Exp</i>	lain I	logic gates and their applications and <i>construct and</i>	Cog	Understanding								
verif	y the	logic	gates and construct simple adders and subtractors	Psy	S	Set	•						
using	g logi	c gate	28.										
CO5	: Des	cribe	microprocessors in detail	Cog	I	Reme	ember	ring					
							10 +	9 +					
Unit	- 1	FU	NDAMENTAL OF DC AND AC CIRCUITS, MEA	SUREMEN	NTS		20)					
Funda	menta	ls of	DC- Ohm's Law - Kirchoff's Laws - Sources - Vo	Itage and C	Curre	nt re	latio	ns –					
Star/D	elta T	ransf	Formation - Fundamentals of AC – Average Value, RM	AS Value, I	Form	Fac	tor -	AC					
power	and	Powe	r Factor, Phasor Representation of sinusoidal quantit	ies - Simpl	le Se	eries,	Para	allel,					
Series	Para	llel	Circuit - Operating Principles of Moving coil an	d Moving	Iror	n Ins	strum	ents					
(Amm	eter, '	Voltn	neter) and Dynamometer type meters (Watt meter and I	Energy meter	er).								
Unit	- 2	EL	ECTRICAL MACHINES				8+	9					
Constr	uction	n, Pri	nciple of Operation, Basic Equations, Types and Appli	ication of D	C G	enera	ators,	DC					
motors	- Ba	sics o	of Single Phase Induction Motor and Three Phase Ind	luction Mot	or -	Con	struct	tion,					
Princip	ole of	Oper	ation of Single Phase Transformer, Three phase transfo	ormers, Aut	o tra	nsfoi	mer.						
Unit	- 3	SE	MICONDUCTOR DEVICES			9	9 + 3	+ 5					
Classif	icatio	on of	Semiconductors, Construction, Operation and Charact	eristics: PN	Jun	ction	Dio	de –					
Zener	Diod	e, PN	NP, NPN Transistors, Field Effect Transistors and S	ilicon Cont	rolle	d Ro	ectifi	er –					
Applic	ation	s											
T Incit	4	DIC				0	. (. 5					

Unit- 4	DIGITAL ELECTRONICS	9 + 6 + 5										
Basic of C	Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, S	Subractors,										
multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.												
Unit- 5	MICROPROCESSORS	9 + 3										

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

- 1. Study of Electrical Symbols, Tools and Safety Precautions, Signal Generators, Power Supplies and Voltage Regulators.
- 2. Study of Active and Passive Elements Resistors, Inductors and Capacitors, Bread Board and Printed Circuit Board.
- 3. Verification of AC Voltage, Current and Power in Series connection and Parallel connection.
- 4. Fluorescent lamp connection with choke.
- 5. Staircase Wiring.
- 6. Calibration of Ammeter, Voltmeter, Wattmeter, Energy meter, Multimeter and Lux meter.
- 7. Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
- 8. Measuring input signal magnitude and frequency by using Cathode Ray Oscilloscope.
- 9. Forward and Reverse bias characteristics of PN junction diode and Zener diode.
- 10. Input and Output Characteristics of NPN transistor.
- 11. Verification of Truth Tables of Logic Gates.
- 12. Construction and verification of simple adders and subtractors.

Lecture = 45; Tutorial = 30; Lab = 30; Total = 105 Hours

TEXT BOOKS:

ILAI	books.									
1	Mittle, V. N., 2007. Basic Electrical and Electronics Engineering. 1st ed. New Delhi: Tata									
1.	McGraw-Hill.									
2.	Malvino, A. P., 2006. Electronics Principles. 7th ed. New Delhi: Tata McGraw-Hill.									
3.	Rajakamal, 2007. Digital System-Principle & Design. 2 nd ed. Pearson education.									
4.	Moris Mano, 1999. Digital Design. Prentice Hall of India.									
5	Ramesh, S. Gaonkar, 2013. Microprocessor Architecture, Programming and its									
5.	Applications with the 8085. 6 th ed. India: Penram International Publications.									
REFE	RENCE BOOKS:									
1.	Corton, H., 2004. Electrical Technology. CBS Publishers & Distributors.									
2.	Syed, A. Nasar, 1988. Electrical Circuits. Schaum Outline Series, McGraw-Hill.									
2	Jacob Millman and Christos, C. Halkias, 2010. Electronics Devices and Circuits. 3rd ed.									
э.	New Delhi: McGraw-Hill.									
4	Millman, J. and Halkias, C. C., 2011. Integrated Electronics: Analog and Digital Circuits									
т.	and Systems. 2 nd ed. New Delhi: McGraw-Hill.									
5	Mohammed Rafiquzzaman, 1992. Microprocessors - Theory and Applications: Intel and									
5.	Motorola. Prentice Hall International.									

E-REFERENCES:												
1	NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De,											
1.	Prof. T. K. Bhattacharya and Prof. G. D. Roy, IIT Kharagpur.											
2	http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#,											
2.	Prof. L. Umanand, IISc Bangalore.											
3.	http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura , IIT Madras.											

	http://www.nptelvideos.in/2012/11/basic-electrical-technology.html,	Dr.	L.	Umanand,
4.	IISC Bangalore.			

СО	PO1	PO2	PO3	PO4	PO5	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	-	-	1
CO2	3	2	-	2	1	-	-	-	1
CO3	3	-	-	-	1	1	-	-	1
CO4	3	2	2	2	1	1	-	-	1
CO5	3	-	-	-	1	-	-	-	1
Total	15	6	4	6	5	3			5
Scaling	3	1	1	1	1	1			1

XI	BT 10	94	APPLIED PHYSICS	_	L 3	T 1	P 1	С 5					
С	P	Α			L	Т	Р	Η					
2.8	0.8	0.4			3	2	2	7					
PRE	PREREQUISITE: Nil												
		Domain		Ι	Jeve	1							
After	the c	omple	tion of the course, students will be able to										
CO1:	Iden	tify t	he basics of mechanics, explain the principles of	Cog	Re	emei	nber	ring					
elasti	city,	viscos	ity and <i>determine</i> its significance in engineering	Psy	Uı	nder	stand	ding					
system	ms an	d tech	nological advances.		Μ	n							
CO2:	Desc	ribe	he production, propagation, perception & analysis	Cog	Re	emer	nber	ring					
of ac	oustic	al wa	ve and <i>locate</i> basic acoustical problem encountered	Aff	Uı	ding							
in co	nstruc	ted bu	ildings.		Receiving								
CO3	: Un	dersta	<i>und</i> the fundamental phenomena in optics by	Cog	Uı	ding,							
meas	surem	<i>ient</i> a	nd <i>describe</i> the working principle and <i>application</i>	Psy	A	pply	ing,						
of va	arious	lasers	and fibre optics.	Aff	Μ	echa	inisn	n					
			1		Re	eceiv	ving						
CO4	Ana	lyse di	fferent crystal structures, <i>discuss</i> and <i>use</i> physics	Cog	Uı	nder	stand	ding,					
princi	iples (of late	st technology by <i>visualizing</i>	Psy	Aı	naly	zing	,					
				Aff	Μ	echa	inisn	n					
					Re	eceiv	/ing						
CO5	Deve	elop K	nowledge on engineering materials, its properties	Cog	Understanding,								
and <i>a</i>	and <i>application</i>												
UNI	Γ - Ι	ME	CHANICS AND PROPERTIES OF MATTER			9-	+6+1	12					

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 - I shape girders.

Viscosity: Coefficient of viscosity - Laminar flow - streamline flow - turbulent flow - Reynold's number - Poiseuille's method.

UNIT - II ACOUSTICS, ULTRASONICS AND SHOCK WAVES

9+6

Acoustics: Classification of sound - Characteristics of musical sound - Loudness - Weber

Fechner law - Decibel - Absorption coefficient - Reverberation - Reverberation time - Sabin's formula (growth and decay) - Factors affecting acoustics of buildings (reverberation time, loudness, focussing, echo, echelon effect - resonance and noise) and their remedies.

Ultrasonics: Production: Magnetostriction and Piezoelectric methods - NDT: Ultrasonic flaw detector.

Shock waves: Definition of Mach number - Description of a shock wave - Characteristics - Methods of creating shock waves.

UNIT – III **OPTICS. LASERS AND FIBRE OPTICS**

9+6+12

9+6+6

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 - CO2 laser -Semiconductor Laser (homojunction) - Applications

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

UNIT –IV SOLID STATE PHYSICS

Crystal Physics: Lattice - Unit cell - Lattice planes - Bravais lattice - Miller indices - Sketching a plane in a cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - Packing density for SC, BCC, FCC and HCP structures.

Semiconductors: Semiconductor properties - Types of semiconductor - Intrinsic - Extrinsic: P-type and N-type semiconductor - PN junction diode - Biasing - Junction diode characteristics. 9+6

UNIT –V NOVEL ENGINEERING MATERIALS AND BIOMETRICS

Novel Engineering Materials: Introduction - Metallic glasses: Melt spinning technique, properties, applications - Shape Memory Alloys: Transformation temperature, working of SMA, characteristics - Biomaterials: Properties, interaction of biomaterials with tissues, applications - Nano phase materials: Production, properties and applications.

Biometrics: Introduction - definition - instrumentation - devices -advantages

TEXT BOOKS

- 1. Avadhanulu M. N. and Kshirsagar P. G., "A Text Book of Engineering Physics", 7th Enlarged Revised Edition., S. Chand & Company Ltd., New Delhi, 2005.
- 2. Senthil Kumar G., "Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2003.
- 3. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2005.
- 4. Prabu P. and Gayathri P., " Applied Physics", PMU Press, Thanjavur, 2013

REFERENCE BOOKS

- 1. Gaur R.K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publishers, New Delhi, 2001.
- 2. Pillai S.O., "Solid State Physics", 5th Edition, New Age International Publication, New Delhi,2003.

E RESOURCES

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

			LABORATORY								
1.	Torsional I material of	Pendulum - determinat the wire.	tion of moment of ine	ertia and rigidity n	nodulus of the given						
2.	Uniform B	ending - Determinatio	on of the Young's Mo	dulus of the materi	al of the beam.						
3.	Non-Unifo	rm Bending - Determi	ination of the Young	's Modulus of the n	naterial of the beam.						
4.	. Poiseuille's flow - Determination of coefficient of viscosity of the given liquid.										
5.	5. Spectrometer - Determination of dispersive power of the give prism.										
6.	6. Spectrometer - Determination of wavelength of various colours in Hg source using grating.										
7.	Air wedge	- Determination of thi	ckness of a given thi	n wire.							
8.	Laser - De	termination of waveler	ngth of given laser so	ource and size of th	e given micro particle						
	using Lase	r grating.									
9.	Post office	Box - Determination	of band gap of a give	en semiconductor.							
10.	PN Junctio	on Diode - Determinati	ion of V-I characteris	stics of the given di	ode.						
REFE	ERENCE B	OOKS									
1.	Srinivasan	M. & others, "A text	book of Practical Phy	ysics", Sultan Chan	d & Sons, 2001.						
2.	Shukla R.I	K., "Practical Physics"	, New Age Internatio	onal Publication, N	ew Delhi, 2011.						
3.	Umayal Su	undari AR., "Applied I	Physics Laboratory N	Ianual", PMU Pres	s, Thanjavur, 2012.						
		LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS						
		45	30	30	105						

	PO1	PO 2	PO 3	PO 4	PO 5	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	1	1	-	-	1
CO2	3		1		1		-	-	1
CO3	3	2	2	2	1	1	-	-	1
CO4	3	2	2	2	1	1	-	-	1
CO5	3		2				-	-	1
Total	15	6	9	6	4	3			5

1 - Low, 2 – Medium, 3 – High

_	~~~								L	Τ	P	SS	C		
X	GS1	05	CTUD	1 7 (1711 1			E L A D		1	0	0	2	1		
C	D	•	STUD	Y SKILL	LS AND L	ANGUAG	E LAB		Т	т	D	CC	п		
1.4	0.0	6 0.4							<u>L</u> 1	0	1 0	2	3		
	1		Cour	rse Outco	omes			D	oma	in		Level			
CO1	: Ide	ntify o	fferent strategie	es of readi	ing and wr	iting skills.			Cog		Rer	nembering			
CO2	:Re	<i>vise</i> th	library skills in	n their lear	rning proc	ess.			Aff		Inti	mation			
CO3: <i>Apply</i> different techniques to various types of material such as a Cog App novel, newspaper, poem, drama and other reading papers.											olying	,			
CO4	: Us	e visua	aids to support	verbal ma	atters into	language d	iscourse.		Cog		Uno	lerstar	nding,		
CO5	: Pro	pares	o face the writte	en exam v	with confid	lence and w	vithout any		Cog		Unc	derstar	nding,		
fear o	or te	nsion.					2		Psy		Gui	ded	U,		
									•		resp	onse			
												HOURS			
Ι		INTR	DUCTION TO	O STUDY	Y SKILLS	5;						5			
	Learning Skills and Strategies of Learning; Cognitive Study skills and physical														
study skills, Library skills (How to use Library), familiarization of library facilities															
	study skills, Library skills (How to use Library), familiarization of library facilities by the librarian; familiarization of basic cataloguing techniques, how to ransack														
		the lib	ary etc.												
Π		REFE	RENCE SKILI	LS,					_				5		
		How t	use the library	facilities 1	for researc	h and to w	rite assignn	nents	; hov	v to i	find				
		diction	ary and thesauru	ucies, jou	imais and (other e- lea	rning mater	iais;	now	to us	se a				
III		REAI	ING RELATE	D STUDY	Y SKILLS	5							5		
		Proces	of reading, var	ious types	s of readin	g materials	and varied	readi	ing						
		techni	ues; familiariza	tion to ma	aterials wri	itten by var	ious author	s; fea	tures	s of					
		scienti	ic writing and fa	amiliariza	ation to sci	entific writ	ing by reno	wned	l autl	nors;					
		note n	aking skills												
IV	IV WRITING RELATED STUDY SKILLS										5				
		Proces	of writing, cha	racteristic	es of writin	ng, discours	e analysis,	use o	f vis	ual a	ids,				
	and note making and note taking skills														
V		EXAN	PREPARATI	ON SKII	LLS;								5		
		Anxie	y reduction skil	ls; familia	arization w	vith various	types of ex	am/e	evalu	ation					
		techni	ues etc.												

LANGUAGE LAB (Practical)	
SOUNDS OF ENGLISH LANGUAGE;	5
Vvowels, consonants, diphthongs, word stress, sentence stress, intonation patterns,	

connected speech etc						
VOCABULARY BUILDING	5					
Grammar, synonyms and antonyms, word roots, one-word substitutes, prefixes						
and suffixes, idioms and phrases.						
READING COMPREHENSION						
Rreading for facts, meanings from context, scanning, skimming, inferring						
meaning, and critical reading. Active listening, listening for comprehension etc.						
Lab = 20 hrsSelf Study -25 hrsTotal:45	Hrs					
Text books						
Appropriate Chapters/Units from the following textbooks						
1. V.R. Narayanaswamy ,Strengthen Your Writing Orient Longman, 2000						
2. Ghosh, R N; Inthira, S R, A Course in written English: Oxford Univ Press,	New Delhi,					
2001						
3. Jaya Sasikumar, Champa Tickoo, Writing With A Purpose, Published	by <u>Oxford</u>					
University Press, 2000						
4. Freeman, Sarah: Study Strategies. New Deini: Oxford University Press, 1979	, L (1 - 2000					
5. Paul Gunasnekar M.L. Tickoo, Reading for Meaning, S. Chand & Company	Ltd., 2000					
7 Bernard Hartley Peter Viney, Streamline English: Departures, Oxford Engli 7 Bernard Hartley Peter Viney Streamline English: Destinations Oxford	1.511, 1.990.					
University Press 1992	I. OXIOIU					
8. Bernard Hartley, Peter Viney, Streamline English Directions, Oxford Univ	ersity Press					
1982.	5					
References						
1. Jaya Sasikumar, Champa Tickoo, Writing With A Purpose, Oxford University	ersity Press					
2001.						
Freeman, Sarah: Study Strategies. New Delhi: Oxford University Press, 1979).					
2. Reading for Meaning, Paul Gunashekar M.L. Tickoo, Published by S	. Chand &					
Company Ltd. Sultan Chand & Company, 2000	T 4					
3. Susan Fawcett Evergreen: A Guide to Writing with Readings Paperback –	January 4,					
2013.						

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										2		
CO2										2		
CO3				2						1		
CO4												1
CO5				2						1	2	1
Total				4						6	2	2

XUN	A 10	I 106 HUMAN ETHICS, VALUES, RIGHTS AND L T P		Р	С				
			GENDER EQUALITY		4	0	0		
C	Б				<u> </u>	U	U	1	
	P	A				1	P	Н	
1.8	1.8 0 0.2 1+2*55 0						0	3	
			D	omain	L	/evel			
CO1	: Rel	ate and	<i>Interpret</i> the human ethics and human		Cog	Remer	nberi	ng	
relati	ionsh	ips				Unders	stand	ing	
CO2	: Exp	olain ai	nd <i>Apply</i> gender issues, equality and		Cog	Unders	stand	ing,	
viole	ence a	igainst	women			Applying,			
CO	3: Cla	assify a	nd <i>Develop</i> the identify of human rights and		Cog	Analyzing,			
their	viola	tions			Aff	Receiv	ing		
CO4	: Cla	ssifv a	nd Dissect necessity of human rights and		Cog	Unders	stand	ing.	
repor	rt on	violatio	ons.		8	Analyz	zing.	0'	
CO5	: Lis	t and re	espond to family values, universal		Cog	Remer	nberi	ng.	
broth	erho	nd fiol	at against corruption by common man and		Aff	Respon	ndino	B, r	
good		ernance	s		7 111	Respon	laine	»	
	<u>т</u> т		AN ETHICS AND VALUES					7	
Hum	an F	thics a	nd values - Understanding of oneself and oth	erc_	motives	and need	1e- 9	/ ocial	
servi	ce. S	unes a Social	Justice Dignity and worth Harmony in hu	mar	relations	shin: Fa	milv	and	
Soci	etv. I	ntegrity	v and Competence. Caring and Sharing. Hones	tv a	nd Couras	ze. Valu	ing T	ime.	
Co-o	perat	tion, C	Commitment, Sympathy and Empathy, Self-	-resp	bect, Self	-Confid	ence	and	
Perso	onalit	y- Livi	ng in harmony at various levels.						
UNI	TII	GEND	ER EQUALITY					9	
Geno	ler I	Equality	y - Gender Vs Sex -, Concepts, definiti	on,	Gender	equity,	equ	ality,	
empo	oweri	nent. S	tatus of Women in India Social, Economical, E	lduc	ation, Hea	lth, Em	ployr	nent,	
HDI	, GDI	I, GEM	. Contributions of Dr. B.R. Ambethkar, Thanth	ai P	eriyar and	l Phule t	o Wo	omen	
Emp	ower	ment.							
UNI	<u>T III</u>	WOM	IEN ISSUES AND CHALLENGES	• 1	T 7' 1	• ,		9	
Won	nen Is	ssues a	nd Challenges- Female Infanticide, Female fetic	cide	, Violence	against	won	ien,	
Dom Moa		Acts	related to women: Political Right Property Pic	rhte	Pight to	mage. r Educativ	ceme	ulai	
Med	Medical Termination of Programmy Act, and Dovery Prohibition Act								
Medical Termination of Fregnancy Act, and Dowry Fromotion Act.									
UNI	UNIT IV HUMAN RIGHTS							9	
Hum	Human Rights Movement in India – The preamble to the Constitution of India, Human Right						ghts		
and l	Dutie	s, Univ	rersal Declaration of Human Rights (UDHR), C	livil	, Political,	Econor	nical,	,	
Soci	al and	d Cultu	ral Rights, Rights against torture, Discriminatio	on ar	nd forced	Labour,	Righ	ts of	
Child	dren.	Nation	al Human Rights Commission and other statute	ory (Commission	ons, Cre	ation	of	
Hum	an R	ights L	iteracy and Awareness Intellectual Property I	kigh	ts (IPR). I	National	Poli	су	
on o	on occupational safety, occupational health and working environment.								

UNIT V GOOD GOVERNANCE AND ADDRESSING SOCIAL ISSUES				
Good Governance - Democracy, People's Participation, Open and Transparence governance,				
Corruption, Impact of corruption on society, on how and whom to make corruption complaints,				
fight against corruption and related issues and c	haracter buildir	ng, Fairness in cri	minal justice	
administration, Government system of Redres	sal. Issues and	intervention in	situations of	
family violence, substance abuse and corruption	. Creation of Pe	ople friendly envi	ronment and	
universal brotherhood.	1			
	LECTURE	SELF STUDY	TOTAL	
	15	30	45	
REFERENCES				
1. Aftab A, (Ed.), Human Rights in Indi	a: Issues and	Challenges, (New	v Delhi: Raj	
Publications, 2012).				
2. Bajwa, G.S. and Bajwa, D.K. Human R	ights in India: I	mplementation an	d Violations	
(New Delhi: D.K. Publications, 1996).				
3. Chatrath, K. J. S., (ed.), Education for H	uman Rights and	d Democracy (Shi	imala: Indian	
Institute of Advanced Studies, 1998).				
4. Jagadeesan. P. Marriage and Social legi	slations in Tam	il Nadu, Chennai	: Elachiapen	
Publications, 1990).				
5. Kaushal, Rachna, Women and Human 2000)	Rights in India	i (New Delhi: Ka	averi Books,	
6. Mani. V. S., Human Rights in India: An Congress on Human Rights, 1998).	Overview (New	Delhi: Institute f	or the World	
7. Singh, B. P. Sehgal, (ed) Human Right	s in India: Pro	blems and Perspe	ectives (New	
Delhi: Deep and Deep, 1999).		Ĩ	× ×	
8. Veeramani, K. (ed) Periyar on Women R	ight, (Chennai:	Emerald Publishe	rs, 1996)	
9. Veeramani, K. (ed) Periyar Feminism	, (Periyar Ma	niammai Univers	ity, Vallam,	
Thanjavur: 2010).				
11.Planning Commission report or	Occupation	al Health a	nd Safety	
http://planningcommission.nic.in/aboutus/committee/wrkgrp12/wg_occup_safety.p				
11. Central Vigilance Commission (Gov. of I	ndia) website: <u>h</u>	ttp://cvc.nic.in/we	elcome.html.	

	PO6	PO7	PO8	PO9	PO10	Total	Scaled total
CO1	2	2	2	2	2	10	2
CO2	1				1	2	1
CO3	3	3	3	3	3	15	3
CO4			2	2	0	4	1
CO5			2	2	1	5	1
	6	5	9	9	7		

XMA 201CALCULUSAND LAPLACE TRANSFORMSLTP						Р	С	
					3	1	0	4
С	Р	Α						
3	0	0			L	Т	Р	Η
					3	2	0	5
PREREQUISITE: Basic concepts of Differentiation, Integration, Vectors and Complex						lex		
num	bers.							
COURSE OUTCOMES:								
Cou	irse ou	tcomes	3	Domai	n 🛛	Level		
CO	l: Mak	e Use	of standard results to Find the Laplace	Cog		Remer	nberi	ng
tran	sforms	of deri	vatives and integrals and to solve differential			Apply		
equa	ations.	1.1	1	0			1 .	
CO.	2: Apply	multip	the order of integration	Cog		Kemer Apply	nberi	ng
	R. Defi	<i>ne</i> the	gradient divergent curl of vectors Find	Cog		Remer	nheri	nσ
dire	ctional	derivat	tive. unit vector normal to the surface. Apply	COS		Apply	noen	115
corr	espond	ing the	orems to <i>Find</i> the line, surface and Volume			rr J		
inte	grals.	•						
CO4	4: Con	struct	and examine the analytic functions, and the	Cog		Unders	stand	ing
com	plex C	onjuga	te and to <i>Explain</i> the concept of conformal			Apply		
map	ping a	nd to C	onstruct the bilinear transformation.					
CO	5: Expl	<i>ain</i> the	poles, singularities and residues of functions	Cog	-	Unders	stand	ing
and	to <i>solv</i>	e the p	roblems using contour integration.			Apply		
UNI	ΤΙ Ι	LAPLA	ACE TRANSFORMS					15
Trai	nsforms	s of ele	ementary functions – properties – derivatives a	nd inte	grals	of trai	nsfor	ms-
Trai	nsforms	s of de	erivatives and integrals - Transforms of unit	step fu	nctio	n and	imp	ulse
func	ction -	Transf	orm of periodic functions – Convolution Theor	em – I	nvers	e trans	sform	1s —
Solı	utions c	f diffe	rential and integral equations.					
UNI	TII	MULT	IPLE INTEGRALS					15
Dou	ble int	egratio	n – Cartesian and polar coordinates – change of	order	of int	egratio	on - a	area
as a	double	e integ	ral – change of variables between Cartesian and	d polar	coor	dinates	s - tr	iple
inte	gration	Sim	ple applications (Finding area & volume of a cert	ain reg	ion).			1
UNI	T III	VEC'	TOR CALCULUS	1 4				15
Gra	ulent, d	ivergei	$\frac{1}{1}$	i tangel		a giver	i suri	ace
-ar	- angle between two surfaces – irrotational and solenoidal vector fields - Line, Surface and							
VOI	Volume Integral – Green's theorem in a plane, Gauss divergence theorem and Stoke's							
theorem (excluding proof).						15		
UNIT IV ANALYTIC FUNCTIONS						15 tion		
(exc	luding	proof)	- Cauchy Riemann equations – properties of an	alytic f	unctio	ons - h	armo	onic
conj	ugate -	constr	ruction of an analytic function – Conformal mapp	oing: w	= z +	c, cz,	$\frac{1}{z}$, s	inz,
cosł	nz, $_{z+\frac{h}{2}}$	$\frac{z^2}{z}$ - Bil	inear transformation.					
		-						

Statement and application of Cauchy's integral theorem and integral formula - Taylor's and Laurent's expansion - Residues – Cauchy's Residue Theorem - Contour integration over unit circle. LECTURE TUTORIAL TOTAL 45 30 75 TEXT 1. Grewal, B.S. Higher Engineering Mathematics, 41 st Edition, Khanna Publication, Delhi, 2011. 2. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. REFERENCES 1. Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Ceerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. 3. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005.	UNIT	V COMPLEX INTEGRATION			15		
Laurent's expansion - Residues – Cauchy's Residue Theorem - Contour integration over unit circle. LECTURE TUTORIAL TOTAL 45 30 75 TEXT 1. Grewal, B.S. Higher Engineering Mathematics, 41 st Edition, Khanna Publication, Delhi, 2011. 2. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. solution REFERENCES I. Bali N.P and Narayana Iyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. c 2. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. solution, Tata – McGraw Hill 3. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005.	Staten	Statement and application of Cauchy's integral theorem and integral formula - Taylor's and					
 circle. LECTURE TUTORIAL TOTAL 45 30 75 TEXT Grewal, B.S. Higher Engineering Mathematics, 41st Edition, Khanna Publication, Delhi, 2011. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 	Laurer	t's expansion - Residues – Cauchy's Residue	e Theorem - C	ontour integrati	on over unit		
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 TEXT Grewal, B.S. Higher Engineering Mathematics, 41st Edition, Khanna Publication, Delhi, 2011. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 			45	30	75		
 Grewal, B.S. Higher Engineering Mathematics, 41st Edition, Khanna Publication, Delhi, 2011. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 	TEXT						
 Delhi, 2011. 2. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 	1.	Grewal, B.S. Higher Engineering Mathemati	ics, 41 st Editi	on, Khanna Pub	lication,		
 Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001. REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 		Delhi, 2011.					
 Son(Asia) Ltd, Singapore, 2001. REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 	2.	Kreyszig, E, Advanced Engineering Mathem	natics, Eighth l	Edition, John W	iley and		
 REFERENCES Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 		Son(Asia) Ltd, Singapore, 2001.	-				
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 Ltd, New Delhi, 2003. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 	1.	Bali N.P and Narayana lyengar, Engineering	Mathematics,	, Laxmi Publicat	tions (P)		
 Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005. 		Ltd, New Delhi, 2003.					
Publishing Company Ltd, New Delhi, 2005.3. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005.	2.	Veerarajan T, Engineering Mathematics Fou	rth Edition, Ta	ata – McGraw H	lill		
3. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005.		Publishing Company Ltd, New Delhi, 2005.					
I, II and III, S. Chand & Co, New Delhi, 2005.	3.	Kandasamy P., Thilagavathy K, and Gunava	thy K, Engine	ering Mathemat	ics Volume		
		I, II and III, S. Chand & Co, New Delhi, 200)5.	C			
4. Venkataraman M. K, Engineering Mathematics, Volume I and II Revised enlarge	4.	4. Venkataraman M. K. Engineering Mathematics. Volume I and II Revised enlarge					
Fourth Edition, The National Publishing Company, Chennai, 2004.							
E REFERENCES	E REI	FERENCES					
1. www.nptel.ac.in	1	www.nptel.ac.in					
Advanced Engineering Mathematics Prof Litendra Kumar Department of		Advanced Engineering Mathematics	Prof litendro	Kumar Dar	artment of		

Mathematics Indian Institute of Technology, Kharagpur

	PO1	PO2	PO4	PO5	PO9	PO10	PO11	PO12
CO 1	3							1
CO 2	3							1
CO 3	3	2				1	1	2
CO 4	3	2		1		1	1	1
CO 5	3	2		1		1	1	1
	15	6	0	2	0	3	3	6

1 - Low , 2 – Medium , 3- high

XEM	202		ENGINEERING MECHANICS		L	Т	Р	С	
		-1			3	1	0	4	
C	P	Α							
2.6	0.2	0.2			L	Т	P	Η	
						2	0	5	
PREF	PREREQUISITE: Applied physics								
COU	RSE O	UTCO	MES:	·					
Cours	se outc	omes		Domai	n	Level			
CO1: I	ldentify	v and cl	noose various types of loading and support	Cog		Under	stand	ing	
	tions u taaly n	at act	mathematical physical and engineering	Cog		Apply			
mecha	anics pr	inciples	s to the system to predict the problem.	Cog		Apply			
CO3:	Display	and A	<i>pply</i> knowledge on the concepts of centroid	Cog		Apply			
and m	oment	of inert	ia of various sections and solids.	Aff		Develo	opme	nt	
CO4: 4	Analyz	e and M	<i>lodel</i> the problem using free-body diagrams	Cog		Analyz	ze		
and ac	ccurate	equilib	rium equations and finding the solution.	Psy		Model			
CO5: <i>I</i>	Develop	concep	ots of friction, rigid body kinematics and	Cog		Create			
dynan	nics wi	ith an o	emphasis on the modeling and analysis						
and so	olving s	imple d	ynamic problems involving kinematics and						
mome	entum								
COU	RSE C	ONTE	NT						
` UNI	T-I	BASIC	S AND STATICS OF PARTICLES			15 hr	S		
Introd	luction	- Units	and Dimensions - Laws of Mechanics -Cop	olanar ar	nd	Non	copla	anar	
Force	s - Re	solution	and Composition of forces - Equilibrium	n of a p	oartic	ele - E	quiva	lent	
system	ns of fo	orces - F	rinciple of transmissibility – single equivaler	nt force.					
UNIT	I–II	EQUII	LIBRIUM OF RIGID BODIES			15 hr	S		
Free	body o	diagram	- Types of supports and their reaction	s - req	uirer	nents	of st	able	
equili	brium -	- Equili	brium of Rigid bodies in two dimensions - E	Quilibriu	ım o	f rigid	bodie	es in	
three	three dimensions.								
UNIT	UNIT-IIIPROPERTIES OF SURFACES AND SOLIDS15 hrs								
Deter	minatio	n of A	reas and Volumes - First moment of area ar	nd the co	entro	oid - se	cond	and	
produ	product moments of plane area - Parallel axis theorem and Perpendicular axis theorem - Polar								
mome	ent of ir	nertia –	Mass moment of inertia - relation to area more	ment of i	inert	ia.			
L									

UNIT -IV	DYNAMICS OF PARTICLES	15 hrs
Displacemen	nt, Velocity and Acceleration - their relationships - I	Relative motion - Curvilinear
motion - Ne	ewton's Law - Work Energy Equation of particles	- Impulse and Momentum -

Impact of el	Impact of elastic bodies.					
UNIT V	ELEMENTS OF RIGID BODY DYNAMICS AND FRICTION 15 hrs					
Translation	and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion -					
Moment of I	Momentum Equations - Rotation of rigid Body - Work energy equation. Frictional					
Force - Lav	vs of Coulomb friction - Simple Contact friction - Rolling Resistance - Belt					
Friction.						
	L=45 hrs T -30 hrs					
Text books						
1. D.S.	Kumar "A text book of Engineering Mechanics" Publishers S.K.Kataria and Sons					
, 201	2					
2. R.S.	Khurmi "A Textbook of Engineering Mechanics", S. Chand Publishers, 2011					
3. Engi 2015	neering Mechanics: Statics (14th Edition) by <u>Russell C. Hibbeler</u> , Best Sellers,					
4. Engi	neering Mechanics: Dynamics (14th Edition) by Russell C. Hibbeler, Best					
Selle	ers, 2015					
5. Velu 2012	sami.M.A. "Engineering Mechanics with Vector Approach": S.Chand Publishers,					
6. J. L.	Meriam, L. G. Kraige "Engineering Mechanics: Dynamics", Sixth Edition 2012					
References						
1. Beer	F.P and Johnson E.R., "Vector Mechanics for Engineers – Statics and					
Dyna	amics", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001.					
2. K.V.	Natarajan, "Engineering Mechanics", Dhanalakshmi Publishers, Chennai, 2006.					
3. Char	ndramouli, Engineering Mechanics, PHI Learning Pvt Ltd, 2011					
4. Jaya	kumar and Kumar, Engineering Mechanics, PHI Learning Pvt Ltd, 2013					

Mapping of CO's with PO 's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	3								
CO2		3		2								
CO3									2			
CO4	3	3										1
CO5	3	3										
	8	12	1	5					2			1

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

XBW 203		MECHANICAL AND CIVIL ENGINEER	RING	L	Т	Р	С					
		3	1	1	5							
СР	Α			-	-	-	•					
15 15	0			L	Т	Р	н					
	v			3	2	2	7					
PREREOU	JISIT	: Applied physics		U			-					
COURSE OUTCOMES:												
Course ou	come		Domai	n	Level							
CO1: Define and visualize the working principles of theCogKnowledge												
various boilers, turbines and engines Psy												
CO2: Differentiate and auscultate the measurements by using Cog Comprehension												
various me	rology	instruments	Psy		1							
CO3: Cate	gorise	and palpate the various metal forming,	Cog		Synthe	esis						
joining and	cuttin	g processes	Psy		5							
CO4: Cha	acteri	<i>e and diagnose</i> the quality of the good	Cog		Know	ledge						
Building m	aterial	; and measure linear and angular dimensions	Psy			0						
CO5: Sum	marize	and palpate the components of a	Cog		Evalu	ation						
substructur	es and	super structures.	Psy									
Ι	Basi	cs of Thermal and Energy Systems	-		9+6	+6 hı	S					
Introductio	to M	echanical Engineering – Streams – Thermal De	sion and	d M:	anufact	uring						
Conventior	al and	non conventional sources of energy – Heat en	ergv = N	Aode	es of he	at tra	nsfer					
– Working	princi	bles of Boilers and Turbines – Classification of	IC Eng	ines	-4 str	oke a	and 2					
stroke eng	nes –	Petrol and diesel engines – Performance a	nd heat	bal	ance –	Wo	rking					
principles of	of hvde	steam and nuclear power plants.		041								
Practical:	j	,										
Petrol engi	ne perf	ormance – BHP										
Diesel engi	ne per	ormance – BHP										
Demonstra	ion of	refrigeration and air conditioning units										
II	Fun	lamentals of Machine Elements and Measure	ements		9+6+	-6 hrs	5					
Enginoarin	n moto	rials Machina alamanta fastanara and sun	nort ava	tom		t driv	100					
Tupos Vo	2 mait	ratio and L angth of bolt Goar drives. Types	Volocit		s - Del	t un	ves –					
Types – Ve	² moos	rements Accuracy Precision Errors Me	- velocit	.y Ia instr	uo. umonta	Sc.	مام					
Vernier Ca	iner	Micrometer Slip gauges Spirit level	asunng	msu	umente	5 – SC	aic –					
Practical.	ipei –	wherometer – ship gauges – spirit level.										
Measureme	nts us	ng Vernier Caliner Micrometer Slin gauges an	d Spirit	leve	1							
Demonstra	ion of	transmission system in machines and suspension	n system	1000	automo	hiles						
III	Eler	ents of Manufacturing	n systen		9+6+	-6 hrs						
Manufactur	ing nr	C_{C}	forming	– fc	roino	moul	, dino					
casting - P	incipl	es of metal joining – welding soldering and brack	zing	IC	, <u>, , , , , , , , , , , , , , , , , , </u>	mour	umg,					
Machining – turning drilling milling and grinding – Machining time and material removal												
rate												
Practical:												
Exposure to	o work	shop tools										
Fitting exer	cises:	Square and triangle										
Simple turn	ing an	d drilling										
Demonstra	ion of	welding and mould preparation										
IV	Surv	eying and Construction Materials			9+6+	6 hrs	5					

Surveying: Definition – Survey Instruments – Classification of Survey – Linear and Angular Measurements – Measurement of area – Illustrative Examples.

 $Construction \ Materials: \ Bricks-Stones-Timber-Steel-Cement-Sand-Aggregates-Concrete.$

Practical: Surveying.

V	Components and of Construction of Civil Structures	9+6+6 hrs
Substructure	: Bearing capacity - Types of Foundation - Application -	Requirement of good
foundations.		
Superstructu	re: Brick masonry - Types of bond - Flooring - Beams -	Columns – Lintels –
Roofing – D	oors and windows fittings - Introduction to bridges and dams	s – Building drawing.
Practical: B	uilding drawing, Carpentry, Plumbing.	
	Total Contact hrs (L-45 h	rs & P-30&T-30 hrs)

Text books

- 1. Dr. P.K. Srividhya, P. Pandiyaraj, S. Balamurugan, "Basic Civil and Mechanical Engineering", PMU Publications, Vallam, 2013.
- 2. Dr. B.C.Punmia, Ashok Kumar Jain, "Basic Civil Engineering", Laxmi Publications, New Delhi, 2003.
- 3. Dr. B.C.Punmia, "Surveying Volume I", Laxmi Publications, New Delhi, 2005

References

- 1. Venugopal K., Basic Mechanical Engineering, Anuradha Publications, Kumbakonam, 2007.
- 2. Shanmugam G. and Palanichamy M. S., "Basic Civil and Mechanical Engineering", Tata Mc Graw Hill Publishing Co., New Delhi, 3rd Edition, 2009.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	-	-	-	-	-	-	-	-
CO2	2			2		1	-	-	-	-	-	-
CO3		2			2	-	-	-	-	-	-	-
CO4		3		1		-	-	-	-	-	-	-
CO5	1	1			3	-	-	-	-	-	-	-
Total	5	6	-	5	5	1	-	-	-	-	-	-

Mapping of CO's with PO's:

1 - Low, 2 – Medium, 3 – Hig

XAC	XAC204		APPLIED CHEMISTRY		L	Т	Р	С			
					3	1	1	5			
С	Р	Α			L	Т	Р	Н			
2.8	0.8	0.4			3	2	2	7			
PRE	REQU	ISITE	: Nil								
			Course Outcomes	Domain		Le	evel				
Afte	r the co	mpleti	on of the course, students will be able to								
CO1	: Ident	ify and	l describe the various water quality parameters	Cog	Re	Remembering					
and	Pe	rcept	ion								
usag											
CO2	Un	ders	tandi	ng							
reactions, its applications in redox reactions and calculate the Aff											
different electrochemical processes.											
CO3: Interpret the types of corrosion, use and measure its Cog							ng,				
con	trol by	various	s methods including protective techniques.	Psy	Me	echai	nism				
	Aff					ceivi	ing				
CO ²	O4: <i>Describe</i> , <i>Illustrate</i> and <i>Discuss</i> the generation of energy Cog					men	beri	ng,			
in ba	batteries, nuclear reactors, solar cells, fuel cells and anaerobic Aff					alyz	ing,				
dige	digestion.						Responding				
CO	5: Apply	v and <i>n</i>	<i>neasure</i> the different types of spectral	Cog	Re	men	beri	ng,			
tech	niques f	for qua	ntitative chemical analysis and <i>list</i>	Psy	Ap	Applying,					
nanc	materia	als for	various engineering processes.		Me	Mechanism					
The	ory Pai	t									
Ι	WA	ATER	TECHNOLOGY			7 + 8	8 +9				
Sour	ces and	d types	of water - water quality parameters - BIS and	d ISO specifi	catior	ıs- h	ardn	ess:			
type	s and e	stimati	on of hardness (problems) - alkalinity: types and	estimation (p	oroble	ems)	– bc	oiler			
feed	water	– requ	irements - disadvantages of using hard water i	in boilers – i	ntern	al tr	eatm	ent,			
exte	rnal tre	atment	- demineralization process - desalination using	g reverse osn	nosis	- 0	lome	stic			
wate	er treatn	nent - E	Effluent treatment processes in industries								
II	EI	ECTE	ROCHEMISTRY		8+5 +15						
Basi	c conc	epts o	f conductance – Kohlraush's law and condu	ctometric titr	ration	s —e	lectr	ode			
pote	ntials–	Nerns	t equation: derivation and problems - reverse	sible and irr	evers	ible	cell	s –			
elect	rolytic	and el	ectrochemical cells – emf and its measurements	- types of ele	ectroc	les-r	efere	nce			
elect	rodes -	prima	ry and secondary - glass electrode - determination	n of pH using	g quin	hydı	one	and			
glass	s electro	odes - e	electrochemical series and its applications - Galva	nic cells and c	conce	ntrat	ion c	ells			
- pot	entiom	etric til	rations - redox titrations.				-				
III CORROSION AND PROTECTIVE COATINGS							+3				
Corrosion- causes- types-chemical, electrochemical corrosion (galvanic, diffe							erati	on),			
corrosion in electronic devices, corrosion control - material selection and							l design aspects -				
electrochemical protection – sacrificial anode method and impressed current catho							od.				
Protective coatings: paints- constituents and functions - electroplating of copper and gol								old,			
Elec	Electroless plating - Distinction between electroplating and electroless plating,										
advantages of electroless plating, electroless plating of nickel and copper on PCB.											
	IV F	NERG	Y STORAGE DEVICES AND NUCLEAR EN	ERGY		12 -	+ 7				

IT LIGHTOIDI			LI (LICOI	
Energy storage devices	- Batteries: Types -	primary (dry cell,	alkaline cells) an	nd secondary (lead
acid, Ni-Cd and Lithiun	n ion batteries) - Supe	ercapacitors - Fuel	cells-Hydrogen	-Oxygen fuel cell-

Solar cells .

V

Nuclear energy: nuclear fission and fusion –chain reaction and its characteristics – nuclear energy and calculations (problems) – atom bomb –Nuclear reactor- light water nuclear power plant – breeder reactor- Weapon of mass destruction- nuclear, radiological, chemical and biological weapons. Disarmament - National and International Cooperation- Chemical Weapon Convention (CWC), Peaceful Uses of Chemistry. Bio fuels: biomethanation- anaerobic digestion process, biomass: sources and harness of energy.

SPECTROSCOPY AND NANOCHEMISTRY

9 +6 +3

30 hrs

Electromagnetic spectrum - Lambert law and Beer-Lambert's law (derivation and problems) – molecular spectroscopy -UV- visible spectroscopy: electronic transitions - chromophores and auxochromes – instrumentation (block diagram) - applications – IR spectroscopy: principle – fundamental modes of vibrations – calculations of vibrational frequency – IR spectrophotometer instrumentation (block diagram) – applications of IR spectroscopy.

Nanochemistry - Basics - distinction between molecules, nanoparticles and bulk materials; sizedependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis ; properties and applications of nano materials-Buckminister fullerenes, CNT^S(Single walled carbon nano tubes and Multi-walled carbon tubes)-Graphene- advantages and applications.

LECTURE	TUTORIAL	PRACTICAL	HOURS
45	30	30	105

TEXT BOOKS

- 1. Jain and Jain, "A Text book of Engineering Chemistry", Dhanapatrai Publications, New Delhi, 2011.
- 2. Gadag and NityanandaShetty, "Engineering Chemistry", I.K International publishing House Pvt. Ltd, 2010.

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. P. Atkins, J.D. Paula, "Physical Chemistry", Oxford University Press, 2009.
- 4. S. S. Dara, S. S. Umare, "A Text Book of Engineering Chemistry", S. Chand Publishing, 2011
- 5. C.P. Poole and F.J. Owens, "Introduction to Nanotechnology", , Wiley, New Delhi ,2007.

E Resources - MOOCs:

- 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/

Laboratory Part

- 1. Determination of total hardness, temporary and permanent hardness of water by EDTA method.
- 2. Determination of alkalinity of water sample.
- 3. Determination of chloride content of water sample by Argentometric method.
- 4. Conductometric titration of a strong acid with a strong base.
- 5. Determination of strength of hydrochloric acid by pH metric method.

- 6. Conductometric precipitation titration using barium chloride and sodiumsulphate.
- 7. Determination of strength of iron by potentiometric method using dichromate.
- 8. Potentiometric acid-base titration using quinhydrone electrode.
- 9. Corrosion inhibition efficiency by weight loss method.
- 10. Estimation of iron by colorimetric method.

REFERENCE BOOKS

- 1. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
- 2. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.
- 3. Sirajunnisa.A., Sundaranayagi.S.,Krishna.,Rajangam.R.,Gomathi.S., "Applied Chemistry Lab Manual", Department of Chemistry, PMU Press, Thanjavur, 2016.

E Resources - MOOCs:

1.http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques

2. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011

3.http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3			1	2	1	1	1	2
CO2	2	1	0			1		1	1		1
CO3	3	3	3	2	2	1	2		1	1	1
CO4	3	3	2	2	2	1	2		1	1	1
CO5	2	2	1	1	1	1	1	1	1		1
Total	13	12	9	5	5	5	7	3	5	3	6

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

XEG	205		ENGI	NEERING GRAPHICS		L	Т	P	С
						2	1	0	3
С	Р	Α				L	Т	Р	Н
0.7 5	2	0.25				2	2	0	4
Cour	se C) Jutcom	e		Domain		Le	evel	
	-				(C or P or A)				
GO1		7.1			Cog		App	lyin	ng
		ply the	national	and international standards,	Psy		Guid.	Re	sp.
	0	nsiruci					Responding		
CO2	In	Cog Psv		Understan					
	projections of points, st. lines and planes. Aff								se
Cog								lyin	ng
CO3	Ca	onstruc	t Sketch	and <i>Practice</i> projection of solids in	Psv	(Comp	. 01	vert
	va	rious p	ositions a	and true shape of sectioned solids.	Aff		Re	esp.	
					Car		Respo	ondi	ing din a
COA	In	terpret,	Sketch	and <i>Practice</i> the development of	Cog				ung
0.04	lat	eral s	urfaces	of simple and truncated solids,	Aff		Re	. Ov esn	ven
	in	tersection	on of soli	ds.			Resp	onding	
					Cog		Applying		
CO5	Ca	onstruc	t,sketch	and <i>practice</i> isometric and	Psv	(Comp	. Ov	vert
	pe	rspectiv	ve views	of simple and truncated solids.	Aff		Resp.		
` T	IN	ΙΤΡΟΓ		N EDEE HAND SKETCHING OF		CTC	Respo	ondi	ing
		ONSTI		N, FREE HAND SKETCHING OF			AINI		0+0
Impo	rtan	re of	praphics	in engineering applications – use	of drafting in	strui	nents		BIS
speci	ficat	ions an	d conver	tions as per SP 46-2003.	or unuting in		nonto		210
Picto	rial	represe	ntation c	f engineering objects – representatio	n of three dime	nsio	nal ol	ojeci	ts in
two-c	lime	nsional	media -	need for multiple views - developin	g visualization s	skills	thro	ıgh	free
hand	sket	ching o	f three d	imensional objects.	C				C
Polyg	gons	& cur	ves used	in engineering practice – methods	of construction	- cc	onstru	ctio	on of
const	ructi	$\sin a = dr$	awing of	tangents to the above curves.	cycloldal alld I		uie e	uiv	<u>cs</u> –
II	P	ROJEC	CTION (OF POINTS, LINES AND PLANE S	SURFACES			6	6+6
Gene	ralı	principl	es of o	thographic projection _ first angle	projection – la	VOU	tof	vieu	WS
proie	ction	ns of po	ints, stra	ight lines located in the first quadrant	- determination	of t	rue le	ngth	hs of
lines and their inclinations to the planes of projection – traces – projection of polygonal surface.									faces
and circular lamina inclined to both the planes of projection.									
III	Pl	ROJEC	CTION (OF SOLIDS AND SECTIONS OF S	OLIDS			e	6+6
Proje	ctio	n of sin	nple soli	ds like prism, pyramid, cylinder and	cone when the a	axis	is inc	line	ed to
one p	olane	e of pro	ojection	- change of position & auxiliary pr	ojection method	s –	sectio	onin	g of
above	e sol	ids in	simple v	ertical positions by cutting plane inc	clined to one ref	eren	ice pl	ane	and
perpe	endic	ular to	the othe	r and above solids in inclined positi	on with cutting	plan	es pa	ralle	el to
one r	etere	ence pla	ine – true	shapes of sections.		T	FION	T I Z	6.6
		IV		DEVELOPMENT OF SURFACES	S AND INTERS	DEC	IION		0+0

OF SOLIDS									
Need for development of surfaces - development of lateral surfaces of simple and trunc									
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									
Principles of isometric projection – isometric scale – isometric projections of simple	solids,								
truncated prisms, pyramids, cylinders and cones - principles of perspective projection	ons –								
projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.									
LECTURE: 30 TUTORIAL: 30 TOTA	AL :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									
REFERENCES									
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 Internatio	nal(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 RESOURCES									
1. <u>http://periyarnet/Econtent</u>									
2. http://nptel.ac.in/courses/112103019/									

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO12
CO1	3	2	3	1	1	1
CO2	3	2	1	1	1	1
CO3	3	2	1	1	1	1
CO4	3	2	1	1	1	1
CO5	3	2	1	1	1	1
Total	15	10	7	5	5	5
Scaled	3	2	2	1	1	1

					L	Т	P	SS	С	
X	GS 2	206			1	0	0	0	1	
			SPEECH COMMUNICATION							
С	P	Α			L	Т	Р	SS	Η	
1.6	1	0.4			1	0	0	2	3	
PRE	ERE	QUIS	ITE: Nil							
COU	URS	E OU	TCOMES:							
			Course Outcomes		Doma	in]	Level		
Afte	r the	comp	letion of the course, students will be able to							
COI	l:Id	entify	different styles to various forms of public speaking	5	Cog	5	Reme	ember	ing,	
skill										
CO2	2: U	nderst	and and identify the proper tone of language rec	uired	Cog	5	Unde	rstand	ling,	
in w	ritin	g and	speaking.							
CO3	8: Ad	laptin	g the speech structures and developing the speech		Psy		Adap	tation		
outli	ne									
CO4	1: Al	oility t	o communicate and develop presentation skills		Aff		Resp	ondin	g	
COS	5: Ca	alibra	tes the speaker to face the audience without any an	xiety	Psy		Guid. Resp.			
Ι		Introd	luction to public speaking				9			
		Functi	ons of oral communication; skills and competen	cies n	eeded f	or				
	:	succes	sful speech making; importance of public spe	aking	skills	in				
		everyd	ay life and in the area of business, social, politic	al and	all oth	ner				
тт		places	of group work					0		
11		1 ypes Manus	cript impromptu rememorized and extemporar	eous	sneeche	26.		9		
		analvz	ing the audience and occasion: developing ide	as: fir	iding a	nd				
	1	using s	supporting materials.	,	8					
III	. (Organ	ization of Speech					9		
		Introdu	action, development and conclusion; language u	ised i	n vario	us				
	1	types	of speeches; Adapting the speech structures to	the .	Audienc	e;				
IV		Basic 1	tins					9		
		how to	present a paper/assignment etc: using visual aids	to the	speech	-8.		,		
	1	using l	pody language to communicate		specen	,				
V		Speec	h Anxiety					9		
	Public speaking and speech anxiety, public speaking and critical							-		
listening										
Speech practice (4-6 speeches per student)										
			Lecture	S	elf Stud	l y	Total			
			20 Hours	2	5 Hours	5	45 H	ours		
TEX	КТ									
1	l. <u>C</u>	Gordon	H. Mills Technical Writing –Oxford Press, 1978							
2	2. E	Barun H	K. Mitra, Effective Technical Communication: A g	uide f	or scien	tists	and E	Ingine	ers.	

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										2		
CO2										2		
CO3				2						1		
CO4												1
CO5				2						1	2	1
				4						6	2	2

					L	Т	Р	С
X	BT 2	07	ΙΝΤΡΟΡΙΙΟΤΙΟΝ ΤΟ ΒΙΟΤΕΟΙΙΝΟΙ ΟΟ	X 7	0	0	0	0
			INTRODUCTION TO BIOTECHNOLOG	r Y				
С	P	Α			L	Т	Р	Н
3	0	0			3	0	0	3
PR	ERE	QUIS	SITE: Nil		<u> </u>			
со	URS	E OI	JTCOMES:					
			Course Outcomes	Domain	L]	Leve	l
Aft	er the	com	pletion of the course, students will be able to					
CO	1: R	ecall,	Outline and Discuss the fundamentals of microbial,	Cog	I	Reme	mbe	ring,
plar	nt, an	imal	and food biotechnology and the Laboratory safety	-	τ	Unde	rstan	ding,
and	bioe	thics			(Creat	ing	
CO	2: Cl	τ	Unde	rstan	ding,			
mac	cromo	olecul	les and micromolecules	-	F	Reme	mbe	ring
CO	3: Re	ecall,	Summarize and Experiment with the techniques	Cog	I	Reme	mbe	ring,
invo	olved	in va	rious fields of biotechnology	-	τ	Unde	rstan	ding,
					ŀ	Applying		
CO	4: K	now a	and Relate the current trends in various fields of	Cog	τ	Understanding,		
biot	echn	ology	and Adapt to good laboratory practices		F	Reme	mbe	ring,
					(Creat	ing	
CO	5: Id	entif	y their field of interest and make use of various	Cog	I	Apply	ying	
opp	ortun	ities	available in the biotechnological sector					
UN	IT-I		Overview of Biotechnology				9 hr	s
An	intro	oduct	ion to biotechnology including, History and con	nparison o	of Ol	d &	: Mo	odern
biot	echn	ology	, Molecular biology and Bioethics; Laboratory sa	fety; Introd	ductio	on to	o Va	rious
Bio	techn	ology	y fields – Plant, Animal, Food and Nutraceuticals	, Medical,	, Env	viron	ment	and
Ene	rgy.							
UN	IT –]	Ι	Biomolecules				9 hr	S
An	intr	oduct	ion to Macromolecules – Carbohydrates, Prote	ins, Lipid	ls, N	Jucle	eic a	acids;
Mic	romo	olecul	es - Primary metabolites, Secondary metabolites.	Analysis	and	proc	essin	ig of
bio	noled	cules	and their pertinence to biotechnology.					
UN	IT-II	Ι	Biotechnological Techniques				9 hr	'S
An	intro	oduct	ion to Applications of Animal Cell Culture tech	niques; Pl	ant '	Tissu	le ci	ılture
tech	nniqu	es; M	olecular Biology techniques; Immunological technique	s.				
UN	IT-I	V	Current Research in Biotechnology				9 hr	'S
Res	earch	tool	s and equipments; Good laboratory practices; Emerg	ing trends	in va	riou	s fiel	ds of
biot	echn	ology	v – Agriculture, Industrial, Plant, Animal, Medicine, In	munology	<u>. </u>			

UNIT-V Career Opportunities in Biotechnology						9 hrs	
Opportunities i	n Pharmaceutical	sectors;	Agricultural	sectors;	Food	sectors;	Environmental

sectors; Research opportunities; Career exploration as Entrepreneurs.											
]	LECTURE	TUT	ORIAL	PRACTICAL	TOTAL						
	30		15	0	45						
TEXT	BOOKS:										
1.	C. Ratledge& B. I	Kristiansen, '	Basic Biotechr	ology" 3rd Edn. Cambrid	ge University Press						
	(2008).										
2.	Buchholz, Klaus,	and John Co	llins. Concepts	in biotechnology: history,	science and						
	business. John Wi	iley & Sons,	2014.								
REFE	RENCES:										
1.	Kuby J., "Immuno	ology", W.H.	Freeman & Co	o. (2002).							
2.	Harper's illustrate	d Biochemis	try 28th Edition	, Tata MC Graw hill Publ	iser2009.						
3.	Nicholl "Introdu	ction to Gen	etic Engineeri	ng" Cambridge Low Pr	rice Edition, 2006.						
4.	B.D.Singh Biotec	hnology-,Kal	lyani Publicatio	n							
5.	Guilford-Blake, R	loxanna, and	Debbie Strickla	and. "Guide to Biotechnol	ogy 2008, Basics,						
	Technical Explana	ations, Indust	try Economics,	Ethical Issues, and more.'	' (2016).						
6.	Gupta, Varsha, M	anjistha Seng	gupta, Jaya Pral	kash, and Baishnab Charai	n Tripathy. "Basic						
	and Applied Aspects of Biotechnology." (2016).										
7.	www.vlab.co.in			,							
8.	www.nptel.iitm.ac	c.in									

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	2	0	0	0	0	0	1	0	0	1
CO 2	3	2	0	0	0	0	0	0	0	0	1
CO 3	3	3	0	0	0	0	3	0	0	0	2
CO 4	3	3	0	0	0	0	3	0	0	0	2
CO 5	3	1	0	1	0	0	0	0	0	0	3
	15	11	0	1	0	0	6	1	0	0	9

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

XM	A 3()1	TRANSFORMS AND PARTIAL DIFFERENT	ΓIAL	L	Τ	P	С
			EQUATIONS					
					3	1	0	4
С	Р	Α			L	Τ	P	Η
3	0	0			3	2	0	5
PRE	REC	QUIS	SITE: Algebra , Calculus and Laplace transforms					
Cou	rse o	outco	mes:	Domain	Leve	el		
CO1	: Ex	plair	n and <i>Demonstrate</i> the basic concepts in partial	Cog	Rem	emb	erin	ıg
diffe	renti	al	equations and to <i>solve</i> linear, nonlinear,		Und	ersta	ndi	ng
homogeneous and nonhomogeneous partial Differential								
equations.								
CO2	c:De	mon	strate the basic concept and properties of Fourier	Cog	Rem	emb	erin	ıg
serie	s and	1 to <i>s</i>	tate Parseval's identity and Diritchlet's		Und	ersta	ndi	ng
condition.								
CO3: Solve the standard Partial Differential Equations, arising Cog A								
in engineering Problems, like Wave equation and Heat flow								
equation by Fourier series method.								
CO4	Ex	plair	<i>a</i> and <i>Apply</i> the concept of Fourier transform and	Cog	Understanding			ng
its p	ropei	ties.			App	ly		
COS	5: <i>St</i>	ate a	nd Apply the properties of Z transform and to	Cog	Rem	emb	erin	ıg
Find	the l	Z tra	nsform and inverse Z transform .		App	ly		
UNI	ΤI	Pa	rtial Differential Equations					15
Forn	natio	n of	partial differential equations by elimination of arb	itrary consta	ints a	nd ai	bitr	ary
func	tions	– Sc	olution of standard types of first order partial differ	ential equation	ons –	Lag	rang	ge's
linea	r eq	uatic	on – Linear partial differential equations of sec	cond and hi	gher	orde	er v	vith
cons	tant	coeff	icients.					
UNI	T II	Fo	urier Series					15
Dirio	chlet	's co	nditions – General Fourier series – Odd and ever	functions –	- Half	ran	ge s	sine
serie	s – F	Ialf r	ange cosine series –Parseval's identity – Harmonic	e Analysis.				
UNI	ΤI	IA	Applications of Boundary Value Problems					15
Clas	sifica	ation	of second order quasi linear partial differential	equations –	Solut	ions	of	one
dime	ensio	nal v	vave equation – One dimensional heat equation –	Steady state	e solu	tion	of	two
dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian								
coordinates.								
UNIT IV Fourier Transform 15								
Four	ier i	ntegr	al theorem (without proof) - Fourier transform pa	irs – Fourier	Sine	and	Cos	sine
trans	form	ns – p	properties – Transforms of simple functions – Conv	volution theo	rem -	- Par	sev	al's
iden	identity.							

UNIT V Z – Transform and Difference Equations	15
Z-transform - Elementary properties - Inverse Z - transform - Convolution theorem - Inverse Z	itial

and Final value theorems - Formation of different	ence equations	s – Solution of	difference
equations using Z-transform.			
	LECTURE	TUTORIAL	TOTAL
	45	30	75
TEXT BOOKS			
1. Grewal, B.S., "Higher Engineering Mathe	matics", 40 th I	Edition Khanna	Publishers,
New Delhi, (2007).			
2. Narayanan, S., Manicavachagom Pillay, T.K	K. and Ramania	h, G., "Advance	d
Mathematics for Engineering Students", V	olumes II and I	II, S.Viswanath	an (Printers
and Publishers)Pvt. Ltd. Chennai, (2002).			
REFERENCES			
1. Churchill, R.V. and Brown, J.W., "Fourier S	Series and Bour	ndary Value Pro	blems",
Fourth Edition, McGraw Hill Book Co., Sin	gapore, (1987)		
2. Kandasamy, P., Thilagavathy, K., and Guna	vathy, K., " En	gineering Mathe	ematics
Volume III", S. Chand & Company Ltd., N	lew Delhi, (199	96).	
3. Bali N.P. and Manish Goyal, "A Text Book	of Engineering	g Mathematics"	7 th Edition
Lakshmi Publications (P) Limited, New Del	hi, (2007)		
E REFERENCES			
1. <u>www.nptel.ac.in</u>			
2. Advanced Engineering Mathematics, Prof.	Jitendra Kuma	r,	
Department of Mathematics, Indian Institute	e of Technology	y, Kharagpur.	

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

1 - Low , 2 – Medium , 3- high

V	рт 3	0.2			L 3	T 1	P 0	C
Λ	DIJ	02	PRINCIPLES OF CHEMICAL ENGINEER	RING	3	1	U	4
С	Р	Α			L	Т	Р	H
3	0	0			3	2	0	5
PR	ERE	QUIS	SITE: XAP 104 Applied Physics, XEM 202 Engine	ering Mecha	anics			
CO	URS	ΕΟ	JTCOMES:					
			Course Outcomes	Domain			Leve	1
Afte	$\frac{1}{1}$	com	pletion of the course, students will be able to				1	•
eng	1: Re ineer	ing	and understand basic units and calculations in	Cog	ŀ	Reme	mbei	ing
CO2: Understand and perform material balances for unitCogRespond								
ope	ration	ns in l	bioprocess industries					
CO	3: Aj	oply]	knowledge and aids energy balances in bioprocess	Cog	A	Apply	ying	
CO	4: Di	s sting	uishes the types of fluid and understands the	Cog	T	Inde	rstan	ding
process of mixing							ving	ung
CO5: Know about the heat transfer and design heat transfer Cog						Reme	mbe	ring,
equ	ation							
I INTRODUCTION TO ENGINEERING CALCULATIONS, 12 hrs UNITS AND DIMENSIONS								
Intr	oduct	ion	– Units and dimensions, Fundamental and de	rived quant	ities,	Me	easur	ement
con	venti	ons,	Unit conversions, stoichiometric principles; Basic cl	hemical calc	ulati	ons -	– sol	utions
and	gase	ous n	nixtures, Ideal gas law and its application, Dalton law	, Raoult's lav	w, He	enry	's law	7.
	II		MATERIAL BALANCE WITHOUT CHEMIC	AL	1	2 hr	S	
			REACTION					
Mat	erial	balar	nce without chemical reactions: Process flow sheet, The	hree general	meth	lods	of	
solv	ring r	nateri	al balance problems, Material balance of unit operation	ons like disti	llatio	on co	lumr	ıs,
extr	actor	s, dry	vers, evaporators, crystallizers and leaching equipmen	ts; Recycle,	bypa	ss an	id pu	rge
stre	ams.							
UN	IT-II	Ι	ENERGY BALANCE			12 I	nrs	
The	rmo j	physi	cs: Law of conservation of energy, Heat capacity of s	olids, liquid	s, gas	ses a	nd ga	iseous
mix	tures	, Sen	sible and latent heat, Thermochemistry: Enthalpy cha	nges accomp	banyi	ng b	y che	mical
reac	tions	, star	ndard heat of reaction, formation and combustion, E	Effect of tem	pera	ture	on h	eat of
form	natio	n an	d reaction, Absolute enthalpy, adiabatic reactions	, thermo ch	nemi	stry	of n	nixing
processes.								
UN	IT-IV	V	FLUID FLOW AND MIXING			12 I	nrs	
Clas	ssific	ation	of fluids: Fluids in motion, Viscosity, Momentum	transfer, Ne	ewtoi	nian	and	non –

Newtonian fluids, Viscometers, Mixing: mixing equipments, flow pattern in mixing, Mechanism of mixing, mixing time estimation, Power requirement for mixing, Scaleup of mixing systems, effect of rheological properties on mixing

UNIT-V	HEAT TRANSFER	12 hrs
Introduction –	Heat transfer equipments in bioreactors. Heat exchangers. Me	chanism of heat

transfer – Conduction, Convection and Radiation, Over all heat transfer co efficient and its determination, Design equation for heat transfer system, Application of heat transfer equation.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	15		60
TEXT BOOKS:			

1. Bhatt B.I. and Vora S.M., "Stoichiometry", 4th Edition, Tata McGraw Hill Publishers Ltd., 2005.

Pauline M. Doran, "*Bioprocess Engineering Principles*, 2nd Edition, Academic Press. 2012.
 McCabe W.L., Smith J.C. and Hariott P., "Unit Operation in Chemical Engineering"7th

Edition, Tata McGraw – Hill, 2004.

REFERENCES:

Geankoplis C.J. "Transport Processes and Unit Operation" 4 th Edition, Prentice Hall, 2007.
 Coulson J.M. and Richardson J.F., "Coulson and Richardson's Chemical Engineering" Vol-I 3rd Edition, Butter woth – Heinemann Publishers, 2004.

Mapping Cos Vs Pos:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	1	3	0	2	0	0	0	0	2	1	1
CO 2	1	1	0	3	0	0	0	0	2	0	1
CO 3	1	1	0	3	0	0	0	0	2	0	1
CO 4	1	0	1	1	0	0	0	0	2	1	2
CO 5	1	1	2	3	0	0	0	0	2	0	1
	5	6	3	12	0	0	0	0	10	2	6

XBT 303			INSTRUMENTAL METHODS OF ANALY	L 3	Т 0	P 1	С 4						
С	P	Α		L	Τ	P	Η						
1.5	1	0.5		3	0	2	5						
PRE	PREREQUISITE:												
COURSE OUTCOMES:													
			Course Outcomes	Domain]	Leve	1					
After	r the	e comp	letion of the course, students will be able to										
CO1	:	Explai	<i>n</i> the basic fundamentals of analytical	Cog	ι	Understanding							
		Instrur	I	Precision									
	biomolecules using spectroscopy.												
CO2	:	Know	the principle of instrumentation and to calibrate	Cog	1	Remembering							
		variou	s electrochemical instruments.	Psy	I	Precision							
CO3	:	Under	stand the X-ray diffraction and thermal	Cog	J	Unde	rstan	ding					
		analyti	cal principle and various other instrumentation	Psy	1	Analyzing							
		availał	ble to <i>analyze</i> the sample.										
CO4	:	Descri	I	Remembering									
		variou	I	Responds									
CO5	:	Under	stand the basic principles of chromatography and	Cog	J	Understanding							
		demon	strates the GC-MS, HPLC and other	Psy	I	Precision							
		chrom	atographic methods.										
	Ι		FUNDAMENTALS OF SPECTRAL ANALYSIS		9	9 + 12 hrs							

ELECTROMAGNETIC RADIATION: Regions and properties, Various energy levels, Interaction of photons with matter, absorbance, & amp; transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties. VISIBLE SPECTROSCOPY AND COLORIMETRY: Beer-Lambert's Law, Limitations, Deviations (Real, Chemical and Instrumental deviations) UV-VISIBLE AND IR SPECTROSCOPY: Instrumentation (Source, Optical parts and Detectors) – Various electronic transitions in organic and inorganic compounds effected by UV, Visible and infrared radiations. Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds). Effects of auxochromes and effects of conjugation on the absorption maxima.

Lab 1. Precision and validity in an experiment using absorption spectroscopy.

Lab 2. Absorption spectra for KMnO 4

Lab 3. UV spectra of nucleic acids, protein

Lab4. Sample surface using SEM (practical) and topography measurement using AFM (demonstration with instrument)

II	ELECTROMETRIC ME	THODS		9 + 3 hrs								
Conductometric	Conductometric Titrations: Instrumentation-Types- Advantages-Application: Potentiometric Titrations:											
Londucionietric litrations: instrumentation-1ypes- Advantages-Application; Potentiometric litrations: Instrumentation-Types- Advantages-Application; Measurement of pH: Instrumentation-Applications; Ion												
selective electrodes: Electrode setup- Applications · Amperometric titrations · Principle-instrumentation-												
Applications												
Lab 5. Estimation	n of Chloride using conduc	tivity meter										
III	X-RAY DIFFRACTION	& THERMAL ANALYSIS		9 + 6								
	METHODS			Hrs								
XRD: Introducti	on, Mosley's law, Differe	ent emission and diffraction	methods	s, various X-ray								
detectors. Thern	nogravimetic Analysis (TC	GA): Instrumentation, factor	s affectin	g the shapes of								
thermograms, a	pplications, thermograms	of some important com	pounds	$(CuSO_4, 5H_2O,$								
CaC ₂ O ₄₂ H ₂ O etc	c). Differential thermal an	alysis (DTA) & Different	ial Scanr	ning Calorimetry								
(DSC): Principle	, Instrumentation and app	lications of DSC and DTA,	difference	es between DSC								
and DTA.	, 11											
Lab 6. Analysis of given sample using TGA/DSC (demonstration with the instrument)												
Lab 7. XRD results interpretation (analysis of results available in literature)												
IV	SPECTROSCOPIC M	IETHODS OF ANALYSIS		9 +9 hrs								
 Applications. Flame Photometry and Inductively coupled Plasma Atomic Emission spectroscopy (ICPAES): Principle, Instrumentation and Applications. Polarimetry: Principle, Instrumentation and Applications. Refractometry: Principle, Instrumentation and Applications. Nephlometry/Turbidimetry: Principle, Instrumentation and Applications. Lab 8. Finding the pKa of 4- nitrophenol using Absorption spectroscopy. Lab 9. Raman spectrophotometer analysis of biological samples 												
Lab 10. Electroci	CHROMATOCRAP	HIC METHODS		0 ± 6 hrs								
•				> + U III 5								
Chromatographic	methods - Types (colum	nn, Thin layer, paper, Gas,	High per	rformance liquid								
Chromatographic	methods) – principle- separate	aration technique - separation	of organ	ic compounds by								
column and thin	layer, Amino acids and m	ixture of Cu, Co & Ni by Pa	per, estin	nation of organic								
compounds by G	C and HPLC.		1	U								
Lab 11. Analysis Lab 12. GC, HPI	of amino acids using TLC C- (demonstration)	(experiment) and ethanol using	ng GC (de	emonstration)								
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.

REFERENCES:

- 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.
- Parikh V.M., " Absorption spectroscopy of organic molecules ", Addison Wesley Publishing Company, 1974.

E REFERENCES:

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

	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO o	PO10	PO11	PSO1	PSO
CO 1	3	1	2	2	0	0	0	0	0	3	1	2	2
CO 2	2	3	1	2	1	0	0	0	0	2	2	2	2
CO 3	3	2	3	1	1	0	0	0	0	3	1	2	2
CO 4	2	3	2	1	2	0	0	0	0	2	3	2	2
CO 5	1	0	1	3	2	0	0	0	0	3	3	2	2
	11	9	9	9	6	0	0	10	0	13	10	10	10

Table 1: Cos Vs POs

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

							P	C			
X	BT 3	04		3	1	1	5				
			CELL BIOLOGY AND MICROBIOLO			L	L				
С	P	Α			L	Т	P	Η			
3	1	0			3	2	2	7			
PREREQUISITE: Nil											
CO	URS	E OI	UTCOMES:								
			Course Outcomes	Domain		Lev	el				
Aft	er the	e com	pletion of the course, students will be able to		•						
CO1: Comprehend knowledge about historical perspective of											
mic	robic	ology	and its developments. <i>Perform</i> staining techniques	Cog		dod w		ig			
to o	bserv	ve mi	croorganisms	PSy	Gui	ded re	espor	ise			
CO	2: De	emon	strate the microbial nutritional requirements for	Cog	D	mom	horir	20			
bac	terial	grow	with and control. <i>Perform</i> culturing techniques to	Dev	Gui	dod r		ng			
isol	ate m	nicroo	organisms	rsy	Ou	ueu n	spor	.150			
CO	3: Re	ecogn	<i>tize</i> the fundamental concepts in the structure and	Cog	Understanding			ıg			
functioning of a cell. <i>Perform</i> cell counting using haemocytometer Psy							Guided response				
CO4: <i>Acquire</i> knowledge about cell cycles mitosis and meiosis. Cog							Understanding				
Perform experiment to observe mitosis division in cellsPsyGu								nse			
CO5: Acquire knowledge on cellular signalling and membrane											
receptors present inside the cell.											
	I INTRODUCTION TO MICROBIOLOGY 9+6										
His	tory a	and S	cope of Microbiology – Study of microbial structure: M	Aicroscopy (light	t, dark	-field	, pha	ise			
con	trast,	elect	ron), Specimen preparation, Staining techniques (simp	le and differentia	ul) – C	vervi	ew o	f			
Pro	karyo	otic co	ell structure: Cell membrane, Cytoplasmic matrix, Cell	wall.							
Lal): 1 F	Handl	ing and examining the microbial cultures								
Lal	b: 2 S	staini	ng and identification of microbes using simple staining								
Lal	b: 3 S	Staini	ng and identification of microbes using differential stai	ning							
	II		MICROBIAL NUTRITION, GROWTH AND COM	NTROL		9	' + 6				
Nut	ritior	nal ty	pes of microorganisms: Autotrophs, Heterotrophs, Pho	totrophs, Chemo	trophs	5,					
Lith	notroj	phs, C	Organotrophs, Culture media (defined, complex) – Mic	robial Growth: C	Growth	n curv	e (la	g,			
exp	onen	tial, s	tationary, death phase), Measurement (cell number, cell	l mass), Factors	influe	encing	grov	wth			
(wa	ter ac	ctivit	y, pH, temperature, oxygen, pressure, radiation) – Micr	obial Control: U	se of j	physic	al				
met	hods	(moi	st heat, dry heat, radiation), Use of chemical agents (ph	enols, alcohols,	gases).					
Lal	5: 4 I	solati	on of microbes from soil using spread plate method								
Lal	b: 5 I	solati	on of microbes from milk using streak plate method								
Lal	5: 6 I	solati	on of microbes from water using pour plate method								
Lal): 7 N	Aicro	bial growth control by chemical agents using Kirby-Ba	uer method							
	III		CELLULAR ORGANIZATION AND MEMBRAN	E TRANSPOR	Т	9	' + 6				
Ove	erviev	w of l	Eukaryotic cell structure: Cytoplasmic matrix, Endopla	smic Reticulum,	Golgi	com	olex,				
Mit	ocho	ndria	, Chloroplast, Nucleus – Functions of cell organelles –	Membrane Tran	sport:	Passi	ve ar	ıd			

Active transp	ort – Sodiur	n/potassium p	pumps, Ca2+, A	TPase pumps						
Lab: 8 Isolation of chloroplast from plant leaves										
Lab: 9 Performance of cell counting using haemocytometer										
IV	IV CELL DIVISION 9+6									
The cell cycle	e – General	description ar	nd different stag	es of mitosis and meiosis (Inter	phase,	Prophase,				
Metaphase, A	Anaphase, Te	elophase) – C	onsequences of	meiosis – difference between n	nitosis a	and				
meiosis.										
Lab: 10 Stain	ning and obs	servation of m	nitosis division i	n onion root tip cells						
V	CELL SIG	GNALING				9 + 6				
Cellular junc	tions – Cell	Signaling: Ge	eneral Principles	of Cell Signaling, Calcium sig	naling	- Receptors				
in Signaling:	Signaling v	ia G-Protein-l	linked Cell Surfa	ace Receptors, Signaling via Er	nzyme-l	linked Cell-				
Surface Rece	ptors.									
LECT	URE	TUTORIAL		PRACTICAL	TOTAL					
46				44	90					
TEXT BOOKS:										
TEXT BOO	KS:			••		20				
TEXT BOO 1. Presc	KS: ott, L. M., H	arley, J. P., &	z Klein, D. A. (2	2005). Microbiology. 5th. <i>McG</i>	rawJHi	ill Higher				
TEXT BOO 1. PrescEduce2. Pasto	KS: ott, L. M., H ation.	arley, J. P., &	z Klein, D. A. (2	2005). Microbiology. 5th. <i>McGi</i>	rawJHi 2nd Edi	ill Higher				
TEXT BOO1. PrescEduca2. RastoREFERENCE	KS: ott, L. M., H <i>ation.</i> gi, S.C.,"Ce	arley, J. P., &	z Klein, D. A. (2 New Age Interna	2005). Microbiology. 5th. <i>McGi</i> ational Publishers, New Delhi: 2	<i>rawJHi</i> 2nd Edi	ill Higher ition,.2004.				
TEXT BOO1. PrescEduce2. RastoREFERENC1. Saday	KS: ott, L. M., H <i>ation.</i> gi, S.C.,"Ce CES: va D E (19	arley, J. P., & 11 Biology", N	z Klein, D. A. (2 New Age Interna	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2	<i>rawJHi</i> 2nd Edi Bartlet	<i>ill Higher</i> ition,.2004.				
TEXT BOO1. PrescEduca2. RastoREFERENC1. Sadav2. Alber	KS: ott, L. M., H <i>ation.</i> gi, S.C.,"Ce Z ES: va, D. E. (19 ts, Bruce, D	arley, J. P., & 11 Biology", N 93). <i>Cell biol</i> a ennis Bray, K	z Klein, D. A. (2 New Age Interna <i>logy: organelle s</i> Caren Hopkin, A	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 structure and function. Jones & lexander Johnson, Julian Lewis	<i>rawJHi</i> 2nd Edi Bartlet	<i>ill Higher</i> <u>ition,.2004.</u> tt Learning. in Raff.				
TEXT BOO1. PrescEduca2. RastoREFERENC1. Sadav2. AlberKeith	KS: ott, L. M., H <i>ation.</i> gi, S.C.,"Ce CES: va, D. E. (19 ts, Bruce, D Roberts, an	farley, J. P., & <u>11 Biology'', N</u> 93). <i>Cell biol</i> ennis Bray, K d Peter Walte	z Klein, D. A. (2 New Age Interna <i>ogy: organelle s</i> Karen Hopkin, A er. <i>Essential cell</i>	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 <i>structure and function</i> . Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2012	<i>rawJHi</i> 2nd Edi Bartlet s, Marti 3.	<i>ill Higher</i> ition,.2004. tt Learning. in Raff,				
TEXT BOO1.PrescEduca2.RastoREFERENCE1.Sadav2.AlberKeith3.Morce	KS: ott, L. M., H <i>ation.</i> gi, S.C.,"Ce CES: 7a, D. E. (19 ts, Bruce, D Roberts, an ello, J. A., N	farley, J. P., & <u>11 Biology", N</u> 93). <i>Cell biol</i> ennis Bray, K d Peter Walte fizer, H. E., &	z Klein, D. A. (2 New Age Interna <i>ogy: organelle s</i> Caren Hopkin, A er. <i>Essential cell</i> & Granato, P. A.	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 <i>structure and function</i> . Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2012 (2003). Laboratory manual and	<i>rawJHi</i> 2nd Edi Bartlet s, Marti 3. d workt	<i>ill Higher</i> ition, 2004. tt Learning. in Raff, book in				
TEXT BOO1.PrescEduca2.RastoREFERENC1.Sadav2.AlberKeith3.MorcMicro	KS: ott, L. M., H ation. gi, S.C.,"Ce ZES: Va, D. E. (19 ts, Bruce, D Roberts, an ello, J. A., N obiology: Ap	farley, J. P., & Il Biology", N 93). <i>Cell biolo</i> ennis Bray, K d Peter Walte fizer, H. E., & oplication to p	z Klein, D. A. (2 New Age Interna ogy: organelle s Caren Hopkin, A er. <i>Essential cell</i> & Granato, P. A. patient care.	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 <i>structure and function</i> . Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2013 (2003). Laboratory manual and	<i>rawJHi</i> 2nd Edi Bartlet s, Marti 3. d workt	<i>ill Higher</i> ition,.2004. tt Learning. in Raff, book in				
TEXT BOO1.PrescEduca2.RastoREFERENC1.Sadav2.AlberKeith3.MorcMicro4.Presc	KS: ott, L. M., H ation. gi, S.C.,"Ce CES: va, D. E. (19 ts, Bruce, D Roberts, an ello, J. A., M obiology: Ap ott, L. M., H	farley, J. P., & <u>11 Biology'', N</u> 93). <i>Cell biol</i> ennis Bray, K d Peter Walte fizer, H. E., & plication to p farley, J. P., &	k Klein, D. A. (2 New Age Interna <i>logy: organelle s</i> Caren Hopkin, A er. <i>Essential cell</i> & Granato, P. A. patient care. k Klein, D. A. (2	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 structure and function. Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2012 (2003). Laboratory manual and 2002). Laboratory exercises in r	<i>rawJHi</i> 2nd Edi Bartlet s, Marti 3. d workt microbi	<i>ill Higher</i> <u>ition, 2004.</u> tt Learning. in Raff, book in				
TEXT BOO1.Presc.Educa2.RastoREFERENC1.Sadav2.AlberKeith3.3.MorcaMicros4.Presc	KS: ott, L. M., H ation. gi, S.C.,"Ce ZES: va, D. E. (19 ts, Bruce, D Roberts, an ello, J. A., M obiology: Ap ott, L. M., H NCES:	Carley, J. P., & <u>11 Biology", N</u> 93). <i>Cell biol</i> ennis Bray, K d Peter Walte fizer, H. E., & pplication to p carley, J. P., &	z Klein, D. A. (2 New Age Interna <i>ogy: organelle s</i> Caren Hopkin, A er. <i>Essential cell</i> & Granato, P. A. patient care. z Klein, D. A. (2	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 <i>structure and function</i> . Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2012 (2003). Laboratory manual and 2002). Laboratory exercises in r	rawJHi 2nd Edi Bartlet s, Marti 3. d workt microbi	<i>ill Higher</i> ition, 2004. tt Learning. in Raff, book in				
TEXT BOO1.PrescEduca2.RastoREFERENC1.Sadav2.AlberKeith3.MorcMicro4.PrescE-REFERENC1.http://	KS: ott, L. M., H ation. gi, S.C.,"Ce ZES: va, D. E. (19 ts, Bruce, D Roberts, an ello, J. A., N obiology: Ap ott, L. M., H NCES: /www.austin	farley, J. P., & <u>11 Biology'', N</u> 93). <i>Cell biol</i> ennis Bray, K d Peter Walte fizer, H. E., & pplication to p farley, J. P., &	2 Klein, D. A. (2 New Age Interna ogy: organelle s Caren Hopkin, A er. Essential cell & Granato, P. A. patient care. 2 Klein, D. A. (2 /noteref.htm	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 <i>structure and function</i> . Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2012 (2003). Laboratory manual and 2002). Laboratory exercises in r	rawJHi 2nd Edi Bartlet s, Marti 3. d workt nicrobi	<i>ill Higher</i> ition,.2004. tt Learning. in Raff, book in				
TEXT BOO1.Presc.Educa2.RastoREFERENC1.Sadav2.AlberKeith3.MorcMicro4.PrescE-REFEREN1.http://2.http://	KS: ott, L. M., H ation. gi, S.C.,"Ce ZES: va, D. E. (19 ts, Bruce, D Roberts, an ello, J. A., M obiology: Ap ott, L. M., H NCES: /www.austin /www.uwyo	farley, J. P., & <u>Il Biology'', N</u> 93). <i>Cell biol</i> ennis Bray, K d Peter Walte fizer, H. E., & plication to p farley, J. P., & cc.edu/rohde/ .edu/molb221	k Klein, D. A. (2 New Age Interna <i>ogy: organelle s</i> Karen Hopkin, A er. <i>Essential cell</i> & Granato, P. A. oatient care. k Klein, D. A. (2 /noteref.htm	2005). Microbiology. 5th. <i>McGa</i> ational Publishers, New Delhi: 2 structure and function. Jones & lexander Johnson, Julian Lewis <i>biology</i> . Garland Science, 2012 (2003). Laboratory manual and 2002). Laboratory exercises in r	<i>rawJHi</i> 2nd Edi Bartlet s, Marti 3. d workh microbi	<i>ill Higher</i> <u>ition, 2004.</u> tt Learning. in Raff, book in tology.				

 $4. \ https://cellbiology.med.unsw.edu.au/cellbiology/index.php/Cell_Biology_Introduction$

Table 1: Cos Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PSO	PSO 2
										0	1	1	
CO 1	3	1	2	2	0	0	0	0	0	3	1	2	2
CO 2	2	3	1	2	1	0	0	0	0	2	2	2	2
CO 3	3	2	3	1	1	0	0	0	0	3	1	2	2
CO 4	2	3	2	1	2	0	0	0	0	2	3	2	2
CO 5	1	0	1	3	2	0	0	0	0	3	3	2	2
	11	9	9	9	6	0	0	10	0	13	10	10	10

No relation, 1-Low Relation, 2- Medium Relation, 3-High Relation
					L	Т	Р	С				
X	ES 3	05			3	0	0	3				
			ENGINEERING MATERIALS			1						
C	P	A				T	P	H				
3 DD	U FDF		NITE · Nil		3	0	0	3				
	URS	$\frac{\mathbf{U}}{\mathbf{E}}$	JTCOMES:									
			Course Outcomes	Domai	n]	Level					
Aft	er the	e com	pletion of the course, students will be able to									
CC	CO1: <i>Study</i> the Basic Properties of Engineering Materials. Cog						erstand	ing				
CC)2: Ai	nalyz		An	alyzin	g						
CC)3: Ai	nalyz	e nonmetallic materials and application.	Cog		An	alyzin	g				
CC me)4: <i>In</i> tallur	spect	ion of engineering materials (mechanical and	Cog		An	alyzin	g				
CC)5: Li	st the	properties and applications of modern engineering	C								
ma	terials	S.		Cog		ing						
Ìτ	JNIT	-I	BASIC PROPERTIES OF METALLIC MATER	IALS			9 hi	S				
В	asic (Crysta	llography- Crystal structure – BCC, FCC and HCP st	ructure – u	init cell	- crys	stallog	raphic				
p	lanes	and	directions, miller indices. Crystal imperfections, poin	t, line, pla	nar and	volur	ne def	ects –				
G	rain s	size,	ASTM grain size number. Frank Reed source of dis	location E	lastic &	z plast	ic mo	des of				
d	eform	ation	, slip & twinning, strain hardening, seasons cracking	g, Iron carl	oide eq	uilibriu	ım dia	ıgram.				
C	lassif	icatio	n of steel and cast Iron microstructure, properties	and appli	plication effect, yield poin							
p	henon	nenor	n, cold/hot working, recovery, re-crystallization, and gr	ain growth,	strengt	hening	g of me	etals.				
U	NIT	–II	HEAT TREATMENT OF MATERIALS				9 h	rs				
Н	eat T	reatm	ent- Definition – Full annealing, stress relief, recrystal	lisation – n	ormalis	ing, ha	ardenii	ng and				
te	mper	ing o	f steel. Isothermal transformation diagrams -cooling of	curves supe	erimpos	ed on	I.T. di	agram				
CCR Hardenability, Austempering, martempering.Case hardening, carburising, nitriding, cyanidi							iding,					
carbonitriding - Flame and Induction hardening. Ferrous and Non Ferrous Metals- Effect of							t of al	loying				
additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels - HSLA. Gray, V							White					
n	alleal	ble, s	pheroidal -Graphite - alloy cast-iron. Copper and	Copper allo	oys – I	Brass,	Bronz	e and				
C	upror	nickel	. Aluminium and Al-Cu – precipitation strengthening t	reatment –	Bearing alloys.							
L												

UNIT-III	NON METALLIC MATERIALS	9 hrs
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.

UNIT -IV	INSPECTION OF ENGINEERING MATERIALS	9 hrs
Mechanical Pr	operties and Testing- Mechanism of plastic deformation, slip and twinning	. Types of
fracture - Testi	ng of materials under tension, compression and shear loads - tests (Brinell, V	vickers and
Rockwell) Imp	act test, Izod and charpy, fatigue and creep test.	

UNIT V	MODERN ENGINEERING MATERIALS	9 hrs
Metallic glasse	es- preparation of metallic glasses- properties – applications of the metal	lic glasses -
Shape Memory	Alloys (SMA) - Characteristics, properties of NiTi alloy - applications	of the Shape
memory alloys	- advantages and disadvantages of SMA - Nanomaterials-synthesis -cher	nical vapour
deposition – Se	ol Gels – ball Milling – properties of nanoparticles and applications of na	noparticles -
Carbon Nanotu	bes(CNT)-structure-properties-applications of the CNTs.	

		LECTURE: 45	TUTORIAL: 0	TOTAL :45							
Text b	ooks										
1.	Enginee	ering Materials: Pro	operties and selection/ Kenneth	n G. Budinski, Michael K. Budinski/							
	Prentice	e Hall									
2.	Enginee	ering materials / R K	K Rajput / S Chand and compan	y Ltd.							
3.	Deformation and Fracture Mechanics of Engineering Materials/R. W. Hertzberg/ John Wiley &										
4	Sons.										
4.	Powder	Metallurgy: An A	Advanced Technique Of Proce	essing Engineering Materials/ B. K.							
5	DATIA	V PHI Learning PVI	. Lla. nooring (Paghayan/ Prontico H	all of India							
J. Refere	nces	is Science and Engi	neering / Kagnavan/ Frentice-IIa								
1	Kash (I matariala, mucasasing and ampl	iantiana, William Andrew Dub							
1.	Kocn, C	. C. Nanostructured	i materials: processing and appl	ications: william Andrew Pub.							
2.	James 1	F Shackelford, S "	Introduction to materials Scie	nce for Engineers", 6 th Macmillan							
	Publishi	ing Company, New	York, 2004								
3.	William	n D CallisterJr, "Ma	terials Science and Engineering	g – An Introduction", John Wiley and							
	Sons In	c., 6 th edition, New	V York, 2003								
4.	Jayakur	nar S, "Materials Sc	cience", RK Publishers, Coimba	tore, 2004							
5.	Bolton,	W., Engineering ma	aterials technology: Butterworth	n-Heinemann.							
	E RES	OURCES									
1.	NPTEL	courses, http://ww	ww.nptel.iitm.ac.in/courses.php	?disciplineId=112: related web and							
	video re	sources under Mecl	nanical Engineering & Metallurg	gy and Material Science categories							
2.	http://w	ww.intechopen.com	<u>ı/books</u>								

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	3	1	1		2	2	3	3	1	3		1
CO2	3	1	1		1	2	3	2	1	2		1
CO3	3	1	1		1	2	3	2	1	2		1
CO4	3	1	1		2	2	3	3	1	3		2
CO5	3	1	1		1	3	3	1	1	2		2
Total	15	5	5		7	11	15	10	5	12		7
Scaled	3	1	1		2	3	3	2	1	2		2

1 - Low, 2 – Medium, 3 – High

Х	CEP 30	6	ENTREPRENEURSHIP DEVELOPMI	L 2	T 0	P 0	C 2				
С	Р	Α			L	Т	Р	H			
2.5	0	0.5			3	0	0	3			
On th	In the successful completion of the course, students will be able to										
Cour	Course Outcome: Domain Leve										
CO1	Red	cognise	and <i>describe</i> the personal traits of an	Aff	Recei	ivin	g				
	ent	repreneu	ır.	Cog	Unde	ersta	ndi	ng			
CO2	Det	ermine	the new venture ideas and <i>analyse</i> the	Cog	Unde	ersta	ndi	ng			
	feas	sibility i	eport.		Anal	ysin	g				
CO3	De	elop the	e business plan and <i>analyse</i> the plan as an	Aff	Recei	ivin	g				
	Ind	ividual o	or in team.	Cog	Anal	yzin	ıg				
CO4	Des con	siderati	arious parameters to be taken into on for launching and managing small business.	Cog	Unde	ersta	ndi	ng			
CO5	Des Pro	c <i>ribe</i> T perty Ri	echnological management and Intellectual ights	Cog	Understanding						
UNI Defir Entre Entre UNI	$\frac{\Gamma I EN}{\Gamma tition c}$	TREPI of Entrep urship D urship as NEW P	RENEURIAL TRAITS AND FUNCTIONS preneurship; competencies and traits of an entrepevelopment; Role of Family and Society; Achies a career and national development; RODUCT DEVELOPMENT AND VENTUR development: Sources and Criteria for Selection	preneur; facto evement Mot RE CREATIO	ors affectivation;	cting	g g)			
asses	sment	; Feasib	ility Report ;Project Profile; processes involved wnership: Case Study	in starting a	new ver	ntur	e;				
UNI	Γ–III	ENTR	EPRENEURIAL FINANCE				9)			
Finar Sourc prom	ncial fo ces of l lotion.	orecastin Financir	g for a new venture; Finance mobilization; Busing, Angel Investors and Venture Capital; Govern	iness plan pre nment suppor	paration t in star	n; rtup)				
UNI	<u>Γ –IV</u>		CHING OF SMALL BUSINESS AND ITS M	IANGEMEN	T	1 .	9)			
Oper	ations	Plannin Monito	g - Market and Channel Selection - Growth Stra	tegies - Produ	act Laui	nchi	ing n of	-			
Busir	iess U	nits.	ing and Evaluation of Dusiness - Freventing St	LAIIUSS AIIU KO	chaointi	auo	11 01				
UNI	Γ-V	FECHN	OLOGY MANAGEMENT, IPR PORTFOL	IO FOR NE	W		9)			
PRO	DUCI	VEN T	URE								
Tech suppo Train	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	TOTAL							
	45	0	45							
TEXT BOOKS										
• Hisrich, 2016, Entrepreneurshi	ip, Tata McGraw Hill, Nev	v Delhi.								
		1 1 0	T I I I I							

• S.S.Khanka, 2013, Entrepreneurial Development, S.Chand and Company Limited, New

Delhi. **REFERENCE BOOKS** Mathew Manimala, 2005, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis. Biztrantra ,2nd Edition. Prasanna Chandra, 2009, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill. • 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. 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 RESOURCES** Jeff Hawkins, " Characteristics of a successful entrepreneur", ALISON Online • entrepreneurship courses, "https://alison.com/learn/entrepreneurial-skills

• Jeff Cornwall, "Entrepreneurship -- From Idea to Launch", Udemy online Education, https://www.udemy.com/entrepreneurship-from-idea-to-launch/

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	3	1	1		2	2	3	3	1	3		1
CO2	3	1	1		1	2	3	2	1	2		1
CO3	3	1	1		1	2	3	2	1	2		1
CO4	3	1	1		2	2	3	3	1	3		2
CO5	3	1	1		1	3	3	1	1	2		2
Total	15	5	5		7	11	15	10	5	12		7
Scaled	3	1	1		2	3	3	2	1	2		2

1 - Low, 2 – Medium, 3 – High

				_	Ĺ	T	P	SS	C	
X	GS 3	07	INTEDDEDSONAL COMMUNICATION	-	0	0	0	2	0	
С	Р	Δ	INTERFERSONAL COMMUNICATION	-	L	т	Р	SS	н	
0.4	0.4	0	0	0	2	2				
PRE	CREQ									
cot	URSE									
			Course Outcomes	Don	nain]	Level		
After	r the o	compl	etion of the course, students will be able to							
CO1	:Rec	ogniz	<i>e</i> culture and a need for interpersonal	Co	og	I	Reme	mber	ing	
com	munic	cation								
CO2	2: De	mons	trate on the need for effective communication	Co	og	I	Unde	rstand	ling	
betw	een t	wo pe	ople							
CO3	B: Exp	olain (on family and social relationships and need for	Co	og	Understanding				
socia	alizati	on								
CO4	: Pra	ctice	the IP principles as to how to reduce and repair	Ps	sy	(Guid.	Resp).	
conf	lict in	inter	personal relationships							
CO5	5: Ma	ke use	to use effective and appropriate language at	Co	og	1	Remembering			
vario	ous in	terper	sonal situations to avoid conflict.							
	SYL	LAB	US							
Unit	S.						H	Iours		
Ι	1	UNIV	ERSALS OF INTERPERSONAL COMMUNICATI	ION	S		5			
	1	Axion	ns of interpersonal Communication; culture in interperso	onal						
	0	comm	unication and the self in interpersonal communication							
II	1	APPR	EHENSION AND ASSERTIVENESS				5			
	4	Aggre	ssiveness and assertiveness; perception in interpersonal							
	(comm	unication; listening in interpersonal communication.							
III	III VERBAL AND NON VERBAL MESSAGES;									
]	Relatio	onship and involvement; relationship maintenance and r	repai	r.					
IV]		ER IN INTERPERSONAL RELATIONSHIP;				5			
V	+	1	0							
	l			-						

Self Study: 30 Hrs

Total

: 30 Hrs

TEXT BOOKS

1. *DeVito*, *Joseph*, The *Interpersonal Communication* Book, 13th Edition - , Published by *Longman* Pub Group, Updated in its *13th edition*,2000

- 2. Kathleen S. Verderber, Inter-Act: Interpersonal Communication Concepts, Skills and Contexts, Rudolph F. Verderber, 2000
- **3.** Clifford Whitcomb, Effective Interpersonal and Task Communication Skills for Engineers, Atlantic Publishers. 2010

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1										2		
CO2										2		
CO3				2						1		
CO4												1
CO5										1	2	
				2						6	2	1

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

v	рт 3	08		•	L	T	P	SS	C 1		
Λ	113	UO	INPLANT TRAINING - I		U	U	U	U	1		
С	Р	Α			L	Т	Р	SS	Η		
1	1	1			0	0	0	0	0		
PRE	REQ	UISI	ГЕ: Nil								
COU	JRSE	COUT	COMES:								
			Course Outcomes	Dor	nain		Level				
Afte	r the o	compl	etion of the course, students will be able to								
CO1	: Rel	ate cla	assroom theory with workplace practice	С	og	τ	Understanding				
CO2 pract	: Con tices.	nply	with Factory discipline, management and business	A	ſf	F	Respo	onding	3		
CO3	: Den	nonst	rates teamwork and time management	А	ſf	V	/alue	e e e e e e e e e e e e e e e e e e e			
CO4	: De	scribe	and <i>Display</i> hands-on experience on practical	Р	sy	F	Perce	ption			
skill	skills obtained during the programme. Set										
CO5	CO5: Summarize the tasks and activities done by technical Cog Evaluating										
docu	ment	s and	oral presentations.								

All COs are equally weighted

Note:

Revised Bloom Taxonomy of the Cognitive Domain Simpson's Taxonomy of the Psychomotor Domain Krathwohl's Taxonomy of the Affective Domain

Table 1: Mapping COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	2											
CO2							1	3			1	
CO3									3	1	3	1
CO4		1	2	1	3							3
CO5				3						3		1
Total	2	1	2	4	3	0	1	3	3	4	4	5
Scaled	1	1	2	1	1	0	1	1	1	1	1	1

					L	Т	Р	С
X	PS 4	01			3	0	0	3
С	Р	Α	PROBABILITY AND STATIS	STICS	L	Т	Р	Η
3	0	0			3	0	0	3
PR	ERE	QUI	SITE: Basic concepts of Probability theory	, Differentiation an	nd Inte	grati	on	
CO	URS	SE O	UTCOMES	Domain	Level			
CO	01: D va m co	efine riabl nome ontin	e discrete and continuous random es and to <i>Find</i> the expected values and nt generating functions of discrete and uous distributions.	Cog	Reme	nber	ing	
CO	02: <i>E</i> : M	x plai argir	<i>n</i> the joint distribution and hal distribution and to <i>Find</i> the	Cog	Remei Under	nber stanc	ing ling	
	co	orrela	tion and regression.					
CO	03: D Ap	efine oply 1	e null and alternate hypothesis, test statistic.	Cog	Remei Apply	nber	ing	
CO	94: <i>E:</i> to aı	xplai > Con nalys	<i>n</i> the concept of analysis of variance and <i>npare</i> between one and two factor is of variance tests.	Cog	Under	stanc	ling	
CO me the pro	5. <i>Ex</i> thod statis	xplai s of s stical , serv	<i>n</i> the purpose, function and basic statistical process control and to <i>Apply</i> techniques to measure the quality of a vice, or process.	Cog	Under Apply	stanc	ling	
UN	IT I	Ra	andom variables:					9
Dis Bin	crete Iomia	and I, Po	continuous random variables - Moment isson, Geometric, Uniform, Exponential and	s, Moment Gener	ating toons.	funct	tions	; —
UN	IT I	[T	wo dimensional Random variables:					9
Join line	nt dis ear re	stribu gress	itions – Marginal and conditional distribut	ions – covariance	– Corr	elati	on a	ind
UN	ΙΤΙ	II '	Testing of hypothesis:					9
Lar F- t	rge sa test, c	mple hi-sc	e tests- procedure of testing hypothesis- sma quare test- independence of attributes and go	ll sample tests- Stu oodness of fit.	dent's	t-tes	t,	
UN Ana	I T F alysis	VD s of v	Design of Experiments : ariance – one and two way classifications -	CRD- RBD- LSD.				9
UN	IT V	St	atistical Ouality Control					9
Intr	oduc	tion	– Process control – control charts for va	ariables – Mean a	ind Ra	nge	char	rts-
		marts						<u>.</u>
			45	UTURE TUTOF 0	KIAĹ	TO 45	ΓA	L
TE	XT	c -						
1.G e	upta extens	.S.C sively	and Kapoor .V.K, "Fundamentals of Mathe y revised edition, Sultan Chand & Sons, (20	matical Statistics", 07).	llth			

- 2. Veerarajan .T, Probability, "Statistics and Random Processes", Tata McGraw Hill, 3rd edition, (2008).
- 3. Kandasamy.P, Thilagavathy.K, Gunavathy.K, "Probability, Statistics and Queueing Theory", S.Chand & Company Ltd, (2004).

REFERENCES

- 1. Ross. S, "A first Course in Probability", Fifth Edition, Pearson Education, New Delhi (2002).
- 2. Johnson .R.A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson Education, Delhi, (2000).
- 3. Walpole .R. E, Myers, Myers .R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Seventh Edition, Pearsons Education, Delhi, (2002).
- 4. Lipschutz. S and Schiller. J, "Schaum's outlines Introduction to Probability and Statistics", McGraw-Hill, New Delhi, (1998).

E REFERENCES

www.nptel.ac.in

1. Advanced Engineering Mathematics Prof. Somesh Kumar Department of Mathematics, Indian Institute of Technology, Kharagpur.

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

1 - Low , 2 – Medium , 3- high

				L	Т	Р	C
XBT 402		02		3	0	0	3
			GENETICS AND MOLECULAR BIOLOGY				
С	Р	Α		L	Т	Р	Н
3	1	0		3	0	0	3

PREREQUISI	TE: XBT 304 Cell and Microbiology, XBT 404 Bioc	hemistry						
	Course Outcomes	Domain	Level					
On the success	ful completion of the course, students will be able to							
CO1: Able to I	Recall the principles in genetics.	Cog	Remember Perception					
CO2: <i>Choose</i> t material.	he experimentations pertaining to DNA as genetic	Cog Psy	Apply					
CO3: <i>Develop</i> eukaryotic DNA	<i>and examine</i> the replication of prokaryotic and A	Cog Aff	Create Responding					
CO4: <i>Explain</i> transcriptional	and realise the synthesis of RNA and post- modifications and protein synthesis.	Cog Aff	Understanding Mechanism					
CO5: Interpret	and <i>analyze</i> the gene regulation, DNA damage and sms.	Cog Aff	Applying Responding					
UNIT I	MODEL SYSTEMS IN GENETIC ANALYSIS		12					
Bacteriophage, Zebra fish, Hor inheritance: M Chromosome th	E. coli, Neurospora crassa, yeast, Arabidopsis, ma no sapiens - General outline of life cycle, importance lendel's Laws, concept of dominance, segregation neory of inheritance.	ize, Drosop in Genetic n, independ	bhila, C. elegans, analysis. Laws of dent assortment;					
UNIT II	LINKAGE, INHERITANCE AND MUTATION		12					
Concepts, record Sex-linked inhe Quantitative inhe expressivity. Cy – Classification	Concepts, recombination, gene mapping in prokaryotes and eukaryotes, fine structure mapping. Sex-linked inheritance: Conceptual basis, sex influenced traits, mechanism of sex determination. Quantitative inheritance – Concept, Genes and Environment - heritability, penetrance and expressivity. Cytoplasmic inheritance – Basis and mechanism, role of organellar genes. Mutation – Classification, mechanism, repair, role in genetic analysis and evolution.							
UNIT III	NUCLEIC ACIDS AND GENOME REPLICAT	ION	12					
DNA as genetic material – Griffith; Hershey and Chase; Avery McLeod & McCarty experiments. Extrachromosomal DNA, retroviruses, Molecular structure of genes and chromosomes; Conformations of DNA and RNA; DNA replication and control; Unit of replication, Enzymes in replication, Prokaryotic replication; Replication in eukaryotic chromosomes; Replication of telomeres in eukaryotes.								

UNIT IV	TRANSCRIPTION AND TRANSLATION	12						
Features of promoters and enhancers; Transcription factors (activators and repressors); Classes								
of RNA molecu	of RNA molecules; Types of RNA polymerases; Transcription and its control in prokaryotes and							
eukaryotes. Pos	t-transcriptional modifications; RNA Splicing, Polyadenylation a	nd Capping,						
RNA editing, t	ypes of RNA -SnRNA & hnRNAs; Antisense RNA, microRNA	A, and RNA						
Interference (R	NAi), ribozymes. Wobble hypothesis, tRNA activation by amino	acyl tRNA						
sysnthetases, P	rotein synthesis in prokaryotes and eukaryotes (Initiation, Elon	ngation, and						
Termination); Ir	hibitors of Translation; Post-translational modifications.							
UNIT V	REGULATION OF GENE ACTIVITY AND DNA REPAIR	12						

MECH	ANISMS								
Principles of gene Regul	ation in prokaryotes and eul	caryotes, Transcriptional	Regulation : Lac						
Operon; Tryptophan Ope	eron; Attenuation; Constitutiv	vely Expressed Genes, C	ase study lambda						
gene regulation in lytic a	gene regulation in lytic and lysogenic cycles, gene silencing, PTGS, Introduction to Mutations;								
Physical, Chemical and	Biological Mutagens; Reve	ersion; DNA Repair Me	chanisms, Direct						
Reversal; Excision Repai	r; The SOS Response.								
LECTURE	TUTORIAL	PRACTICAL	TOTAL						
45	15	0	60						
TEXT BOOKS		·							
1. De Robertis and I	De Robertis, "Cell and Molece	ular biology", WaverlyPv	rt. Ltd, 1998.						
2. Hyde David R., "	Genetics and Molecular Biolo	ogy: with Fundamentals of	f Biostatistics",						
Tata McGraw-Hil	1 Education India								
REFERENCES:									
1. Harvey Lodish, A	rnold Berk, S.L Zipursky, Pa	ul Matsudaira, David Balt	timore and						
James Danell, "M	olecular Cell Biology", 4thE	dition, New York: W.H F	reeman and						
company,2002.									
2. De Robertis, E.D	P.P and De Robertis E.M.F.,"	Cell and Molecular Biolo	ogy", 8th Edition,						
New York: Lippin	cott Williams and Wilkins. 2	2001.							
3. Friefelder, D., "M	Iolecular Biology", 2nd Editi	on, Narosa Publishing H	ouse, New Delhi.						
2009.									
4. Lewin B., "Genes	IX" Jones and Bartlett, 2008								
5. Weaver, R.F. "Mo	olecular Biology", 3rd Edition	n, McGraw Hill., 2005.							
6. Alberts et al., "Me	olecular Biology of The Cell"	, 6th Edition, Garland Sci	ience Publisher,						
E REFERENCES									
1. NPTEL, Biot	echnology, Prof. G.S. Randh	awa, Department of Biot	echnology,Indian						
Institute of Te	chnology, Roorke.								

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	1	1								1	
CO 2	1	3	2		1	1			1	1	
CO 3	2	1	1					2		1	
CO 4	1	1	1	1	3	1		1			
CO 5	2	1	1	1	3						
	7	7	5	2	7	2	0	3	1	3	0

XI C	L T P C 3 0 1 4 L T P H									
3	1	0			3 0 2 5					
PRI	ERE	QUI	SITE: XBT 304 Cell Biology & Microbiology , XBT	7 404 Biochem	istry					
CO	URS	E O	UTCOMES:							
				Domain	Level					
On a	the s	ucce	ssful completion of the course, students will be able	to						
CO	1: <i>D</i>	isting	<i>wish</i> the different types of fermentation Process	Cog	Remembering					
usin	g sp	ecific	microorganism.	Psy	Perception					
CO2 meta	CO2: Describe and apply the production process of primary metabolites.Cog									
CO	3: E:	xplai	<i>n</i> and <i>Demonstrate</i> the production of secondary		Understandin					
meta	aboli	tes.		Cog	g					
				Psy	Guided					
				-	Response					
CO	4: D	iffere	entiate and execute the procedures for production	Cog	Create					
of fo	pod I	orodu	cts.	Psy	Mechanism					
CO	5: <i>R</i>	ecogi	<i>uise</i> the production process of recombinant	Cog	Create					
proc	lucts	•								
τ	U NI T	ГΙ	INTRODUCTION TO INDUSTRIAL BIOPRO	DCESS	9+6					
Isola	ation	, pre	servation and inoculums development of industrially	y important mi	croorganisms –					
Тур	es o	f fer	mentation and its application. Unit operations inv	olved in biop	rocesses. Basic					
desi	gn a	nd co	nstruction of fermenter and ancillaries:							
Lab	1: Iı	ntrod	uction to fermentation Technology.							
U	INI	' II	PRODUCTION OF PRIMARY METABOLIT	ES	9+6					
Proc	ducti	on o	f primary metabolites: Organic acids fermentation:	Citric acid –	Acetic acid –					
Lact	tic a	cid –	Amino acids: L-glutamic acid – L-lysine – L -try	ptophan – Solv	vents: Acetone-					
Buta	anol	– Eth	anol.							
Lab	1: P	rodu	ction of aminoacids							
Lab	2: P	roduc	ction of Biodiesel		0 (
U	UNIT III PRODUCTION OF SECONDARY METABOLITES 9+6									
Anti	ibiot ulase	r = pr	roduction and its classification, industrial Enzymotes - linese Vitamins: Cyanaocobalamin - Ribofl	ne production	: α-amylase –					
Lah	1: Pr	oduc	tion of Protease	a v 111.						
Lab	2: Pr	oduc	tion of Amylase							
Lab	Lab3: Production of Linase									
U	NIT	IV	FOOD AND BEVERAGE FERMENTATION		12+9					

Food fermentations: Cheese – yogurt – sauerkraut – soy sauce- Food flavoring agents: MSG –
 Food preservative: Nisin – Food colorants: *Monascus* pigments fermentation – Production of single cell protein: - Beverages: Brewing process – Wine and Cider production.

Lab1: Production of wine

Lab 2: Production of Cheese

UNIT V PRODUCTION OF OTHER COMMERCIAL PRODUCT

Recombinant protein production: Insulin – interferon – Production of nucleosides and nucleotides: 5' IMP – 5' GMP – Enzyme biotransformations: Types- steriod – Biopolymers: Xanthan gum – PHA – PHB – Agrochemicals: *Bacillus thuringenesis* insecticide production.

9+6

Lab1: Production of Biofertilizer

LECTURE	PRACTICAL	TOTAL
45	30	75

TEXTBOOKS:

1. Presscott S.C. and Dunn C.G., "Industrial Microbiology", CBS Publishers & Distributors; 4th edition (2004)

2. Wulf Crueger and Anneleise Cruger, "Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing ,2000.

REFERENCES:

1. Moo-Young M., "Comprehensive Biotechnology: The Principles, Applications, and Regulations of Biotechnology in Industry, Agriculture, and Medicine", Pergamon, 1985.

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

2. Casida Jr, L.E., "Industrial Microbiology", Wiley, 1968

			L	Т	Р	C			
XBT 404			3	1	1	5			
	BIOCHEMISTRY		т	T	D	тт			
C P A 2 175 025			L 2	1	2 2	H 7			
<u> </u>			3	2	2	/			
PREREQUISITE	: XAP 104 Applied Physics, XAC 204 Applied C	hemistry, X	KBT	304	Cell				
Biology & Microb	iology								
COURSE OUTC	OMES:								
	Course Outcomes	Domaiı	n		Level				
On the successful	completion of the course, students will be able to								
CO1: Recognize a	nd <i>Understand</i> biochemical molecules structure	Cog		Ren	nember	ing			
and functions in th	e cell. Ramambar amino acids structure and	Psy Cog		Rec	alling				
properties & fundar	nentals of Ramachandran Plot	Psv		Orig	ginatior	ı			
CO 3: Discuss and	apply enzyme properties and metabolic	Cor		Cre	ate	-			
pathways (Glyclol	ysis, TCA cycle)	e e e e e e e e e e e e e e e e e e e		Gui	ded				
COA: Palata and	fallow biogynthesis and astabalism of fatty	-~J		Res	ponse				
acids.	tonow biosynthesis and catabolish of fatty	Cog	Guided						
		Psy		resp	onse				
CO5: Measures an	nd Analyze biosynthesis of nucleotide and	Cog		Cre	ate				
structure of DNA a	and relate diseases to DNA sequence and	Psy		Gui	Guided				
	5.	Aff		resp	onse				
CO 1 F	OUNDATION OF BIOCHEMISTRY			1 010	$\frac{9+9}{9+9}$				
Cellular Foundatio	ns. Chemical Foundations. Physical Foundations.	Genetic Fo	ounda	ations	<u>, , , , , , , , , , , , , , , , , , , </u>				
Evolutionary Foun	dations, Water, Weak Interactions in Aqueous Sys	tems, Ioniz	zatio	n of	Water.				
Weak Acids, and V	Veak Bases, Buffering against pH changes in biolo	ogical syste	ems.	Wate	er as a				
reactant.									
Lab									
1. Blood grouping									
2. Estimation of bl	ood glucose given blood sample								
3. Determination o	f protein estimation in a broth (Bradford)								
CO 2 A	MINO ACIDS, PROTEINS AND PEPTIDES				9 + 6				
Amino acids, struc	tures of 20 common acids and properties, Peptides	, Proteins,	worl	king	with				
proteins – Electrop	proteins - Electrophoresis. Structure of Proteins- Primary, Secondary, Tertiary structure and								
Quaternary Structures – Fibrous Proteins. Methods for determining the three-dimensional structure									
of protein (XRD and NMR). Protein denaturation and Folding – Protein Diseases- Ramachandran									
Plot.									

Lab

- 4. Quantitative analysis of proteins (Lowry)5. Calculation of Rf for given amino acids and unknown sample by TLC

CO 3	ENZYMES AND CARBOHYDRATES METABOLISM	9 + 3
Enzymes- Fund	amentals - Enzyme Kinetics and approach to understand mechanis	sm – Two-Step-
reaction catalyz	ed by enolase. Carbohydrates and Glycobiology, Monosaccharides	-Disaccharides-
Blood glucose r	neasurement in diagnosis and treatment of diabetes. Working with	n carbohydrates.
Introduction to 1	netabolism, Glycolysis, Gluconeogenesis, Pentose Phosphate pathw	vay. TCA cycle.
Lab		
6. Determination	n of β-carotene, Flavonoid	
CO 4	BIOSYNTHESIS OF FATTY ACIDS AND CATABOLISM	9 + 3
Biosynthesis of	fatty acids, Oxidation of fatty acid - beta oxidation and or	nega oxidation.
Biosynthesis of	Cholesterol, Biosynthesis of phospholipids and glycolipids, Metab	olic disorders of
carbohydrate me	etabolism (pathophysiology, clinical symptoms and treatment)	
Lab		
7. Acid hyd	lrolysis and action of salivary amylase on starch	
CO 5	BIOSYNTHESIS OF AMINO ACIDS AND NUCLEOTIDES	9 + 9
Overview of Ni	trogen Metabolism, Biosynthesis of amino acids, biosynthesis and	l degradation of
nucleotides – De	e Novo Purine Nucleotide synthesis – Purine Nucleotide Biosynthe	sis – Pyrimidine
Nucleotide-Nuc	leotide Monophosphates-Ribosomal - Purine and Pyrimidine base	es are restricted
by Salvage Path	ways.	
Lab		
8. Ouantita	tive analysis of urea in serum	
9. Ouantita	tive analysis of serum bilirubin	
10. Quantita	ative estimation of serum cholesterol by Zak's method	
Yound		
	LECTURE PRACTICAL TO	TAL

LECTURE	PRACTICAL	TOTAL
45	30	75

A. TEXT BOOK

- 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, <u>Donald Voet</u>, <u>Judith G. Voet</u> 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.

B. REFERENCES:

- 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.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	1	1	2	0	1	0	0	1	1	1	1
CO 2	1	1	2	0	1	0	0	1	1	1	1
CO 3	1	1	2	0	1	0	0	1	1	1	1
CO 4	1	1	2	0	1	0	0	1	1	1	1
CO 5	1	1	2	0	1	0	0	1	1	1	1
Total	5	5	10	0	5	0	0	5	5	5	5

Table 1: COs Vs. Pos

XBT 405 CHEMICAL ENGINEERING THERMODYNAMICS 3 1 0 4 C P A L T P H 3 0 0 L T P H 3 0 0 0 S 2 0 5 FREREQUISITE: Engineering chemistry, Basic calculations Course Outcomes Domain Level After the completion of the course, students will be able to COC CO2: Interpret and analyze the PVT relationship for various Cog Remembering GO3: Know the thermodynamic relations and estimate the thermodynamic properties. Cog Analyzing, evaluating Cog Analyzing, evaluating CO4: Analyze and evaluate the phase equilibrium in various systems. Cog Analyzing, evaluating Cog Analyzing, evaluating CO5: Knows the chemical equilibrium for industrial reactions and will calculate required free energy. VINT-I FUNDAMENTALS OF THERMODYNAMICS 9 + 3 hrs Fundamentals of Thermodynamics: Laws of thermodynamics as applied to open and closed system - reversible and irreversible processes - state and point function - Absolute entropy - Thermodynamic relations: PVT relationships for gases and liquids - equations of state - Z charts - gas mixtures. Compression - expa								L	Т	P	С	
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2. Narayanan K.V. A textbook of Chemical Engineering Thermodynamics", PHI 2003.

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.Smith, J.M., Van Ness HC and Abbot MM.2001. Chemical Engineering Thermodynamics, 6 th							
Edition, Mcgraw Hill.							
2.Rao., Y.V.C., Chemical engineering	Thermodynamics, University Press, Hyde	erabad, 2005.					

COs Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2		2	1					2		1
CO 2	3		3	3					2		2
CO 3	3		3	2					2		2
CO 4	2		3	3					2		2
CO 5	2		3	3					2		2
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1. Couper, J. R., "Process Engineering Economics", CRC Press, 2003.

2. White, J. A., Case, K. and Prat, D., "Principles of Engineering Economics Analysis" 4th Edition, John – Wiley Publishers, 1997.

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- 1. Towler, G. and Sinnott, R. K., "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design", Elsevier, 2007.
- 2. Brown T., "Engineering Economics and Economic Design for Process Engineers", CRC Press, 2007.
- 3. Peters, M. S and Timmerhaus, K. D., "Plant Design and Economics for Chemical Engineering", 4th Edition, McGraw Hill, 1991

Table 1: Mapping of COs with POs

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

1-5 = 1, 6-10 = 2, 11-15 = 3

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

X	GS 4()7				L 1	T 0	P 0	SS 2	C 1		
			TEC	CHNICAL COMMUNICATION	I							
С	Р	Α				L	Τ	Р	SS	Η		
1.8	0.8	0.4				1	0	0	2	3		
PRE	REQ	UISI	TE: Nil									
COU	URSE	OUI	COMES:									
			Cours	e Outcomes	Doi	main]	Level			
Afte	r the c	compl	etion of the cou	arse, students will be able to	1							
CO1	l: Ide	entify	the features	of a technical project report a	and C	log	F	Reme	mber	ing		
Knov	wledg	e on t	he linguistic co	ompetence to write a technical rep	oort							
CO2	2: Inte	egrate	both technica	l subject skill and language skill	l to C	log	A	Apply	ying			
write	e a pro	oject.										
CO3	B: Cor	nfiden	ce to <i>present</i> a	project in 10 to 15 minutes	A	Aff	F	Respo	onding	2		
CO4	: The	learn	er <i>identifies</i> an	d absorbs the pronunciation of	C	log	F	Reme	mber	ing		
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word	and	in a se	entence properl	У								
CO5	5: Enc	<i>ibles</i> t	the speaker spe	aks clearly and fluently with	P	sy	(Guid.	iid. Resp.			
conf	idenco	e and	it trains the lea	rner to listen actively and criticall	y							
UNI	Т	Co	ntent					I	Iours			
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	T	RA	SIC PRINCIP	PLES OF COOD TECHNICAL	WRITIN	C			0			
	1	Stv	le in technica	writing, out lines and abstract	ts. langua	ge us	ed i	n	,			
		tecl	nnical writing:	technical words, jargons etc	,	5						
]	Π	SP	ECIAL TECH	INIQUES					9			
		use	d in technica	al writing: Definition, descript	tion of n	necha	nisn	ı,				
		Des	scription of a p	rocess, Classifications, division ar	nd interpre	tatior	1					
I	II	RE	PORT/ PROJ	ECT					9			
		lay	out the forma	ts: chapters, conclusion, bibliog	raphy, and	nexur	e an	d 5				
		gio	ssary, Graphics	s and etc - Presentation of the wi	ritten proje) – 1	3				
I	V	SO	UNDS OF EN	GLISH LANGUAGE:					9			
		Vo	wels, conso	nants, diphthongs, word stre	ess, senter	nce	stres	5.				
		into	onation pattern	as, connected speech etc Vo	ocabulary	build	ing	_				
		gra	mmar, synon	ms and antonyms, word roots, o	one-word	subst	itute	5,				
		pre	fixes and suffix	kes, idioms and phrases.								
	V	RE	ADING COM	PREHENSION					9			
		Rea	ading for facts,	meanings from context, scanning	, skimmin	g, inf	errin	g				
		mea	aning, critical	reading, active listening, listenin	ig for com	prehe	ensio	n				
		etc.	-		-	-						
Lect	IIITA			Self Study 7	Fotal							
Lecture Sen Study Total												

15 Hours	30 Hours	45 Hours

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1										2		
CO2										2		
CO3				2						1		
CO4												1
CO5				2						1	2	1
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	JKSE	0010	Course Outcomes	Domain		Ιο	لمر		
Δfter	r the c	omnlet	ion of the course students will be able to	Domani	Level				
	CO1: Describe the plant tissue culture and knows various media								
for ti	for tissue culture.								
CO2: <i>Compare</i> the various gene transfer methods in plants and Cog								g	
<i>relate</i> each other with its pros and cons. Aff								to 1a	
CO3	B: Exp	<i>lain</i> the	e various tissue culture techniques and <i>describes</i>	Cog	Re	emen	beri	ng	
the p	rotop	last isol	ation techniques	C	Ur	nderst	and	ing	
CO4	: Rela	<i>te</i> and	analyze various plant breeding and related	Cog	Ur	nderst	and	ing	
techr	niques				Analyzing				
CO5	5: Cho	ose and	apply the plant genetics to develop	Cog	Understanding				
com	mercia	ally imp	portant products.		Applying				
J	[INTR	ODUCTION TO PLANT TISSUE CULTURE			6+	-3		
Sco	pe of	plant bi	otechnology - Plasticity and totipotency - Histor	y of plant tissue	cultu	ıre – '	Туре	es	
and	comp	osition	of tissue culture media - Role of plant growth reg	gulators and hor	mone	es –			
Phy cult	sioche ure.	emical	conditions for tissue culture – Measurement of gro	owth and viabili	ty in	the ti	ssue		
Ι	I	INVI	FRO PROPAGATION			6+	-3		
Type cell-s cultu of pr	es of j susper ire, Ai rotopla	plant tisnsion c nther cu ast – Ge	ssue culture - Organogenesis and somatic embry ulture, shoot and root tip culture, hairy root ulture and haploid production – protoplast cultures ermplasm conservation and cryopreservation.	yogenesis - Cul culture, Meriste : isolation, fusio	ture t em cu on and	types: ulture l rege	Ca , pc nera	llus, llen tion	
II	I	PLAN	T BREEDING TECHNIQUES			6+	3		
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Γ	V	Gl	ENETIC 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 of proteins – Bioreactor engineering for recombinant protein production using plant suspension culture - 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 biotechnology.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
30	15	0	45

TEXT BOOKS:

1. C. B. Nirmala, Plant biotechnology, MJP Publishers, India, 2009.

2. Robert J. Lebowitz, Plant Biotechnology: A Laboratory Manual, WCB, 1995

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- 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.

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

Cos Vs POs

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

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	13	8	11	8	14	9	5	4	8	7	5
Scaled to 0,1,2,3	3	2	3	2	3	2	1	1	2	2	1

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

							L	Т	Р	С			
XI	BT 5	02					2	1	0	3			
		1	СН	EMICAL REACTION ENG	INEERIN	G		1					
C	P	A					L	T	P	H			
2	0	1					2	2	0	4			
PRI	ERE	QUI	SITE: Prin	ciples of Chemical Engineerin	ng								
			Co	ourse Outcomes		Domain		I	Leve	l			
Afte	er the	e com	pletion of th	ne course, students will be able	to								
CO	1: Re	ecall	and <i>explain</i>	the kinetics of a chemical reac	ction.	Cog] 1	Reme Unde	embe rstan	ring ding			
CO	2: In	terpr	et and modi	<i>fy</i> the batch reactor data.		Cog Aff		Unde Orgai	rstan nizat	ding ion			
CO CS7	3: <i>Co</i> FR re	o <i>mpa</i> eactor	re and evalı rs.	<i>e</i> and <i>evaluate</i> the performance of batch, PFR and Cog Evaluating Analyzing									
CO4	4: <i>E</i> ,	xplai	n and <i>disting</i> s of reactor	guish the heat and pressure eff	ects on	Cog Aff		Unde	rstan vzino	ding			
CO: reac	5: <i>Id</i>	entif 8.	<i>ify</i> and <i>discuss</i> the designs for single and multiple Cog Understanding Aff Receiving										
	Ι		REACT	ION KINETICS			1	oheno	6+3	1a			
a me	chan	ism.	i oi iuce eqe			i stute theo	1 y	Sea	enn	5 101			
	II		INTER	PRETATION OF BATCH RI	EACTOR	DATA			6+3				
Inte Emj	gral a	and d al rate	ifferential n e equation o	nethods of analysis – Half-life f nth order – Irreversible first a	method – Z and second	Zero-order order react	reac	tion -	_ varia	ble			
and	cons	stant v	volume syste	ems.									
	III		IDEAL	REACTOR DESIGN					6+3				
Idea	l Rea	actor	s – Batch re	actor, plug flow reactor, mixed	l flow react	or– Space	time	, spa	ce				
velo	ocity	Per		luations and their graphical rep	presentation	I - KID st	uaie	s.	612				
	IV HEAT EFFECTS 0+3												
Temperature and pressure effects on single and multiple reactions – Adiabatic, non-adiabatic, isothermal and non-isothermal operations													
	V		DESIGN	OF REACTOR FOR SING	LE & MU	LTIPLE			6+3				
			KLACI	IONS									
Sing reac	gle re	eactio	ons – Size	Comparison of single reactors actions in series and parallel.	– Auto c	atalytic rea	actio	ons –	Mu	ltiple			
Sing reac	gle retions	eactio s – Iri	ons – Size reversible re	IONS comparison of single reactors actions in series and parallel.	– Auto c	atalytic rea	actio	ons –	Mu TOT	ltiple			

TEXT BOOKS:

- 1. Levenspiel, O., "Chemical Reaction Engineering", 3rd Edition, John Wiley, 1999.
- 2. Fogler, W., "Chemical Reaction Engineering", 3rd Edition, Prentice Hall of India, 1999.

REFERENCES:

- 1. Smith, J.M., "Chemical Engineering Kinetics", 3rd Edition, McGraw Hill, 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 3, 3rd Edition, Asian Books (P) Ltd, 2000.

E REFERENCES:

1. http://nptel.ac.in/courses/103101001/

COs Vs POs

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

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	6	7	8	2	0	0	0	0	1	0	1
Scaled to 0,1,2,3 scale	2	2	2	1	0	0	0	0	1	0	1

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

					L	Τ	Р	С		
X	BT 5	03	DECOMDINANT DNA TECHNOLOCY	V	3	0	1	4		
			KECUNDINAN'I DINA TECHINOLOGI	L						
С	Р	Α			L	Т	Р	Н		
1.5	1	0.5			3	0	2	5		
PRE	CRE	QUISI	TE: Genetics and Molecular biology.							
			Course Outcomes	Domain			Lev	el		
Afte	r the	comp	letion of the course, students will be able to							
CO1 Rest	l : Re rictio	<i>call</i> th on and	e basic concepts of gene cloning and various modification enzymes	Cog		Re	men	bering		
CO). F 1	nlain	and distinguish various vastor systems	Cog		Un	dore	ondina		
	1. EX	րատ	and <i>usunguisn</i> various vector systems	Psy		Ē	Perce	ption		
CO3	8: De	escribe	s, Compares and Identifies various techniques	Cog		Re	men	bering		
invo	lved			Psy		A	Analy	zing		
						F	Perce	ption		
CO4	:Di	scusse	s, Manipulates and Describes various screening	Cog			Appl	ying		
and	selec	tion m	ethods.	Aff		R	esp.	Phen.		
				Psy		F	Perce	ption		
COS	5: Ex	plain	and <i>Apply</i> the applications of rDNA technology	Cog	Remember					
unde	r Bi	osafety	y guidelines.			Applying				
	Ι		INTRODUCTION RECOMBINANT DNA TEC	CHNOLOG	Y		ç)		
Basi	c co	ncepts	of gene cloning- Restriction & modification enzy	mes (restrie	ction	end	onuc	lease I	I,	
DNA	A po	lymer	ases, Polynucleotide kinases and alkaline phosphat	tases, DNA	liga	ases	and	RNase))-	
Rest	rictio	on map	pping, Design of linkers and adaptors.							
	II		BIOLOGY OF VECTORS				9+	6		
Char	acte	ristics	of cloning vectors, types of bacterial plasmid vectors	s (pBR322,	pUC	C57, j	pSC1	01),	λ	
vecto	ors,	M13	vectors, cosmids, phagemids, yeast artificial of	chromosom	e, b	acter	ial	artificia	ıl	
chro	mos	ome a	nd Mammalian artificial chromosomes as cloning	vector. Exp	press	ion	vecto	ors: pE	Г	
vecto	ors, l	Baculo	wirus vectors.							
Expe	erim	ent No	1: Genomic DNA extraction							
Expe	erim	ent No	2: Restriction enzyme digestion of vector							
	III		MOLECULAR TECHNIQUES				9+	12		
DNA	A lal	oelling	(radioactive and non-radioactive method); DNA	sequencing	g (M	axun	n &	Gilbert	t,	
Sang	gers,	pyro-	sequencing, shotgun sequencing method)'; Southern	n, northern	and	west	ern	blotting	5-	
PCR	$-\mathbf{P}$	rincipl	e- types- applications- DNA fingerprinting (RAPD; R	RFLP, AFLF	P).			C		
Expe	erim	ent No	3: Western blotting.							
Expe	erim	ent No	4: DNA finger printing							
Expe	erim	ent No	5: SDS PAGE.							
<u>-r</u>		0								

IV SCREENING AND SELECTION OF <u>TRANSFORMANTS</u>								
	9+12							
Transfer of rDNA into cells- transformation, transfection, Sonoporation, Microin	jection and Calcium							
phosphate methods- Genomic and cDNA library construction- Selection	and screening of							
recombinants - nucleic acid hybridization- Grunstein hogness and benten- Da	avis plaque method,							
immunological screening- Blue - white selection- Reporter gene based select	ion- GUS, GFP and							
Luciferase.								
Experiment No 7: Partial digestion of genomic DNA								
Experiment No 8: ligation of restricted vector and genomic DNA								
Experiment No 9: Competent cell preparation- calcium chloride method								
Experiment No 10: Screening and selection of recombinants								
V APPLICATIONS OF RECOMBINANT DNA	9							
TECHNOLOGY								
Production of recombinant- insulin, human growth factor, vaccine and gene the	rapy- gene silencing							
using RNAi. Human genome project and its application. Biosafety guidelines a	nd ethical issues of							
recombinant DNA techniques.								
LECTURE TUTORIAL PRACTICAL	TOTAL							
45 30	75							
TEXT BOOKS:								
1. Primrose S.B. and Twymann R.H., "Principles of Gene Manipulation:	An Introduction to							
Genetic Engineering", Sixth Edition, Blackwell Scientific Publications, 20	004.							
2. Das H.K., Gene and its engineering: replication, expression, cloning and r	nanipulation, Wiley							
India; 1 edition (2005)								
REFERENCES:								
Brown T.A., "Gene Cloning and DNA Analysis", Fourth Edition, E	Blackwell Scientific							
Publications, 2003.								
Glick B.R. and Pasternak J.J., "Molecular Biotechnology", Third Edition, ASN	1 Press, 2003.							
Sandhu, Sardul Singh. Recombinant DNA technology. IK International Pvt Ltd, 2010.								
E REFERENCES:								
1. http://nptel.ac.in/courses/102103013/								

COs Vs POs

POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
-----	-----	-----	-----	-----	-----	------------	-----	-----	------	------	--

CO 1	1	1	2	1	1	1			1		1
CO 2	3		3	2	2	1					1
CO 3	3		3	1	3			1		2	
CO 4	3		3	1	3			2		1	
CO 5	3		3	2	3	2	3	3		1	2
	13	1	14	7	12	4	3	6	1	4	4

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original	13	1	14	7	12	4	3	6	1	4	4
value											
Scaled	3	1	3	2	3	1	1	2	1	1	1
to											
0,1,2,3											
scale											

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

ND	T	P	С							
XBI	504				3	1	1	5		
C			BIOPROCESS ENGINEERING		т	Т	n	TT		
	$\mathbf{P} \mathbf{A}$	_				1	P 2	<u> </u>		
1.5	1 0.3	>			3	2	2	1		
PRER	EQUI	[SI	TE: Basic Industrial Biotechnology, Microbiolog	SY						
COUR	RSE O	U	ΓCOMES:							
			Course Outcomes	Domain			Leve	ł		
After th	he cor	npl	letion of the course, students will be able to							
CO1: <i>I</i>	Recall	an	nd <i>identify</i> the basic parts of a fermented and its	Cog		Ren	nemb	ering		
operati	ons.			Psy		Pe	rcept	ion		
CO2: 1	Identij	fy,	organise, and perform the different media	Cog		Ren	nemb	ering		
compo	nents		V	/alui	ng					
	Psy									
CO3: I	[nterp	ret	, <i>compare</i> and <i>describe</i> various control systems	Cog		Und	ersta	nding		
involve		R	eceiv	ing						
				Psy		Phenomena				
						Perception				
CO4: <i>I</i>	Recog	niz	<i>te, choose</i> and <i>follow</i> the various transport	Cog		Und	ersta	nding		
phenon	nena i	nv	olved in bioprocesses.	Aff		R	eceiv	ng		
				Psy		Ph	enon	iena		
						Gui	ded I	Resp.		
CO5: 1	Expla	in a	and <i>follow</i> the scale up procedure and <i>design</i> a	Cog		Und	ersta	nding		
bio pro	oduct.			Aff		Re	spon	ding		
				Psy		Gui	ded I	Resp.		
	I		INTRODUCTION TO BIOPROCESSS				9+3+	3		
Introduc	ction a	ınd	need for bioprocess Engineering- Biologist and En	gineers differ	in t	heir a	ppro	ach of		
research	n- gen	era	l requirements of fermentation processes - basic co	nfiguration of	f fer	mente	er and	ł		
ancillari	ies, m	ain	parameters to be monitored and controlled - operation	tion of fermer	ntati	on pr	ocess	ses –		
steriliza	tion o	f n	nedia.							
Exp	perim	ent	no 1: Study of Fermenter.							
Exp	perim	ent	no 2: Determination of thermal death rate constant	for the given	mic	robia	l sam	iple.		
	II		MEDIA FORMULATION AND FERMENTA	ΓΙΟΝ			9+3+	3		
			PROCESS DESIGN							
Criteria	a for	go	dod medium, medium requirements for fermentat	ion processe	es, c	arbor	n, nit	trogen,		
minera	ls, vi	tan	nins and other complex nutrients, oxygen requir	ements, med	lium	forr	nulat	ion of		
optima	l grov	vth	and product formation, examples of simple and c	omplex med	ia, d	lesign	ofv	arious		
comme	ercial	me	dia for industrial fermentations – medium optimiz	ation method	s - 1	factor	ial d	esigns,		
Placket	tt- B	urn	nann screening designs. Process Optimization	experiments	: R	espor	ise s	surface		
method	lology	/	concepts & methods, design considerations, cen	tral composit	te d	esign	s and	l Box-		

Behnken response surface design.

Experiment no 3: Comparison of bioprocess efficiencies in synthetic and complex industrial media. Experiment no 4: Medium formulation and optimization studies.

III	BIOREACTOR INSTRUMENTATION AND CONTROL	9+3+3
-----	--	-------

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, FIA, flow cytometry, florescence activated cell sorting (FACS)- Use of molecular methods in the monitoring of cellular parameters-Biosensors.

Experiment no 5: Estimation of biomass concentration for microbial production.

IV

TRANSPORT PHENOMENA IN BIOREACTORS

9+3+3

Flow properties of Fermentation Broths, Factors affecting broth viscosity. Mixing in a Bioreactor – Flow regimes - Power Requirements for Mixing, Ungassed 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.

Experiment no 6: Determination of oxygen mass transfer coefficient by Sulphite oxidation method. Experiment no 7: Determination of oxygen mass transfer coefficient by Dynamic Gassing out method

Experiment no 8: Residence time distribution studies.

\mathbf{V}	BIOPROCESS	SCALE	UP	CONSIDERATIONS	&	9+3+3
	APPLICATION	S				

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

Experiment no 9: Production of Single cell proteins.

Experiment no 10: Various product assay techniques.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	15	15	75

TEXT BOOKS:

1. Najafpour, Ghasem. Biochemical engineering and biotechnology. Elsevier, 2015.

2. Schuler and Kargi, Bioprocess engineering. Prentice Hall

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.

REFERENCES:

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

Cos Vs POs

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

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	8	11	8	7	2	0	2	0	4	0	5
Scaled to	2	3	2	2	1	0	1	0	1	0	1
0,1,2,3 scale											

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

	XBT 505 A PLANT BREEDING AND AGRICULTURAL			L	Т	P	С		
XB				TILTURAL.	3	0	0	3	
	-	-	PRODUCTS	OLIONAL					
С	Р	Α	TRODUCTS		L	Т	Р	Η	
2.5	0	0.5			3	0	0	3	
PRE									
COURSE OUTCOMES:									
			Course Outcomes	Domain			Leve	l	
Afte	r the	comp	letion of the course, students will be able to)					
CO1: <i>Identify</i> the techniques and methodology in plant breeding Cog							Remembering		
CO2: Recall and identify the basics techniques of agricultureCog						Remembering Understanding			
CO3: <i>Describes</i> the properties of soil and production of Cog biofertilizer using various techniques							Understanding		
CO4: Discuss and compiles the techniques opted for pest resistance plantCog Aff							Understanding Receiving Phenomena		
CO5: Explain and apply the concepts of commercialized hybrid productsCog Aff						Understanding Analyzing			
Ι	I PLANT BREEDING TECHNIQUES								

Introduction to plant breeding-history, objectives- domestication and acclimatization. Methods of breeding self-pollinated, cross-pollinated and asexually propagated crops; Land races, pureline selection and mass selection; Pedigree selection, bulk method and its modification; Hybrid breeding, populations and population improvement, intra and inter population improvement; Clonal selection. Mutation breeding, use of polyploidy and distant hybridization in plant breeding

INTRODUCTION TO AGRICLUTURE TECHNIQUE

9

9

Civilization and development of Agriculture – Evolution of modern agricultural practices – Domestication and transdomestication – Centres of origin and diversification of agriculturally important plants. Agrobiodiversity and evolution of land races, traditional varieties and modern varieties and cultivars. Wild relatives of crops.

III SO

Π

SOIL AND FERTILIZER MANAGEMENT

Definition of Rocks and minerals, Weathering, soil formation factors and processes, components of soils, Properties of soil, Soil fertility and productivity, relation between nutrient supply and crop growth, Criteria of essentiality of nutrients, Essential plant nutrients-their functions, Commercial fertilizers, composition, chemical and physiological methods of increasing fertilizer use efficiency nutrient interactions, organicand inorganic fertilizers and its advantages, Time and methods of

manures and fertilizers application, integrated nutrient management, use of vermin compost and residual waste in crops.

IV PEST MANAGEMENT BIOTECHNOLOGY

9

9

Introduction - Applications of Biotechnology for Efficient, Economical and Faster Discovery and Development of Pesticides Biological Control - Bio-insecticides – Bioherbicide -Biofungicide -Biochemical Pesticides - Plant Incorporated Protectants (PIP) - Plant Defence Mechanism Applications of Biotechnology for Development of Target-specific Pesticides Identification of New Growth Regulator Insecticides Pest-tolerant Genetically Modified Crops - Biological Control of Pests - Genetic Modifications to Improve Biological Control Agents.

V HYBRID AGRO- PRODUCTS

Application of Selective hybridization- Economic Importance- Production- Utilization-Commercialization of Hybrid Plants- Hybrid Lilies, Sweet Corn, Olympia, Stargazer Lilies, Meyer Lemon Trees, Early Sungrow, Better Boy Tomatoes, Rabbage, Pomato, Argemone Mexicana

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT BOOKS:

1. C. B. Nirmala, Plant biotechnology, MJP Publishers, India, 2009.

2. Robert J. Lebowitz, Plant Biotechnology: A Laboratory Manual, WCB, 1995

3. Ragland A, Plant Diversity & Plant Pathology, Saras Publication.

REFERENCES:

- 1. Erbish FH and Maredia M. 1998. Intellectual Property Rights in Agricultural Biotechnology. Universities Press, India.
- 2. Maarten J. Chrispeels and David E. Sadava. 1994. Plants, Genes and Agriculture, Jones & Barleft Publishers, London.
- 3. Jones L. 1991. Biotechnological innovation in Crop improvement, ButterworthHiemann, London.
- 4. Forbes JC and Watson RD. 1992. Plants in Agriculture, Cambridge Univ. Press, Great Britain
E-REFERENCES:

- 1. http://agritech.tnau.ac.in/bio-tech/biotech.html5.
- 2. http://www.agrimoon.com/principles-of-plant-breeding-icar-ecourse-pdf-book/

Cos Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	2	1`	1	1	1	3	2	1	1	1
CO 2	3	2	3	3	2	2	3	2	1	2	2
CO 3	2	2	3	3	2	2	2	-	2	2	1
CO 4	3	3	3	3	1	3	3	1	1	1	2
CO 5	2	2	2	3	2	3	2	-	3	2	-
	12	11	12	14	08	11	13	5	8	8	6

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	12	11	12	14	08	11	13	5	8	8	6
Scaled to 0,1,2,3 scale	3	3	3	3	2	3	3	1	2	2	2

				L	T ^	P	C		
X	BT 5	05 B	FOOD BIOTECHNOLOGY		3	0	0	3	
C	D	•			т	т	D	п	
$\frac{c}{2}$	г 0	A 0.25			L 3	1	<u>г</u> 0	<u>п</u> 3	
PR	ERE	QUISI	TE: Microbiology, Basic industrial basic biotechno	ology, Biopr	oces	s en	gineer	ing.	
СО	URS	E OUI	TCOMES:						
			Course Outcomes	Domain		Level			
Aft	er the	e compl	etion of the course, students will be able to						
CO biot	1: <i>K</i> i echn	Cog	R	Reme	mberi	ng			
CO pro	2: D	U	Inde	stand	ing				
CO	3: <i>O</i> ducti		Ana	alyzin	9				
CO	4: <i>D</i>	U	Inder	stand	ing				
pres	serva	Aff	Receiving Phenomena			g			
CO	5: D	escribe	the importance of food quality and regulations	Cog		Eva	luatin	g	
Ι		INTRO	DUCTION TO FOOD BIOTECHNOLOGY				9		
Intr	oduc	tion –	principles, scope and importance of food bio	otechnology	. Bi	otec	hnolo	gical	
app	roach As: C	nes to :	improve nutritional quality and shelf life of fruit of Prebiotics Probiotics and Neutraceuticals	its and vege	etabl	es.	Funct	onal	
II		UTILI	ZATION OF MICROORGANISMS IN FOOD	INDUSTRI	ES		9		
Mic	robe	s norma	ally associated with food products -yeast- alcoholi	c beverages	, bre	ead a	nd re	lated	
pro	ducts	. Gene	tic manipulations- rennet, Penicillium- wine- la	ctic acid ba	acter	ia- s	single	cell	
pro	tein-	Origin	, scope and development of fermented food p	products -	Natt	o- 1	Aiso-S	Sufu.	
mic	robe	s based	products- Mushrooms- Cocoa, tea and coffee ferme	entation					
II	I	GENE'	TICALLY MODIFIED FOOD PRODUCTS				9		
Her	bicid	e toler	ance- soybean, Insect resistance- corn, Altered fa	atty acid co	mpo	sitio	n- ca	nola,	
Virus resistance- Plum, Vitamin enrichment- Golden rice, Faster maturation- Coho Salmo								non.	
Future aspects- Benefits for astronauts from GMF.									
IV		FOOD	PRESERVATION AND PACKAGING				9		
Prir	nciple	es and	methods of food preservation- Food preservation	n by low-te	mp:	Ref	rigera	tion,	
free	treezing and freeze-drying. Food preservation by heating: drying, osmotic dehydration,								
blar	nchin	g, canr	ning, pasteurization, sterilization, extrusion cooki	ng. Non-the	erma	l pre	eserva	tion:	
Hyc	lrosta	atic pre	ssure, dielectric heating, microwave processing,	hurdle tech	nolo	gy,	memt	rane	
tech		gy, irra	autation. Packaging of food- packaging material	s-atmospher	e in	the	pack	age-	
sno	Vaccum packaging, Controlled atmosphere packaging, Modified atmosphere packaging. Food spoilage Food Analysis and Diagnostics, FLISA, Biosensor for food quality assessment								
spo	nage	1 000	a maryoro and Diagnosulos – DLISA - DIOSCHSOI IOI I	oou quanty	asse	osini	JIII		

V FOOD SAFETY AND REGULATIONS

International aspects of quality and safety assessment of food derived by modern biotechnology, Safety of fermented foods. Approval process for food additives, nutritional labeling, dietary supplements, quality assurance/control department- Concept of codex almentarious, Hazard Analysis Critical Control Points (HACCP).

9

LECTURE	TUTORIAL	PRACTICAL	TOTAL					
45	0 0							
TEXT BOOKS:								
1. ZekiBerk., Foo	d process engineering and te	chnology. Academic press, Seco	ond Edition 2013.					
2. Searie B, Food	2. Searie B, Food & Energy, S Chand publication, 2007.							
REFERENCES:								
1. Byong H. Lee.,	Fundamentals of food biote	chnology. John Wiley & Sons, 2	.014.					
2. Ray B., "Funda	mental Food Microbiology"	, Third Edition, CRC Press LLC	, 2003.					
3. Shetty, Kalidas	, et al., eds. Food biotechnol	ogy. CRC Taylor & Francis, 200)6.					
E- REFERENCES	5							
1. http://nptel.	ac.in/courses/103107088/							
2. http://nptel.	ac.in/courses/103103029/34							

Cos Vs Pos

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

Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	10	3	12	9	12	9					5
Scaled to 0,1,2,3 scale	2	1	3	2	3	2					1

			L	Т	P	С			
XBT 505 C			3	0	0	3			
	BIOSAFETY, BIOETHICS AND IPR								
C P A			L	Т	Р	H			
3 0 0			3	0	0	3			
PREREQUIS	SITE: Human Ethics, Values, Rights and Gender Equal	ity							
COURSE O	JTCOMES:								
	Course Outcomes	Domain		Level					
After the com	pletion of the course, students will be able to								
CO1: Summarize the Bio safety regulations and protocols and Cog									
Apply the knowledge of handling Genetically Modified Organisms									
in the biosafe		Аррі	ying	,					
CO2: Recall	CO2: <i>Recall</i> and <i>Outline</i> the ethical conflicts in biotechnology, Cog								
positive and	Ke Un	ders	tandi	ing,					
environment,	environment, Impacts on biodiversity								
CO3: Define	and Summarize the concept of Intellectual Property	Cog	Re	mem	berin	ng,			
Rights (IPR),	Infringement of IPR and the IPR types		Understanding						
CO4: Recall	Un	Understanding,							
intellectual property rights Re									
CO5: Summe	urize the concept related to patents, Indian patent act	Cog	Un	derst	andi	nσ			
and Indian pa	tent application and <i>Apply</i> the knowledge to write		On	Applying					
patent applica	tion			<u>, , , , , , , , , , , , , , , , , , , </u>	ym <u>5</u>	,			
I BIOS	AFETY			10					
Introduction	to Biological Safety Cabinets - Bio safety regul	ations: Nati	ional	gui	delir	nes,			
Regulation fra	me work in India – Assessment of biological hazards -	- Different le	evels	of b	iosat	fety			
– Biosafety a	spects of the transgenic plants – Import and shipmen	t of transge	nic g	germ	plasr	n –			
Procedure for	Handling, Packaging and Transport of GMOs – C	convention of	of Bi	odiv	ersit	у —			
Cartagena Pro	otocol on safety, Advance Informed Agreement (AIA).								
II BIOH	THICS				9				
Introduction t	o Ethics – Ethics in Biotechnology – Ethical conflicts i	n biotechnol	ogy:	Inte	rtere	nce			
with nature, Positive and Negative effects of biotechnology - Socio economics con									
biotechnology – Environmental Concerns and Impacts on biodiversity and sustainable agriculture:									
Terminator se	ed technology, Slow ripening fruits.								
	ODUCTION TO INTELLECTUAL PROPERTY				<u> </u>	1.4			
Concept of In	lamerika Trada accrete Utility models Coographical	Kights – Pat	ents,	Cop	yrig	nts,			
IDESIGNS, ITAC	iemarks, fraue secrets, ounty models, Geographical	mulcation –	- 1111	mge	men	ιOI			
IF K.									
IV IPR – INTERNATIONAL SCENARIO									

Introduction to the leading international instruments concerning intellectual property rights – The Berne Convention – General Agreement on Tariffs and Trade (GATT) – World Trade

Organization (W	Organization (WTO) - Universal Copyright Convention (UCC) - The Paris Convention - The								
Agreement on	Trade-Related Aspects of I	ntellectual Property Rights (TRIPS	S) – The World						
Intellectual Prop	perty Rights Organization (W	IPO) – Budapest treaty.							
V PATEN	TS		7						
Concept related	to patents novelty - Non-ob	viousness - Types of patents: Utili	ty Patent, Design						
Patent, Plant patent – Indian patent act and foreign patents – Indian patent application – Drug									
patent – Patental	ble things and protection – Pa	atenting of living organisms and its o	difficulties.						
LECTURE TUTORIAL PRACTICAL TOTAL									
45	0	0	45						
TEXT BOOKS	:								
1. Iganacimuthu	S I, Bioethics, Narosa public	cations, 2008.							
2. Geethabali, B	iosafety Regulations & Prac	ctives in Biotechnology Industries,	I S T E learning						
Materials Centr	e.								
REFERENCES	5:								
1.Talbot, M. Bi	oethics: an introduction. Can	nbridge University Press, 2012.							
2.Arras, J. D., H	Fenton, E, and Kukla, R. The	Routledge companion to bioethics.	Routledge, 2014.						
3.Campbell, A.	V. Bioethics: the Basics. Ro	utledge, 2013.							
4.Chosewood,	L. C, and Wilson, D. E. Bios	afety in microbiological and biomed	lical laboratories.						
Diane Publi	ishing, 2007.								
5.Salerno, R. M., and Gaudioso, J. Eds. Laboratory Biorisk Management: Biosafety and									
Biosecurity. CRC Press, 2015.									
E-REFERENCES:									
1. http://www.	vub.ac.be/gst/eurobio/Biolog	y&Society.html							
2. http://dbtbio	safety.nic.in/								

http://dotoiosalety.mc.in/
http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf?ua=1

Cos Vs Pos

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

Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	0	0	2	0	5	6	0	12	4	0	0
Scaled to 0,1,2,3 scale	0	0	1	0	1	2	0	3	1	0	0

			L	Т	Р	С			
XTQ 506	TOTAL OUALITY MANACI		3	0	0	3			
	IOTAL QUALITY MANAGE								
C P A			L	Т	P	Н			
2.5 0 0.5			3	0	0	3			
COURSE OU	ICOMES:	Damain			T				
	Course Outcomes	Domain							
After the comp	letion of the course, students will be able to	0							
CO1: <i>List</i> and	<i>explain</i> the basic concepts of total	Cog		Remembering					
quanty concept	s and its initiations.			Und	erstar	nding			
CO2: Analyze	and <i>explain</i> the customer satisfaction,	Cog							
employee invol	vement, supplier selection and appraise			Com	prehe	nsion			
the performanc	e by TQM principle.								
CO3: Explain	and <i>apply</i> the statistical process control	Cog		Und	erstar	nding			
tools.	tools.								
CO4: Select an		Rem	embe	ering					
their significan		Und	erstar	nding					
CO5: Explain	the importance aspects of different	Cog		Understanding					
quality systems	3.								
I INTR	ODUCTION				9				
Definition of q	uality – Dimensions of quality – Quality pl	anning – Quality co	osts –	Anal	ysis				
techniques for	quality costs – Basic concepts of Total Qua	ality Management –	- Histo	orical	revie	w –			
Principles of T	QM – Leadership – Concepts – Role of ser	nior management –	Quali	ty Co	uncil	_			
Quality stateme	ents – Strategic planning – Deming philoso	phy – Barriers to T	'QM i	mpler	nenta	tion			
II TQM	PRINCIPLES				9				
Customer satist	faction – Customer perception of quality –	Customer complai	$\frac{1}{\text{nts} - s}$	Servi	ce qu	ality –			
Customer reten	tion – Employee involvement – Motivatio	on, empowerment, f	teams,	reco	gnitic	on and			
reward – Perfo	ormance appraisal – Benefits – Continuou	s process improver	nent -	– Jura	n tril	logy –			
PDSA cycle –	5S - Kaizen - Supplier partnership - Part	tnering – Sourcing	– Sup	plier	selec	tion –			
Supplier rating	- Relationship development - Performanc	e measures – Basic	conc	epts –	- Stra	tegy –			
Performance m	easure.								
IIISTATISTICAL PROCESS CONTROL (SPC)9									
The seven too	ols of quality – Statistical fundamentals	s – Measures of	centra	al ten	denc	y and			
dispersion – Po	pulation and sample – Normal curve – Co	ontrol charts for var	riables	s and	attrib	utes –			
Process capabil	lity – Concept of six sigma – New seven m	anagement tools.							
IV TQM	TOOLS				9				
			<u> </u>	-	1				
Benchmarking	- Reasons to benchmark - Benchmarking	process – Quality F	unctio	on De	ploy	nent			
(QFD) – House	(QFD) – House of quality – QFD process – Benefits – Taguchi quality loss function – Total								

V QUALITY SYSTEMS

Need for ISO 9000 and other quality systems – ISO 9000:2000 quality system – Elements – Implementation of quality system – Documentation – Quality auditing – TS 16949 – ISO 14000 – Concept, requirements and benefits.

L-45 hrs Total -45 hrs

9

TEXT BOOKS

- 1. Bhaskar S "Total Quality Management", Anuradha Publications, Chennai 2004.
- 2. Kulneet Suri, "Total Quality Management Principles & Practice Tools & Techniques", S K Kataria & Sons Delhi.

REFERENCES

- 1. Feigenbaum, A.V., "Total Quality Management", McGraw Hill, 1991.
- 2. Oakland, J.S., "Total Quality Management", Butterworth Heineman, 1989.
 - 3. Narayana V. and Sreenivasan, N.S., "Quality Management Concepts and Tasks", New Age International, 1996.
- 4. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.

E REFERENCE

1. <u>http://nptel.ac.in/faq/1101010/Prof.IndrajitMukherjee,IIT,Bombay</u>and Prof.TapanP.Bagchi, IIT, Kharagpur.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P12
CO1							2		2			2
CO2	2			2	2	2		2		2		
CO3	2			2	2	2	1	2		2		
CO4	2			2	2	2		2		2		
CO5	1			1	1	1	2	1	2	1		2
	7			7	7	7	5	7	4	7		4

Mapping of COs with POs

1 - Low, 2 – Medium, 3 – High

							L	Т	Р	С		
X	GS 5	507				-	1	0	0	1		
	00.			BUSINESS COMN	AUNICATION							
С	Р	Α				-	L	Т	Р	Н		
3	0	0				_	1	0	2*	3		
PRF	ERE	QUIS	ITE: Co	mmunication Skill and I	Basic Grammar K	nowledge				1		
CO	URS	E OU	TCOME	S:								
				Course Outcomes		Domain		L	evel			
Afte	r the	e comp	oletion of	the course, students will l	be able to							
CO1: Define and Identify different styles to various forms of business communication. Cog Remember												
CO2: Identify the proper tone of language required in writing andCogspeaking in business communication.Remember												
CO3: Display knowledge on grammar and other linguistic featuresCogin writing various forms of business communication.Understar												
CO4: Distinguish between letters and memos and various formsCogof Business Communication.Cog												
COS	5: Pr	repare	business	reports, minutes, proposa	ıls.	Cog	Ар	ply				
Ι		INTR	ODUCT	ON TO BUSINESS CO	OMMUNICATION	I			10			
Intro	oduc	tion to	business	communication; modern	developments in th	e style of w	riting	g lette	ers			
men	105 a	and rep	orts: bloc	k letters, semi block lette	ers, full block letters	s, simplified	l lette	rs et	с.,			
II		USE	OF LAN	GUAG E					10			
The	lang	guage i	used in m	emos/minutes/telephone	memos/ letters/ ass	ignments ar	t of v	vritir	ng E-1	nail		
etc.	Adv	antage	s of writt	en and spoken communic	ation.				1			
III		GRAN	MMAR						10			
The	use	of acti	ive and pa	assive voice; the use of g	rammar, propriety,	accuracy, e	exacti	ness	, the t	one		
& ot	her	elemei	nts of lan	guage used in these writin	ngs.							
IV	•	TYPE	S OF RE	PORTS					5			
The	forn	nat of	various ty	pes of Reports/ projects e	etc.,							
V		BUSI	NESS WI	RITING					10			
Writ	ing	Busine	ess reports	s, proposals and minutes.								
	LE	CTU	RE	TUTORIAL	PRACTICA	L	Τ	OTA	L			
		45		0	0			45				
TEX	KT E	BOOK	S									
1	l. E	Bailey	E P, Writ	ing & Speaking At Work	A Practical Guide	for Business	s Con	nmur	nicatio	ons		
	P	<u>' H I P</u>	ress.									

2. Mukerjee, Business Communication, Oxford, Chennai, 2013.

E REFERENCE

1.<u>https://is.muni.cz/el/1456/jaro2014/MPV_COMA/um/E-book_Business-Communication.pdf</u> 2.http://communication-revolution.biz/wp-content/uploads/2013/12/The-Business-Communication-Revolution.pdf

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	0	0	1	0	0	0	0	0	1	0	0	0
CO2	0	0	0	0	0	1	2	0	0	0	0	0
CO3	0	0	0	0	0	1	1	2	0	0	0	0
CO4	1	1	0	0	1	1	2	1	1	0	0	1
CO5	1	0	0	2	0	2	3	2	3	0	0	1
	2	1	1	2	1	5	8	5	5	0	0	2

1 - Low, 2 – Medium, 3 – High

					L	Τ	Р	C
2	XBT 50	8			0	0	0	1
			INPLANT TRAINING	- II				
С	Р	Α			L	Т	Р	Η
0.66	0.66	0.66			0	0	0	0
PREI	REQUI	SITE:-	Nil					
COU	RSE O	UTCO	MES:					
			Course Outcomes	Domain	L	evel	l	
On th	e succe	essful co	ompletion of the course, students will be ab	ole to				
CO1	Rela	te classr	oom theory with workplace practice	Cog	Und	ersta	and	
CO2	Con	ply with	Factory discipline, management and	Aff	Res	spon	se	
	busi	ness prac	ctices.					
CO3	Den	onstrate	s teamwork and time management.	Aff	V	alue	•	
CO4	Dese	cribe and	l display hands-on experience on practical	Phy	Perc	cepti	on	
	skill	s obtaine	ed during the programme.			Set		
CO5	Sum	marize t iments a	he tasks and activities done by technical nd oral presentations.	Cog	Ev	alua	te	

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	2											
CO2							1	3			1	
CO3									3	1	3	1
CO4		1	2	1	3							3
CO5				3						3		1
Total	2	1	2	4	3		1	3	3	4	4	5

1 - Low, 2 – Medium, 3 – High

L T P C										
X	BT 6	602			3	0	0	3		
			ANIMAL BIOTECHNOLOGY					<u>.</u>		
С	Р	Α			L	Т	P	Η		
2.5	0	0.5			3	0	0	3		
PRF	CRE	QUIS	ITE: Cell biology, Genetic engineering							
COU	JRS	E OU	TCOMES:							
			Course Outcomes	Domain		L	evel			
Afte	r the	comp	letion of the course, students will be able to							
CO1	l: Ex	cplain	animal cell culture media and animal cell culture	Cog	U	nder	stand	ling		
tech	niqu	es.								
CO2	CO2: Describe various gene transfer methods in animal cells. Cog									
CO3	B: Ar	nalyze	various micromanipulation techniques and	Cog	A	pply	ing			
repr	odu	ce the	m in fertilization technology.	Aff	R	esp.	pher	1.		
CO4	:Di	stingu	<i>tish</i> various methods and techniques for production	Cog	U	nder	stand	ding		
of tra	ansg	enic a	nimals and cloning.	- 6				0		
COS	5: De	escribe	manipulation strategies to improve livestock	Cog	E	valua	ating			
prod	uctio	on incl	uding meat and milk production	U			U			
	Ι		CELL CULTURE TECHNIQUES				9			
Туре	es an	d con	position of media – Culture vessels and substrates us	sed for cell	cult	ıre -	Prin	nary		
and	seco	ndary	cell lines - Monolayer culture - Suspension culture	– Types, e	estab	lishn	nent	and		
char	acter	izatio	n of cell lines; Differentiation and Scaling up of anim	al cell cultu	ire-]	Meas	surer	nent		
of ce	ell de	eath, v	iability and cytotoxicity; Immobilized cultures; Hybrid	doma techn	olog	y.				
	Π		GENE TRANSFER TECHNIQUES				9			
Туре	es of	Gene	e transfer methods - Micromanipulation technology;	Biology and	d Co	nstru	ictio	n of		
viral	vec	tors lil	ke SV40, adenovirus, lentivirus, vaccinia virus, herpe	s virus, and	ade	no as	soci	ated		
virus	s, ba	culovi	rus, Transfection methods; stable and transient metho	ods – Clonir	ng te	chnie	ques	and		
strat	egies	5.								
	III		INVITRO FERTILIZATION AND EMBRYO T	RANSFE	8		9			
Invit	ro f	ertiliz	ation and its limitations - Artificial insemination	, Super ov	vulat	ion,	Eml	oryo		
split	ting,	Biop	sy and Sexing of embryos and Embryo transfer	- Embryo	cry	opres	serva	tion		
tech	niqu	es - Li	imitations in embryo transfer - Breeding of farm anim	als.						
		<u> </u>	MANIPULATIONS FOR PRODUCT IMPROV	EMENT			9			
Man	ipula	ation	of Growth hormone; Role of Somatotropic and Th	yroid horm	none	in g	grow	th -		
Prob	10t1C	s as g	growth promoters; Ideal characteristics, Mode of ac	tion and us	ses o	of pr	ob10	tics;		
Man	ipula	ation (or factation – Lactogenesis and galactopolesis, wool	growth and	run	ien n	nicro	onal		
dige	stive	syste					0			
C a -	V	d :	IKANSGENIU ANIWALS	integring f-	+h -		9 104	n of		
Scop	cope and importance of transgenic animal technology - Various strategies for the production of									
trans	gen	c ann	nais: pronuciear microinjection, embryonic stem ce	its and son	natic	cell	nuc	lear		

transfer – Gene knock in and knock out models for studying human disorders - Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutics – Ethical concerns regarding transgenesis.

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
CO 1	3	2	1	2	2	0	1	1	2	1	1
CO 2	3	1	2	1	2	0	0	1	0	2	1
CO 3	3	1	2	3	3	2	2	1	2	2	2
CO 4	3	2	2	2	3	1	1	1	1	2	2
CO 5	3	2	3	1	2	2	1	1	1	2	2
	15	8	10	9	12	5	4	5	6	9	8

Subject Versus POs

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

			L	Т	Р	С			
XBT 603			3	0	1	4			
	IMMUNOLOGY								
C P A			L	Т	Р	H			
1.5 1 0.	5		3	0	2	5			
PREREQU	ISITE: Cell biology and Microbiology								
COURSE O	OUTCOMES:								
	Course Outcomes	Domain		L	evel				
After the cor	npletion of the course, students will be able to	G			1				
COI: Outlin	the general concepts of immune system and	Cog	Remembering						
describe the	cells and organs of the immune system	q	T	Evaluating					
CO2: Expla	ins the properties of antigens and antibodies and	Cog	l	nder	stanc	ling			
<i>identify</i> them	Psy		Perc	ceptio	on				
CO3: Descri	CO3: <i>Describe</i> various mechanisms of antigen presentation and Cog								
<i>discuss</i> the r		Resp	onds	to					
				Pher	nome	na			
CO4: Comp	ares the different types of hypersensitive reactions	Cog		Ana	lyzir	ng			
and <i>explain</i>	the autoimmune disesases.		U	Inder	stanc	ling			
CO5: Comp	<i>rehend</i> the types, mechanism of vaccines and	Cog	U	Inder	stanc	ling			
<i>respond</i> to the	ne various immunization techniques	Psy		Guid. Resp.					
Ι	IMMUNE SYSTEM			ç	9+3				
Introduction	- types of immune system: Innate and adaptive	e – Antigen	prese	entin	g ce	lls -			
Lymphocyte	s their origin, activation and differentiation – Hema	topoiesis - Ce	lls o	f the	imn	nune			
system - Org	gans of the immune system: primary and secondary ly	mphoid organ	s.						
Experiment	No 1: Blood grouping – An immunological view.								
Experiment	ANTICEN ANTIDODY INTED ACTIONS	>			0.2				
Antigona: In	ANTIGEN - ANTIBODY INTERACTIONS	divuente Ar	atibo	dur (9+3	turo			
Classes and	Biological Activities Monoclonal antibodies Mul	ltigene Organi	nuuu zatio	uy. s	Ia G	onos			
- Variable R	egion Gene Rearrangements - Generation of Antibo	lugelle Olgalli. dy Diversity -	Zauo Anti	gen_	Ig U Antil	ody			
Interactions:	Cross-Reactivity Precipitation and Agglutination	Reactions Ir	nmii	notec	hnio	mes.			
ELISA RIA	Flow cytometry etc	Redetions, in		notes	Jinne	[uc 5.			
	, i iow cytomotry cto.,								
Experiment	No 3: Ouchterlony Double diffusion test.								
Experiment	No 4: Single radial diffusion test								
Experiment	No 5: Enzyme Linked Immuno Sorbent Assay								
	-								
III	MHC AND ANTIGEN PRESENTATION				9+3				
MHC Moleu	les: Structure, Organization, Inheritance and Cellula	ar Distribution	. Ag	pres	senta	tion:			
Self-MHC F	Restriction of T Cells, Endogenous Antigens: The	Cytosolic Pat	hwa	y, Ez	xoge	nous			

Antigens: The Endocytic	Pathway, Presentation of Nor	npeptide Antigens.								
Experiment No 6: Immun	oelectrophoresis									
Experiment No 7: Rocket	immunoelectrophoresis									
VI IMMUN	NE RESPONSES		9+3							
Cytokines and their role i	in immune response – proper	ties and receptors, Compl	ement: Functions,							
components and activation, Hypersensitive reactions and their types. Autoimmune diseases:										
organ specific and systemic – Immunological basis of graft rejection – Immunosuppressive drugs										
and clinical transplantations										
Experiment No 8 : Widal	Test									
Experiment No 9 : Latex	agglutinization test									
V VACCI	NES AND CANCER IMM	UNOLOGY	9+3							
Vaccines: Active and	d Passive Immunization,	Whole-Organism Va	ccines, Purified							
Macromolecules as Vac	cines, Recombinant-Vector	Vaccines, DNA and Mu	ultivalent Subunit							
Vaccines. Tumors of the	Immune System - Tumor A	Antigens - Immune Resp	onse to Tumors –							
Cancer immunotheraphy.	-	0								
Experiment No10: Demo	nstration of Selection of anir	nals, Preparation of antige	ens, immunization							
and m	hethod of bleeding, Serum ser	paration and storage.	,							
Experiment No 11 : West	ern blotting									
LECTURE	TUTORIAL	PRACTICAL	TOTAL							
45	0	15	60							
TEXT BOOKS:										
1. Tizard, R.I. (2007). Immunology: An Introduction 1st Edition (English) 4th Edition,										
Brooks/Cole publishers.										
2. Roitt, I., Essential Imm	unology, Blackwell Scientifi	c Publications, Oxford, 12	2th							
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. Janes Kuby., Immunology, WH Freeman and Company, Newyork.,7th Edition, 2013.

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

Cos Vs PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	1	1	0	1	2	2	1	1	0	2	2
CO 2	2	3	2	2	2	1	1	0	1	0	0
CO 3	3	1	2	1	2	0	0	0	1	1	1
CO 4	1	3	2	3	2	1	2	1	1	2	1
CO 5	3	2	3	3	3	2	2	2	3	2	2
	10	10	9	10	11	6	6	4	5	7	6

Subject Versus POs

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

					L	Τ	Р	С		
X	BT6	04			3	1	1	5		
			BIOCHEMICAL ENGINEERING							
С	P	Α			L	Τ	Р	Н		
1.5	1	0.5			3	2	2	7		
PRE	ERE	QUISI	TE: Bioprocess Engineering.							
CO	URS	E OU'	ICOMES:							
			Course Outcomes	Domain			Leve	1		
Afte	r the	comp	letion of the course, students will be able to		I					
CO	l:Re	ecall a	nd <i>describe</i> the basics of biochemical process.	Cog		Remembering				
			-	Aff		Re	ceivi	ing		
						Phenomena				
CO2	2:01	utline	and <i>differentiate</i> the enzymes and its kinetics	Cog		Unde	erstai	nding		
	Psy									
CO	CO3: <i>Identify</i> and <i>select</i> a kinetic model for a biochemical Cog									
proc	ess			Psy		Pe	rcept	ion		
CO ₄	1: Re	cogni	ze, perform and detect various immobilization	Cog		Unde	erstai	nding		
tech	niqu	es for a	a biochemical process.	Aff		Res	pond	ls to		
				Psy		Phenomena				
						Perception				
COS	5: Id	entify,	<i>choose</i> and <i>follow</i> a design for a bioreactor.	Cog		Understanding				
				Aff		Re	ceivi	ing		
				Psy		Phe	enom	iena		
						(Guide	ed		
						re	spon	se		
	Ι		INTRODUCTION TO BIOCHEMICAL ENGI	NEERING		Ģ)+3+	3		
An	over	view o	of industrial biochemical processes with case stud	ies – compa	aring	che	mica	1 and		
bioch	emio	cal pro	cesses - development and scope of biochemical engi	ineering - In	dusti	ially	impo	ortant		
micro	obial	strains	s - classification, structure - molecular genetics and	control syste	ms.					
	II		ENZYMES AND ITS KINETICS			9)+3+;	3		
Enzy	ymes	and t	heir classifications – mechanism of enzyme reacti	ons – M-M	kine	etics	– en	zyme		
inhil	oitio	n – ei	zyme stability- factors affecting reaction rates –	industrial p	orodu	iction	1 pro	ocess-		
Indu	stria	l appli	cations of enzymes.	-			-			
		-								
Expe	erim	ent No	1: Study of M-M kinetics and determination of M-M	I constants.						
Expe	erim	ent No	2: Effect of physical parameters such as temperature	e and pH on	Enzy	me /	Activ	ity.		
	III		BIOCHEMICAL SYSTEMS			9)+3+;	3		
Imm	obil	ized 1	nicrobial cells, carrier binding, Entrapping, Cr	oss linking	, A	dvant	ages	and		
disa	dvan	tages	of immobilized cells, -methods and effect of ma	ss transfer -	-Imr	nobil	izati	on of		

microbial cells for the production of bioproducts–Immobilized cell reactor experiments-Experimental reactor systems Various immobilization Technology Case Study: Ethanol fermentation in an immobilized cell reactor using *Saccharomyces cerevisiae*

Experiment No 3:Enzyme immobilization by physical adsorption.

Experiment No 4: Enzyme immobilization by Gel Entrapment.

IV	BIOCHEMICAL REACTION KINETICS	9+3+3

Microbial, animal and plant cell cultivation – growth measurements – growth kinetics – factors affecting the growth – Monod Model – modeling of batch and continuous cell growth – immobilized whole cells and characteristics – free cell and immobilized cell reactors.

Experiment No 5: Study of Production of growth and/or non-growth associated products.

Experiment No 6: Study of Microbial Growth kinetics and estimation of Monod parameters.

V	BIOREACTORS DESIGN	9+3+3

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

Experiment No 7: Comparative Study of Batch, fed batch and/or continuous cultures. Experiment No 8: Production of Enzymes.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	15	15	75

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.

REFERENCES:

- 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.
- 3. http://www.novozymes.com/en/about-us/our-business/what-areenzymes/Pages/default.aspx

E REFERENCES:

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

COs Vs POs

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

CO 5	1	2	3	1							
	6	7	8	2	0	0	0	0	1	0	1

Subject Vs POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original	6	7	8	2	0	0	0	0	1	0	1
value											
Scaled	2	2	2	1	0	0	0	0	1	0	1
to											
0,1,2,3											
scale											

		L	Т	Р	С					
XI	BT 6	05			3	1	0	4		
			PROTEIN ENGINEERING							
C	P	A			L	T	P	H		
2.5	0	0.5			3	2	0	5		
PREI	REQ	UIST	E: Biochemistry, Molecular Biology							
COU	RSE	OUT	COMES:							
			Course Outcomes	Domain	Level					
After	the c	omple	tion of the course, students will be able to	~						
co1: prima	<i>Exp</i> ry st	<i>lain</i> a ructure	nd understand the aminoacid characteristics and e of proteins	Cog		Understanding				
CO2:	Exp	<i>lain</i> a	nd <i>analyze</i> the secondary and super secondary	Cog	1	Unde	erstar	ding		
struct	ural	feature	s			An	alyzi	ng		
CO3:	Des	cribe a	and <i>compare</i> the different level of protein	Cog		Rem	embe	ering		
struct	ure a		An	alyzi	ng					
CO4:	Exp		Aj	oplyi	ng					
relate		Org	aniza	tion						
CO5:	Exp	<i>lain</i> th	ne protein engineering concepts and <i>assist</i> that in	Cog		Ap	oplyi	ng		
variou	ıs en	gineer	ed protein production.			Responds to				
						phenomena				
	Ι		STRUCTURE AND FUNCTIONAL ASPECTS	OF		9 + 3				
			AMINOACIDS							
Amin	o aci	ds fou	nd in proteins - acid-base properties of amino acids	- Stereoche	emica	al				
repres	senta	tions c	f amino acids - Peptide bonds - chemical and physic	cal properti	es of	ami	no ac	ids -		
Detec	tion,	identi	fication and quantification of amino acids and prote	ins – Sterec	oison	nerisi	n - N	lon-		
standa	ard a	mino a	cids - Primary structure of proteins - peptide mapp	ing and pep	otide	sequ	encir	ıg –		
Edma	n de	gradati	ion method.							
	II		PROTEIN ARCHITECHTURE				9 + 3			
Secon	ndary	struct	ure of proteins – α helix, β strands, turns and addition	onal second	ary s	truct	ure –	-		
Rama	chan	dran p	lot – Tertiary structure – Interactions that stabilize t	he tertiary s	struct	ture -	-			
Organ	nizati	on of	Domains – Quaternary structure – Importance of qu	aternary str	uctur	es in	glob	oin		
family	y – h	aemog	lobin and allosteric regulation – Methods to determ	ine the thre	e-din	nensi	onal			
struct	ure o	f prote	eins.							
	III		PROTEIN FOLDING AND ASSEMBLY				9 + 3			
Protei	in fol	ding:	Molten globule state – Role of hydrophobic residues	s in folding	– Siı	ngle	and			
multi	multiple protein folding pathway - Role of disulphide bonds in protein folding - Invivo protein									
foldin	ıg: St	ructur	e of Molecular chaperones and their role in protein	folding – os	moly	yte as	ssiste	d		
protei	n fol	ding -	Amide exchange and measurement of protein folding	ng – Membr	rane	prote	ein			
foldin	ıg – I	Protein	misfolding and the diseased state: amyloidosis.							

IV	PROTE RELAT	IN STRUCTURE AND FU IONSHIP	UNCTION	9 + 3						
Helix turn helix	motif in	DNA binding proteins - Role	e in prokaryotic and euka	yotic transcription						
factors - Trp rep	pressor -	Zn fingers & Leucine zipper	rs - Membrane proteins ar	nd receptors :						
bacteriorhodops	sin – Strue	cture function relationship in	Immunoglobulin – Enzy	mes: Serine						
proteases mechanism of action.										
V	PROTE	IN ENGINEERING		9 + 3						
engineering – SNP –Production of Peptide Vaccines – Protein microarray and its role on disease diagnosis.										
LECTURE TUTORIAL PRACTICAL TOTAL										
LECTUR	RE	TUTORIAL	PRACTICAL	TOTAL						
LECTUR 45	RE	TUTORIAL 15	PRACTICAL 0	TOTAL 60						
LECTUR 45 TEXT BOOKS	RE S:	TUTORIAL 15	PRACTICAL 0	TOTAL 60						
LECTUR 45 TEXT BOOKS 1. Voet D., Vo	RE S: Det G. Bio	TUTORIAL 15 chemistry, 4th edition, John	PRACTICAL 0 Wiley & Sons, 2010.	TOTAL 60						
LECTUE 45 TEXT BOOKS 1. Voet D., Vo 2. Lilia Alberge Academic Publ	RE S: Det G. Bio nina. Prote ishers, 20	TUTORIAL 15 chemistry, 4th edition, John ein Engineering in Industrial 03.	PRACTICAL 0 Wiley & Sons, 2010. Biotechnology, CRC press	TOTAL 60 ss, Harwood						
LECTUR 45 TEXT BOOKS 1. Voet D., Vo 2. Lilia Albergh Academic Public REFERENCE	RE S: Det G. Bio Dina. Prote ishers, 20 S:	TUTORIAL 15 chemistry, 4th edition, John ein Engineering in Industrial 03.	PRACTICAL 0 Wiley & Sons, 2010. Biotechnology, CRC press	TOTAL 60 ss, Harwood						

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

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

Cos Vs POs

CO 3	3	1	2	1	2	0	0	0	1	1	1
CO 4	1	3	2	3	2	1	2	1	1	2	1
CO 5	3	2	3	3	3	2	2	2	3	2	2
	10	10	9	10	11	6	6	4	5	7	6

Subject Vs POs

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

					L	Τ	Р	С		
XB	T 60)6 A			3	0	0	3		
		1	DRUG DISCOVERY AND DEVELOPME	NT						
C	P	A	-			T	P	<u>H</u>		
2.5	U	0.5			3	U	U	3		
PRF	ERE	QUIS	ITE: Basic chemistry, Biochemistry							
CO	COURSE OUTCOMES:									
			Course Outcomes	Domain]	Leve	l		
Afte	r the	e comp	pletion of the course, students will be able to							
CO	נ <i>E</i> : E	xplain	the drug development time line and <i>compare</i>	Cog	1	Inde	retan	dina		
vario	various drug formulations.									
CO2	CO2: <i>Outline</i> the theoretical concepts behind the drug design. Cog Understanding									
CO3	CO3: Elaborate the steps involved in drug development process. Cog Creating									
CO4: <i>Design</i> and <i>Develop</i> new drug delivery systems Cog Receiving										
	Aff									
	1	Understanding								
CO:	CO5: <i>Understand</i> and <i>Summarize</i> the importance of clinical trials Cog Creating									
I GENESIS OF NEW DRUGS 9										
Intro	- oduc	tion to	o rational drug design & its history: drug discovery and	1 developme	ent ti	me li	ne- F	Plants		
as a	sour	ce of	drugs-Microbial drugs. Pharmacokinetics and pharma		5. Dr	ug fo	ormul	ation		
cons	sider	ations	- Tablets, capsules, powders and granules.	·····j						
	II	•	MECHANISM OF DRUG DESIGN				9			
Rece	eptoi	s, the	eir types, location and isolation, types of interaction	ons with th	ne di	ug 1	nole	cules,		
dosa	ige-r	espon	se relationships, mechanisms of drug action (Receptor	theor	ries).	Mole	cular		
inter	ractio	ons: P	rotein –drug, protein-protein, protein-DNA.							
	III		DRUG DISCOVERY PROCESS				9			
Stages in drug discovery- Target selection, Lead Discovery- assay development, high throughput										
screening, Medicinal chemistry- Structure activity relationship, insilico drug design- In vitro										
studies- In vivo studies, clinical trials.										
	IV		DRUG DELIVERY SYSTEMS				9			
Oral delivery systems- Pulmonary delivery- Nasal, transmucosal and transdermal delivery systems-										
Bio-adhesive drug delivery systems; Proteins and peptide drug delivery. Transdermal therapeutic										
syste	ems	and O	cular and intrauterine delivery systems.							
V			CLINICAL TRIALS AND REGULATORY AFFA	AIRS			9			
Clin	ical	trials	I, II, III- Toxicity studies - Reproductive toxicity and	d teratogeni	city-	Mu	tagen	icity,		
carc	carcinogenicity- The role and remit of regulatory authorities- The Food and Drug Administration-									

The investigational new drug application- European regulations- Drug registration in Japan- World harmonization of drug approvals- Patenting

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT BOOKS:

- 1. Vyvas S P. Pharmaceutical Biochemistry. CBS Publishers.
- 2. Hillary.M. Drug delivery and targetting. CRC publications, New Delhi, 2010.

REFERENCES:

- 1. Harvey, Richard A., et al. Lippincott's illustrated reviews: Pharmacology. Vol. 526. Baltimore, MD: Lippincott Williams & Wilkins, 2012.
- Leach, A.R., Molecular Modelling: Principles and application, Princeton Hall, London, 2nd Edition, 2001
- 3. Krogsgaard, L., Povl Madsen, Text Book of Drug Design and Discovery, CRC, London, 3rd Edition, 2002
- 4. A.D.Baxevanis & B.F.F.Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley Interscience, New York, 3rd Edition, 2004
- Sandler, M., Smith, H. J., Design of Enzyme Inhibitors as Drugs, Oxford University Press, London, 4th Edition, 2002

E- REFERENCES:

- 1. http://nptel.ac.in/courses/104103068/2
- 2. http://nptel.ac.in/courses/102103044/40
- 3. http://nptel.ac.in/courses/104103068/

COs Vs Pos

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

CO 5			3		2	3	3	3			3
	6	3	10	4	10	13	3	8	1	1	6

Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	6	3	10	4	10	13	3	8	1	1	6
Scaled to 0,1,2,3 scale	2	1	3	1	2	3	1	2	1	1	2

					L	Т	P	С	
XBT	C 606 B		PHARMACEUTICAL BIOTECHNOLOG	V	3	0	0	3	
			THANNACEUTICAL DIOTECHNOLOG	1					
С	Р	Α			L	Τ	P	Η	
2.0	0	0.5			3	0	0	3	
PRE	REQUI	SITE: 1	Immunology						
COL	JRSE O	UTCO	MES:						
			Course Outcomes	Domain		Ι	Level		
After	r the con	pletion	of the course, students will be able to						
C01	: Descri	bes the	various aspects of Biopharmaceuticals and	Cog		Rem	embe	ering	
know	vs the fu	ture asp	ects		1	Unde	erstan	ding	
CO2	: Explai	<i>n</i> and <i>c</i>	ompare the various metabolisms involved in	Cog	1	Unde	erstan	ding	
drug	drug delivery. Aff Organization								
CO3	: Explai	<i>n</i> the pr	roduction of various hormones and <i>describes</i>	Cog		Rem	embe	ering	
their	1	Understanding							
CO4	1	Understanding							
enzy	enzymes for therapeutical purposes. Analyzing								
CO5	CO5: <i>Explain</i> and <i>apply</i> the modern approaches in the production Cog Understanding								
of va	of various synthetic drugs Applying								
	т	INTR	ODUCTION TO PHARMACEUTICAL				0		
	1	BIOT	ECHNOLOGY				,		
Intro	duction	to phar	maceutical products- Biopharmaceuticals and	pharmaceut	ical t	oiote	chno	logy-	
Histo	ory of t	he pha	rmaceutical industry- the age of biopharmac	ceuticals- E	Bioph	arma	icueti	icals:	
Curre	ent statu	s and Fi	iture Prospects.						
		DILAT							
A 1	II	PHAR	MACOKINETICS			1 1	9		
ADSC	orption -	- Struct	ure of cell memorane, Gastro-Intestinal absor	ption of dru ibution Ma	igs, i tobol	vieci	1anisi Dha		
and I	ausorpu Phase_II	reaction	sorption of drugs Principles of basic and cl	inical Pharn	tabol	isiii -		180-1,	
	nase-n	reaction	is, Excretion of drugs, i finciples of basic and en	inical i nam		lineu	105.		
	III	GRO	WTH FACTORS AND HORMONES				9		
Haer	nopoieti	c growt	h factors – Granulocyte and Macrophage colony	stimulating	g fact	or, Ir	nsulir	ı like	
grow	th factor	rs , Epic	lermal growth factor, Platelet growth factor, Ne	urotrophic f	factor	rs – I	Horm	iones	
of the	erapeutio	c interes	t – Insulin, Glucagon – Human growth hormone	es – Gonado	otropl	nins			
	IV	BLOO	DD PRODUCTS AND THERAPEUTIC ENZ	YMES			9		
Disc	aca tran	emissio	n Whole blood Platalate and rad blood	celle D	1004	cub	otitut		
Haer	nostasis	– Antitl	rombin – Thrombolytic agents – Enzymes of th	erapeutic v	alue	sub	siitut	05 -	

V ANTIBODIES, VACCINES, ADJUVANTS AND ANTI-SENSE TECHNOLOGY

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.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT BOOKS:

- 1. Vyvas S P. Pharmaceutical Biochemistry. CBS Publishers.
- 2. Walsh and Gory, "Pharmaceutical Biotechnology", Wiley Publishing, Chennai 2011.

REFERENCES:

- 1. Gary W., "Biopharmaceuticals: Biochemistry and Biotechnology", Second Edition, John Wiley, 2003
- 2. F.S.K. Barar, Essential of Pharmacotherapeutics. 1998.
- 3. RS Satoskar Nirmala Rege SD Bhandarkar, Pharmacology & Pharmacotherapeutics, June 2015.

E REFERENCES:

- 1. http://ocw.kyoto-u.ac.jp/en/pharmaceutical/course01/lecturenote.htm
- 2. http://fac.ksu.edu.sa/aalshamsan/course-material/71477
- 3. http://site.iugaza.edu.ps/tbashiti/files/2013/02/2.Pharmaceutical_Biotechnology_ConceptsAppli cations-Gary_Walsh.pdf

Cos Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	-	1	1	2	2	-	-	1	1	1
CO 2	1	1	1	1	2	2	1	2	1	2	2
CO 3	2	2	2	2	1	2	2	-	2	2	1
CO 4	2	1	3	2	2	3	2	-	1	1	-
CO 5	2	3	2	2	3	3	2	2	2	2	1
	9	7	9	8	10	12	7	4	7	8	5

Subject Vs POs

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

			L	Τ	Р	С			
XBT 606C			3	0	0	3			
	CLINICAL TRIALS AND REGULATORY AF	FAIRS							
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			L 2	T	<u>P</u>				
			3	U	U	3			
PREREQUI	SITE: Biosafety and Bioethics								
COURSE O	UTCOMES:				T				
A.C	Course Outcomes	Domaii	n		Le	vel			
After the com	inpletion of the course, students will be able to								
and Post M	CO1: <i>Relate</i> the different phases and types of a clinical trials, and Post Marketing Surveillance (PMS); <i>Make use of</i> the concepts in real life clinical trial experiments								
CO2: Recall	the components of clinical research. Study design	Cog							
Randomizatio	Randomization, Blinding; <i>Outline</i> the Recruitment of study design, participants for clinical trials								
CO3: Define	and <i>Summarize</i> the aims and objectives of drug and	Cog		D	mon	aharing			
cosmetics act			dora	tonding					
packaging of drugs.									
CO4: Recal		Ur	dore	tanding					
pharmaceutic	al industries, Regulatory authorities in India, Indian			DI D	mon	ahoring			
regulatory ap	proval process			Kennenhoernig					
CO5: Explai	<i>n</i> and <i>compiles</i> the types, categories, content of	Cog	Understandin			tanding			
INDs and the	guidance documents for INDs	Aff		Responds to					
		7 111		F	hence	omena			
I INT	RODUCTION TO CLINICAL TRIALS				8	8			
Introduction	to Clinical trials - Phases of a Clinical Trial - Type	es of Clinic	al Tri	als:	Expe	erimental,			
Non-experim	ental, Randomized and Superiority clinical trials - P	ost Market	ing Sı	ırvei	llanc	e (PMS):			
Regulatory G	uidelines governing PMS studies, Advantages of PMS	S studies.							
II CON	MPONENTS OF CLINICAL RESEARCH					8			
Components of Clinical Research – Role of Individual: Clinician, Principal investigator, Biochemist,									
Statistician –	Study Design: Randomization, Blinding, and Recruitr	ment of stud	dy par	ticip	ants	– Role of			
Bioinformatio	cs – Role of pharmacovigilance.								
III THE	E DRUGS AND ACT					10			
Introduction to Drugs and Cosmetics Act – Aims and Objectives, Definitions, Administrative bodies –									
Schedules to	Drug Rules: Import of drugs, Manufacture of dr	ugs, Sale	of dru	ıgs,	Labe	eling and			
Packaging of	drugs – Penalties for offence regarding sale of drugs.	-				-			

IV FOOD AND DRUG ADMINISTRATION (FDA)

10

Introduction to Food and Drug Administration - Laws enforced by the FDA and related statutes -

Related provisions of Code of Federal Regulations – FDA certification – FDA guidelines for industry – Regulatory authorities in India: Indian FDA, DCGI, GEAC, AERB, DGFT, DTAB and DBT Guidelines and other important provisions – Indian regulatory approval process – Regulatory timelines: Approval timeline, Approval letter.

V INVESTIGATIONAL NEW DRUG (IND) REQUIREMENTS

9

Introduction to IND application – Types of INDs – Categories of INDs – Content of INDs – Resources for IND Applications – Guidance Documents for INDs – FDA's Drug Review Process – Stages of Drug Development – Drug Safety Oversight Board (DSOB).

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT BOOKS:

1. Machin D. Clinical Trials. Wiley Publications.

2. Vishal Bansal, D. Clinical Research. Paras Medicals.

REFERENCES:

1.Hackshaw, A. A concise guide to clinical trials. John Wiley & Sons, 2011.

2.Pocock, S. J. Clinical trials: a practical approach. John Wiley & Sons, 2013.

3. Dumitriu, H. I. A Regulatory Affairs Quality Manual, 1997.

4. Meinert, Curtis L. Clinical Trials: Design, Conduct and Analysis. Oxford University Press, 2012.

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 $1. \ https://www.nih.gov/health-information/nih-clinical-research-trials-you/basics \#2$

2. https://clinicaltrials.gov/ct2/info/understand#WhatIs

3. https://policylibrary.gatech.edu/research-support/investigational-new-drug-ind-application

4. https://www.fda.gov/Drugs/DevelopmentApprovalProcess/default.htm

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1				2	1	2		1			
CO 2			3	2	1	2		1			
CO 3					1	2			1		
CO 4					1	2			1		
CO 5			3	2	1	2		2	1		
	0	0	6	6	5	10	0	4	3	0	0

Cos Vs Pos

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	0	0	6	6	5	10	0	4	3	0	0
Scaled to 0,1,2,3 scale	0	0	2	2	1	2	0	1	1	0	0

	L	Τ	Р	С					
Х	KBT6	07	ENVIRONMENTAL STUDIES	3	0	0	0		
С	Р	Α		L	Т	P	Η		
2.6	3	0	0	3					
PRE									
COL									
	n]	Leve	l					
Afte									
CO1	: Abl	e to Su	<i>mmarise</i> and <i>Apply</i> natural resources and Cog		Understanding				
rene	wable	energy	y and non-renewable energy sources. Cog		Cog				
CO2	1	Applyimg							
flows and energy auditing. App									
CO3	: Abl	e to <i>int</i>	erpret genetic species and ecodiversity Cog	4	Analyzing				
CO4 pollu	: Able	e to <i>ide</i> probler	<i>ntify</i> pollutants in day to life and to solve Cog ns.		Identify				
CO5	: Ans	wer for	solving the environmental and social issues Psy		Guid	ed			
(Gui	ded R	espons	se, Responded Phenomena). Cog		Resp	onse,			
							ıds,		
	1	Responded to							
		Phen	omer	ıa					
		MUL.	IIDISCIPLINAKY NATUKE OF ENVIKONMENTAL			9			
		STUD	IES AND NATURAL RESOURCES						
Defi	rces:	Use	and	over-					

Definition, scope and importance, Need for public awareness, Forest resources: Use and overexploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, Case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

II ECOSYSTEMS

Concept of an ecosystem, Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the

9

following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

III BIODIVERSITY AND ITS CONSERVATION

Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

	IV ENVIRONMENTAL POLLUTION 9	
--	------------------------------	--

Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: Foods, earthquake, cyclone and landslides.

V

SOCIAL ISSUES AND THE ENVIRONMENT

9

9

From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population- Population growth, variation among nations. Population explosion – Family Welfare Programme and Environment - Environment and human health, Human Rights, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health. Case Studies and Field visit to local environmental assists.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
30	15	0	45

TEXT BOOKS:

- Introduction to Environmental Engineering and Science (3rd Edition) 3rd Edition, Gilbert M. Masters, Wendell P. Ela, June 18, 2007. ISBN-13: 978-0131481930.
- Principles of Environmental Science : Inquiry and Applications 4th Edition, Publisher: Mcgraw Hill Education, William P Cunningham, Mary Ann Cunningham, 2006, ISBN: 9780070647725, 0070647720.

REFERENCES:

- 1. Cradle to Cradle: Remaking the Way We Make Things by William McDonough, Michael Braungart, Paperback: 208 pages, Publisher: North Point Press, 2008.
- 2. Environmental Science: Toward A Sustainable Future (8th Edition) by Richard T. Wright, Bernard J. Nebel, Hardcover: 681 pages, Publisher: Prentice Hall. 2002.
- 3. Case Studies in Environmental Science by Robert M. Schoch, Textbook Binding: 203 pages, Publisher: Jones & Bartlett Publishers, 1996.
- 4. Living in the Environment : Principles, Connections, and Solutions (with CD-ROM and InfoTrac) by Jr., G. Tyler Miller, Hardcover: 864 pages, Publisher: Brooks Cole, 2008.

- 5. Environmental Science: Earth as a Living Planet by Daniel B. Botkin, Edward A. Keller, Hardcover: 752 pages, Publisher: Wiley, 2014.
- 6. Odum, E.P. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p, 1971.
- 7. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
- 8. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p

E REFERENCES:

- 1. http://nptel.ac.in/course.php?disciplineId=120
- 2. http://www.nptelvideos.in/2012/12/fundamentals-of-environmental-pollution.html
- 3. http://nptel.ac.in/courses/122102006/
- 4. http://nptel.ac.in/courses/120108004/
- 5. https://ocw.mit.edu/courses/environment-courses/

Cos Vs POs

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	9	11	5	5	10	14	15	5	5	5	5
Scaled	2	3	1	1	2	3	3	1	1	1	1
to 0,1,2,3 scale											

					L	Т	P	С
XI	3	0	1	4				
			BIOI OCV					
С	P	Α	BIOLOGI	Т	P	Η		
1.5	1	0.5		3	0	2	5	
PRE								
CO	URS	SE OU	JTCOMES:					
Course Outcomes Domain							Leve	l
After the completion of the course, students will be able to								
CO1: <i>Explain</i> the importance and basic concepts in Cog						Understanding		
bioinformatics and <i>differentiate</i> various databases. Psy						Perception		
CO2 and	2: L perf	Inders forms	<i>stands</i> the significance of sequence analysis sequence alignment.	Cog Psy		Al C re	oplyin Juide spon:	ng d se
CO3 phyl	B: <i>E</i> : ogei	<i>xplain</i> netic 1	a and <i>reproduce</i> phylogenetic trees to study relationships	Cog Psy		Understand Guided response		
CO ²	1: Pi	redict	and <i>construct</i> the protein structure and	Cog		(Create	e
molecular docking Psy						mechanism		sm
CO5: Understand and choose the steps involved in drugCogdiscovery process.Aff						Receiving phenomena		
т								

IO BIOINFORMATICS

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 databasesretrieval system- Entrez- SRS.

Experiment No 1: Accession and retrieval of data from various biological databases.

Experiment No 2: Unix/Linux – basic operations and working with terminal

Experiment No 3: Perl programming - Simple programs using Operators, Control Structures, Subroutines, Hash, Creating a static HTML file by a Perl Program

Π	INTRODUCTION TO COMPUTATIONAL BIOLOGY AND	
11	SEQUENCE ANALYSIS	

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.

9+6

Experiment No 4: Heuristic methods (BLAST, FASTA) of searching for homologous sequences
Experiment No	5: Pair-wise (Needleman – W	Vunch Algorithm & Smith	n waterman									
Algoritghm)and	Multiple sequence alignment											
Experiment No	6: Gene prediction methods ((ORF Finder)										
III PHYL	OGENETICS		9+6									
Introduction to F	hylogenetics, Molecular Evol	lution and Molecular Phy	logenetics, 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.												
Experiment No 7: Phylogenetic tree building using Phylip												
IV PROTEIN STRUCTURE, MODELLING AND 9+6												
SIMULATIONS												
Protein structure basics, Protein structural visualization and comparison, Secondary structure												
prediction- Cha	u-Fasman, GOR, Neural r	networks, Protein tertian	ry structure prediction									
Homology mode	ling, Threading and Fold reco	ognition.	•									
		0										
Experiment No	8: Protein Secondary structur	re prediction										
Experiment No	9: Homology Modeling	1										
Experiment No	10: Molecular Visualization	and 3D structural studies	using Rasmol -									
Commands, Dor	nain identification		C									
Experiment No	11: Molecular Visualization	and 3D structural studies	using Chimera									
I · · · · ·												
V ROLE	OF BIOINFORMATICS I	N DRUG DISCOVERY	9+6									
Drug designing-	objectives- Rational drug d	lesign- Computer assisted	d drug design and drug									
development- M	olecular docking and its apr	plications- OSAR. In Sili	ico drug design- role of									
structural bioinf	prmatics in drug design and	development- Pharmaco	venomics- prospects and									
	sinutes in drug design und		,enomies prospects and									
4505.												
Experiment No	12: Small molecule building	using ISIS Draw and CH	IEM SKETCH –									
Tutorial.	12. Small molecule building,											
Tutorial.												
LECTURE	ECTURE TUTORIAL PRACTICAL TOTAL											

- **TEXT BOOKS:** 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.

- 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

Cos Vs PO s

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

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

XBT 703			L 3	T 1	L T P XBT 703 3 1 1								
	DOWNSTREAM PROCESSIN	١G	•	-	-								
C P A			L	Т	Р	Н							
1 1 1			3	2	2	7							
PREREQUIS	SITE: Microbiology, Basic industrial biote	chnology, Bio	proces	ss Eng	gineer	ing							
COURSE O	UTCOMES:												
	Course Outcomes	Domain		Ι	Level								
After the com	pletion of the course, students will be able to)											
CO1: Recall	and <i>describe</i> the basics of bioseparation	Cog		Remembering									
process.		Aff	Red	Receiving Phenomena									
CO2: Outline	e, differentiate and relates the different	Cog		Unde	rstand	ing							
methods of do	ownstream processing.	Aff		V	aluing								
		Psy		Per	ceptio	n							
CO3: Identif	y, <i>locate</i> and <i>select</i> a specific method for a	Cog		Unde	rstand	ing							
production pr	ocess.	Aff	Red	ceiving	g Pher	iomena							
Psy Percept													
CO4: Recogn	nize, perform and detect various separation	Cog		Understanding									
technique for	a bioproduct development	Aff		Responding									
		Psy		phe	nomer	ia							
CO5. Handid				Understanding									
for the purific	y, choose and jouow the different methods	Cog		Unde	rstand	ing							
for the puttic	ation of a particular product.	Aff		Receiving Phenomena									
		Psy		Finenomena Guided response									
I INTI	RODUCTION TO DOWNSTREAM PRO	CESSING	9+3+3										
PRO	CESSES			-	1010								
Scope and ov	verview-Economics, strategies for initiation	of project, Pro	ocess D	Design	Crite	ria cost							
reduction st	rategies, upstream and downstream pr	ocessing in	biotec	chnolo	ogy,	various							
biotechnology	y products and their biological properties, fu	ndamentals of	biosep	aratio	n. Sep	aration							
process desig	n criteria-Characteristics of biological mixtu	ires, Morpholo	ogical 1	eature	es of t	he cell,							
	f of product of interest and impurities, physic	al and rheolog	ical ch	aracte	r_{1} sucs								
II DOV	VNSTREAM PROCESSING METHODS			9-	-3+3								
Cell disruptio	n Techniques, types of cells, location of pro	ducts inside th	e cells	and p	roduc	ts, cell							
distruption M	Iethods, Mechanical and Non mechanical	methods- Filt	ration,	types	of fi	ltration							
equipments, f	ilter media and filter aids, basic theory of f	iltration, princ	iple of	rotary	y drun	ı filter-							
centrifugation	-principle of sedimentation, types of centrif	uges, flocculat	ion and	1 sedir	nentat	ion.							
Experiment N	to 1: Cell disruption studies by sonication												
Experiment N	lo 2: Sedimentation												
Experiment N													

111	PRODUCT IDE	NTIFICATION TECHNIQ	UES	9+3+3									
Charac	terization of produ	ct- Electrophoresis, Principle	e and methods-An	alysis of product purity-									
Chrom	atography,Enzyme	Linked Immuno Sorbent Ass	ay (ELISA), Ion ex	change chromatography,									
Revers	e phase chroma	tography, Affinity Lig	and Technology	HPLC Radial Flow									
Chrom	atography.												
Experi	ment No 4: Chrom	atography											
IV	PRODUCT SEP	ARATION TECHNIQUES		9+3+3									
Distillation- Principle and types, Extractive distillation, Steam Distillation, Vaccum Distillation-													
Extract	Extraction-Solvent extraction principles, Extraction methods, modes of aqueous two-phase												
extract	ion, Super critical	fluid extraction -Adsorption	n, principle, Isoth	erms, different types of									
adsorpt	adsorption- Evaporation, principle, factors influencing rate of evaporation, types of evaporators.												
_													
Experi	ment No 5: Extract	ion Studies.											
Experi	ment No 6: High-re	esolution purification preparat	ive liquid chromat	ographic techniques									
V PRODUCT PURIFICATION AND RESOLUTION 9+3+3													
Precipi	tation methods (w	th salt, organic solvents, and	l polymers, extract	ive separations, aqueous									
two-ph	ase extraction)- M	Iembrane based separation j	process, Types of	membranes, Membrane									
two-phase extraction)- Memorane based separation process, Types of membranes, Membrane process, theory and types of membrane-Application of ultrafiltration. Application of													
process	microfiltration - Crystallization theory of crystallization- Freeze drving- Principle process and												
process microfi	ltration - Crystalli	zation, theory of crystallizat	ion- Freeze drying	- Principle, process and									
process microfi applica	lltration - Crystalli tion of freeze dryin	zation, theory of crystallizat ng integrated bio-processing-	ion- Freeze drying product polishing s	- Principle, process and stages									
process microfi applica	iltration - Crystalli tion of freeze dryin	zation, theory of crystallizat	ion- Freeze drying product polishing s	g- Principle, process and stages									
process microfi applica Experin	iltration - Crystalli tion of freeze dryin ment No 7: Ammo	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation	ion- Freeze drying product polishing s	- Principle, process and stages									
process microfi applica Experin Experin	iltration - Crystalli tion of freeze dryin ment No 7: Ammon ment No 8: Crystal	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization	ion- Freeze drying product polishing s	- Principle, process and stages									
process microfi applica Experin Experin Experin	iltration - Crystalli tion of freeze dryin ment No 7: Ammon ment No 8: Crystal ment No 9: Drying	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization	ion- Freeze drying product polishing s	g- Principle, process and stages									
process microfi applica Experin Experin Experin	iltration - Crystalli tion of freeze dryin ment No 7: Ammor ment No 8: Crystal ment No 9: Drying ment No 10: Lyoph	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization	ion- Freeze drying	- Principle, process and stages									
process microfi applica Experin Experin Experin I	iltration - Crystalli tion of freeze dryin ment No 7: Ammon ment No 8: Crystal ment No 9: Drying ment No 10: Lyoph LECTURE	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization hillization TUTORIAL	ion- Freeze drying product polishing s PRACTICAI	- Principle, process and stages									
process microfi applica Experin Experin Experin I	iltration - Crystalli tion of freeze dryin ment No 7: Ammon ment No 8: Crystal ment No 9: Drying ment No 10: Lyoph LECTURE 45	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization hillization TUTORIAL 15	ion- Freeze drying product polishing s PRACTICAI 15	- Principle, process and stages L TOTAL 75									
process microfi applica Experin Experin Experin I TEXT	iltration - Crystalli tion of freeze dryin ment No 7: Ammon ment No 8: Crystal ment No 9: Drying ment No 10: Lyoph LECTURE 45 BOOKS:	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization nillization TUTORIAL 15	ion- Freeze drying product polishing s PRACTICAI 15	- Principle, process and stages L TOTAL 75									
process microfi applica Experin Experin Experin I TEXT 1.	iltration - Crystalli tion of freeze dryin ment No 7: Ammor ment No 8: Crystal ment No 9: Drying ment No 10: Lyoph LECTURE 45 BOOKS: Nooralabettu Kri	zation, theory of crystallizat ng integrated bio-processing- nium Sulphate precipitation lization iillization TUTORIAL 15	ion- Freeze drying product polishing s PRACTICAI 15 rocess Technolog	 Principle, process and stages TOTAL 75 y, A New Horizon in 									

2. Pauline M. Doran, "Bioprocess Engineering Principles, 2nd Edition, Academic Press. 2012

REFERENCES:

- 1. Hatti-Kaul, Rajni, and Bo Mattiasson. "Downstream processing in biotechnology." Basic biotechnology. Cambridge University Press, Cambridge ,2001.
- 2. Belter, Paul A., Edward Lansing Cussler, and W. Hu. "Bioseparations: downstream processing for biotechnology" 1987.
- 3. Asenjo J.M. Separation processes in Biotechnology, 1993

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- 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

Cos Vs POs

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

Subject Vs POs

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

XB	T 704	4 A			L 3	Т 0	P 0	C 3
			CANCER BIOLOGY					
С	Р	Α			L	Т	Р	Η
2.5	0	0.5			3	0	0	3
PRE	REQ	UISI	TE: Cell biology molecular biology					
COL	JRSE	C OUT	COMES:					
			Course Outcomes	Domain]	Leve	l
After	the o	compl	etion of the course, students will be able to					
CO1	: Out y var	t <i>line</i> t ious s	he regulation and modulation of cell cycle in cancer ignal switches	Cog	τ	Jnde	rstan	ding
CO2	: Exp	o <i>lain</i> a olism	and <i>compare</i> various types of carcinogenesis and its	Cog	U A	Jnde Analv	rstan /zing	ding
CO3	: Illu	strate	the role of activation of kinases. <i>identification</i> of	Cog	I	Jnde	rstan	ding
0	ncog	enes.	and <i>conforms</i> the role of telomere.	Aff	Ā	Analy	zing	
	I	Responds to						
CO4	• Er	Cog	I	Understanding				
i	COS		Chacistanding					
CO5	: Des	cribe	and <i>compiles</i> molecular tool for early diagnosis of	Cog	τ	Jnde	rstan	ding
c	ancer	diffe	erent forms of cancer therapy.	Aff	I	Respo	onds	to
		,	r i i i i i i i i i i i i i i i i i i i		I	Phenomena		
	Ι		CELL CYCLE AND CANCER				9	
Can mod Telo casp	lcer: (lulation omerationales	Cause on of ase an - mut	s, characteristics and types – Cell cycle phases, cyclin cell cycle in cancer - Effects on receptor, signal switc d its role in cancer – Apoptosis, Extrinsic and intrinsi- ations that leads to cancer.	s and CDK hes, signali c pathways	s, ch ng p , apo	eck j athw ptose	point ays – ome a	3, - and
	II		CARCINOGENESIS				9	
Theo	ory of	carci	nogenesis - Types: Physical, chemical and radiation	carcinoge	nesis	, Dii	rect a	cting
and	indir	ect a	cting carcinogens, Metabolism of carcinogens, CY	P450 red	uctas	e m	echa	nism;
Mecl	hanisi	m of	radiation carcinogenesis, ionizing and non ionizing	radiation, I	Retro	viru	ses -	RSV
life c	ycle	and it	s role in cancer, Identification of carcinogens, Long a	nd short ter	m bi	oassa	ays.	
	III		MOLECULAR AND CELL BIOLOGY OF CAN	ICER			9	
Signa ident relate	al tar ificat ed to	gets a ion ai transf	and cancer, activation of kinases – Oncogenes - type and detection of oncogenes, oncogenes and proto onco formation - epidermal growth factor (EGF), platelet of	s, c-Myc, l gene activi lerived grov	Ras, ty - wth t	Bcl- Grov facto	2 far vth fa r (PE	nily - actors)GF),
trans	form	ing gr	owth factor (TGF), src and myc; RAS cycle – Tumor	suppressor	gene	es.		
	IV		INVASION AND METASTASIS				9	
Clini	cal s	ignifi	cances and three step theory of Invasion, Metastasi	s – Introdu	ictio	n an	d cas	cade,

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 .

VDIAGNOSIS AND THERAPY9)
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Diagnosis: Detection using biochemical assays, tumor markers - Molecular tools for early diagnosis of cancer, Disease staging - FISH, Karyotyping, DNA microarrays, SNPs, CGH and imaging techniques.

Treatment: Chemotherapy – Classification of drugs – Topoisomerase inhibitors – Radiotherapy – Gene therapy – Immuno therapy – Antigen specific and Adaptive therapy – Stem cell therapy - Use of signal targets towards therapy of cancer - Gene therapy

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

COs Vs POs

	PO1	PO 2	PO 3	PO 4	РО 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	1	2	1			2	2	2

CO 2	2	2	2	2	3	3	2	1			
CO 3	3	3	2	2	2				1	1	2
CO 4	2			3	2						
CO 5	3	3	2	3	2	2	2	1	2	2	1
	13	10	8	11	11	6	4	2	5	5	5

Subject Vs POs

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

					L	Т	Р	С			
XB	ST 70	4 B			3	0	0	3			
	-		METABOLIC ENGINEERING								
С	P	Α			L	Т	Р	Η			
2.5	0	0.5			3	0	0	3			
PRE	REQ	UISI	TE: Enzyme engineering, Biochemistry								
COU	URSE	COU	TCOMES:								
			Course Outcomes	Domain]	Leve	l			
Afte	r the o	compl	etion of the course, students will be able to								
CO1	: <i>Sta</i>	<i>te</i> an	d understands the role of transport processes in	Cog		Rem	embe	ering			
metabolic pathways and material balance Under											
CO2: Analyze the regulation of enzymes involved in metabolicCogAnalyze											
pathways											
CO3	: Bui	<i>ld</i> alg	orithms for biosynthesis pathways	Cog		Aj	Applying				
CO4	: Exp	lain 1	metabolic flux analysis and its role in manipulation	Cog	1	Understanding					
C	of met	aboli	te production.								
CO5	: Exp	olain	and <i>compiles</i> various strategies to manipulate the	Cog		Res	pond	s to			
F	orodu	ction	of industrially important Metabolites	Aff		Phe	nom	ena			
	Ι		INTRODUCTION				9				
Imp	ortan	ce of	metabolic engineering - Overview of cellular me	etabolism	– va	rious	typ	es of			
read	ctions	- Ste	pichiometry of cellular reactions - Dynamic mass b	alance – y	ield (coeff	ïcien	t and			
line	ar rat	e equ	ation: metabolic model of Penicillium chrysogenum -	- Black box	x moo	del –	elen	nental			
and	heat	balan	ce using black box model.			1					
	Π		REGULATION OF METABOLIC PATHWAYS	5			9				
Regi	ulatio	n of e	nzyme activity: Overview of enzyme kinetics and inh	nibition – F	Feed	back	inhi	oition			
and	Activ	ation:	Feed back control architecture in aspartate pathway -	 Allosteric 	e enz	yme	regu	lation			
- Re	gulati	on of	enzyme concentration: Control of transcription and tr	anslation –	- Ger	etic	regul	latory			
netw	ork:	choles	sterol synthesis and elimination - Regulation of at the	e whole cel	l lev	el - I	Regu	lation			
of m	etabo	lic ne	tworks – Regulation of eukaryotes versus prokaryotes								
	III		SYNTHESIS OF METABOLIC PATHWAYS				9				
Meta	abolic	path	way synthesis algorithm - Overview of the algorith	m - Pathw	ay fo	or sy	nthe	sis of			
alani	ine an	d seri	ne - Case study: Lysine biosynthesis								

IV	METABOLIC FLUX ANALYSIS AND ITS APPLICATION	9
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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.

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:

V

- 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

Cos Vs POs

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	1	2	1			2	2	2
CO 2	2	2	2	2	3	3	2	1			
CO 3	3	3	2	2	2				1	1	2
CO 4	2			3	2						
CO 5	3	3	2	3	2	2	2	1	2	2	1
	13	10	8	11	11	6	4	2	5	5	5

Subject Vs POs

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

							L	Т	Р	С	
XB	ST 70	4 C					3	0	0	3	
C	D			STEM CELL	BIOLOGY		T	T	р	тт	
	P 0	A						1	P A	<u>н</u> 2	
PR	ERE(SITE -	Cell hiology Immunolog	V		3	U	U	3	
				Cen biology, minunolog	y						
co	URS	EOU	JTCON	1ES:							
				Course Outcomes		Domai	n]	Level		
On	the s	ucces	ssful con	npletion of the course, stud	dents will be able to			Г <u>–</u>			
CO	9 1: At	ole to	r ecall a	and interpret the biology of	stem cells.	Cog		Reme Unde	embe rstan	ring ding	
CO2: Explain and develop the embryonic stem cell culturing.CogUnderstandingApplying											
CO	CO3: Discuss and analyze the differentiation of stem cellsCog										
CO ster	CO4: <i>Explain and evaluate</i> the various techniques involved in Cog stem cell assay.									ding g	
CO	CO5: Discuss and apply the various applications of stem cells.Cog										
IBASICS OF STEM CELL9											
Uni	que p	orope	rties of s	stem cells – embryonic ster	n cells, history and	developm	lent,	charac	teris	tics,-	
Adı	ılt ste	em ce	lls ,Prop	peries, types, clinical applic	ations umbilical cor	d stem ce	lls–	Simila	rities	and	
diff	erenc	es be	etween e	mbryonic and adult stem co	ells - Properties of st	em cells -	– plı	iripote	ncy –	-	
toti	poten	cy.						1			
II	E	EMB	RYONI	C STEMCELLS					8		
In v	vitro f	ertili	zation –	culturing of embryos-isolat	ion of human embry	onic sten	n cel	ls – bl	astoc	yst –	
inne	er cel	l mas	ss - gro	wing ES cells in lab – labo	oratory tests to ident	tify ES ce	ells -	- stimu	ilatio	n ES	
cell	s for	diffe	rentiatio	n - properties of ES cells.							
II		ADUI	LT STE	M CELLS					7		
Son	natic	stem	cells –	test for identification of a	dult stem cells – ad	ult stem of	cell	differe	ntiati	on –	
tran	is diff	terent	ation –	plasticity – different types	of adult stem cells.						
1			1 CELL	IN DRUG DISCOVERY	ANDASSAY				9		
Tar	get 1	denti	fication	– Manipulating differen	tiation pathways –	stem ce	ell t	herapy	v Vs	cell	
pro	tectio	n –H	ematopo	Dietic colony forming cell a	assay- stem cell in c	cellular as	says	s for sc	reeni	ng –	
ster	n cell	base	a drug o	inscovery, drug screening a	nd toxicology.				10		
V	A			UNS OF STEM CELLS				1.	12		
Ster	m ce	II th	erapy f	or Mental disabilities, D	iabetes Mellitus –	Therape	utic	appli	catio	ns –	
Par	KINSO	naise	ase - Ne	A typing A 1-h along 2 1	amputation – neart (uisease - s	spina	u cord	mod	ies –	
	Jetes	-our	us - HL	A typing- Alzneimer's disc	ease –ussue enginee	appl appl	icati	on – p	rodu	cuon	
01 0		TIP	rgan - Ki F	TITOPIAI	PRACTICA	T		тот	'A T		
		1 U K						101			
	4	45		U	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. <u>http://nptel.ac.in/courses/102103012/41</u>

COs Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3					2	1				
CO 2	2	2		1		3	2				1
CO3	2	1	1	2		1	2				1
CO4	2	2	1	3		1	3				1
CO5	2	2	1	3		2	3				1
	11	7	3	9	0	9	11	0	0	0	4

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	11	7	3	9	0	9	11	0	0	0	4
Scaled to 0,1,2,3 scale	3	2	1	2	0	2	3	0	0	0	1

					L	Т	Р	С	
XB	T 70	5 A	MOLECULAR PATHOGENESIS OF INFEC	TIOUS	3	0	0	3	
			DISEASES						
С	Р	Α			L	Т	Р	Η	
2.5	0	0.5			3	0	0	3	
PRE	REQ	UISI	TE: Microbiology						
COU	JRSE	OUT	COMES:						
			Course Outcomes	Domain]	Level	l	
Afte	r the o								
CO1	l: Des	cribe	s the overview of pathogenicity and <i>knows</i>	Cog		Rei	nemł	ber,	
relat	ionsh	ip bet	ween host-parasite.			Un	dersta	and	
CO2	2: Con	npare	various disease's epidemiology and <i>relate</i> its	Cog		Unde	erstan	ding	
mod	e of ti	ansm	ission	Aff		Org	aniza	tion	
CO3	B: Exp	lain 1	he mechanism of invading microorganism	Cog		Rei	nemł	ber,	
desc	ribes	the pr	operties after evading host			Understand			
CO4	: And	lyze	various diseases caused by different organism their	Cog					
symp	ptoms	and p	pathogenicity.			Anaryzing			
CO5	5: App	lying	the modern approaches to control the effect of	Cog		Applying			
path	ogeni	city.				Applying			
	Ι		PATHOGENICITY OF MICROORGANISM			9			
Host	- para	site F	Relationship – Pathogenesis of viral diseases – Over	view of Ba	cteria	l Pa	thoge	nesis	
- To	oxiger	ecity	- techniques and application, Detection and remova	l of endoto	xin -	- Ho	st de	fense	
agaiı	nst M	icrobi	al Invasion- Microbial mechanisms for Escaping Hos	t Defenses.					
	II		THE EPIDEMIOLOGY OF INFECTIOUS DIS	EASES			9		
Reco	ognitio	on of	an infectious disease in a population- Historica	l Highligh	ts, T	ypho	oid N	/lary-	
Reco	ognitio	on of	an epidemic- Infectious Disease Cycle- Virulence a	and the mo	de o	f trai	nsmis	sion-	
Eme	rging	and H	Reemerging Infectious Diseases and pathogens- Con	trol of Epic	lemic	s- N	osoci	mical	
Infection									
	III		MICROBIAL MECHANISM OF PATHOGENI	CITY			9		
Microorganism affecting the hosts- Portals of Entry- Number of Invading Microbes- Bacterial									
Path	Pathogens Damaging Host Cells Using the Host 's Nutrients: Siderophores- Direct Damage- The								
Prod	uction	n of T	oxins - Plasmids, Lysogeny, and Pathogenicity- Pat	hogenic Pr	opert	ies o	f Vir	uses-	
Vira	l Mee	chanis	ms for Evading Host - Defenses - Cytopathic Ef	ffects of V	iruse	s. F	Patho	genic	
Prop	Properties of Fungi, Protozoa, Helminths, and Algae- Portals of Exit.								

IV	MICROORGANISMS AND HUMAN DISEASE	9						
Microbial disea	Microbial diseases of the skin- Wart, Cutaneous Mycoses, Scabies - Microbial diseases of the							
eyes- Ophthalm	ia neonatorum, Herpetic keratitis, Acanthamoeba keratitis - Micr	robial diseases of						

the Nervous S	ystem	n- Haemophillus influenz	zae meningitis, Leprosy, Rabi	es - Mici	robial diseases of					
the Digestive system- Typhoid, Helicobacter peptic Ulcer, Hepatitis- Microbial diseases of the										
Respiratory system- Epiglottitis, Common Cold, Histoplasmosis										
V	VMODERN APPROACHES TO CONTROL PATHOGENS9									
Classical approaches based on serotyping. Modern Diagnosis based on highly conserved virulence										
factors, immu	ne and	d DNA- based Technique	es. New Therapeutic strategie	s based o	on recent findings					
on molecular	path	ogenesis of a variety of	of pathogens, Vaccines- DN	JA, Subu	init and cocktail					
vaccines.										
LECTUR	E	TUTORIAL	PRACTICAL		TOTAL					
45		0	0		45					
TEXT BOOK	KS:									
1. Willey, J	oanne	M, Linda Sherwood,	Christopher J. Woolverton,	and Lans	ing M. Prescott.					
Microbiol	logy. I	New York: McGraw-Hil	l Higher Education, 2008.							
2. Tortora, C	3. J., F	Funke, B. R., & Case, C.	L. (2004). Microbiology: An	introduct	tion. 10 th edition.					
REFERENC	ES:									
1. Coleman,	Willi	am B., and Gregory J. T	songalis, eds. Molecular path	ology: the	e molecular basis					
of human	disea	se, 2009.								
2. Leonard,	Debra	a GB, et al., eds. Molec	ular pathology in clinical pr	actice. Vo	ol. 223. Springer					
Science+	Busin	ess Media, LLC, 2007.								
3. Coleman,	Will	liam B., and Gregory	J. Tsongalis, eds. Essentia	l concep	ts in molecular					
pathology. Academic Press, 2010.										
E REFERENCE:										
1. https://ocw.mit.edu/courses/health-sciences-and-technology/hst-035-principle-and-practice-of-										
human-pathology-spring-2003/lecture-notes/										

COs Vs POs	s POs	Vs	COs
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	-	3	1	2	3	2	-	1	1	1
CO 2	2	1	2	1	3	3	2	2	1	3	2
CO 3	2	2	3	2	2	2	2	-	2	2	1
CO 4	2	2	2	2	2	3	2	2	1	1	-
CO 5	2	1	3	3	3	3	2	2	2	2	2
	10	6	13	9	12	14	10	6	7	9	6

Subject Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	10	6	13	9	12	14	10	6	7	9	6
Scaled to 0,1,2,3 scale	3	2	3	2	3	3	2	2	2	2	2

$\begin{tabular}{ c c c c c c } \hline XBT F05 B \\ \hline XBT F05 B$						L	Τ	Р	С		
$ \begin{array}{ c c c c c } \hline INDUSTRIAL WASTE WATER MANAGEMENT \\ \hline I T P H \\ \hline 2.5 0 0 0.5 \\ \hline I T P H \\ \hline 3 0 0 0 3 \\ \hline PRERE QUISITE: Basic chemistry, Bioprocess engineering \\ \hline COURSE OUTCOMES: \\ \hline Course Outcomes & Domain Level \\ \hline COURSE OUTCOMES: \\ \hline COURSE OUTCOMES: \\ \hline COI: Summarize the characteristics of waste water and its determination. \\ \hline CO1: Summarize the characteristics of waste water and its determination. \\ \hline CO2: Outline the steps involved in waste water treatment \\ \hline CO2: Outline the steps involved in waste water and a Cog the end of the point of the formation of the course, students will be able to \\ \hline CO3: Explain environmental impacts of waste water and the treatment \\ \hline CO4: Differentiate and Explain various methods for Cog the end of the formation of the formation of the formation \\ \hline CO5: Outline and follow the waste water source reduction and follow the waste water source reduction and follow the waste water, types, sources and effects of water pollutants, Waste water characteristics-DO, BOD, COD, TOC, total suspended solids, colour and odour, bacteriological quality, oxygen deficit, determination of BOD constants, heavy metals, Water quality standards: APHA, ICMR, WHO, MPCB and CPCB. \\ \hline I WASTE WATER TREATMENT PLANT 9 \\ \hline Classification of treatment processes - preliminary treatment, primary treatment processes - Activated sludge, Aerated lagoons, sequencing batch reactors, Aerobic digestion - Aerobic attached growth treatment process. Letting filter, towers, rotating discs, rotating drums, oxidation ditch. Pond treatment process trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Pond treatment process - preliminary treatment and blogs and types of industrial wastewater - Environmental impacts - Regulatory requirements - generation rates - characterization - Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution - Source reduction techniques - Waste Audit- Evaluation of pollution prevention options. \\ \hline \etal \ \begin{tabular}{llllllllllllllllllll$	XE	BT 70	3	0	0	3					
CIAIII2.500.5PREREQUISITE: Basic chemistry, Bioprocess engineeringCOURSE OUTCOMES:COURSE OUTCOMES:Course OutcomesDomainLevelAfter the completion of the course, students will be able toCO: Summarize the characteristics of waste water and its determination.CogUnderstandingCO2: Outline the steps involved in waste water treatmentCogAnalyzingCO3: Explain environmental impacts of waste water and pollution prevention.CogAnalyzingCO5: Outline and Explain various methods for wate water minimizationCogAnalyzingOmestic and industrial wastewater, types, sources and effects of water pollutants, Waste water characteristics-DO, BOD, COD, TOC, total suspended solids, colour and odour, bacteriological quality, oxygen deficit, determination of BOD constants, heavy metals. Water quality standard: APHA, ICMR, WHO, MPCB and CPCB.9Classification of treatment processes- preliminary treatment, primary treatment, secondary or biological treatment, Aerobic and Anaerobic treatment processes- Activated sludge, Aerated lagoons, sequencing batch reactors, Aerobic digestion - Aerobic attached growth treatment process- tricking filter, towers, rotating discs, rotating drums, oxidation ditch- Pond treatment process- tricking filter, towers, rotating discs, rotating drums, oxidation ditch- Pond treatment process- tricking filter, towers, rotating discs, rotating drums, oxidation ditch- Pond treatment process- tricking filter, towers, rotating discs	C	р		INDUSTRIAL WASTE WATER MAN	AGEMENT	т	T	р	тт		
21.5 0 0.7 0 </td <td>25</td> <td>P 0</td> <td></td> <td>L 3</td> <td>1</td> <td>P 0</td> <td>н 3</td>	25	P 0		L 3	1	P 0	н 3				
PREREQUISITE: Basic chemistry, Bioprocess engineering COURSE UTCOMES: Course Outcomes Domain Level After the course Outcomes Domain Level After the course Outcomes Domain Level After the course Outcomes Domain Level COI: Summarize the characteristics of waste water and its cog determination. Cog Analyzing CO3: Explain environmental impacts of waste water and pollution prevention. Cog Analyzing CO4: Differentiate and Explain various methods for cog data and follow the waste water source reduction methods for various industries. Cog Analyzing Understanding CO5: Outline and follow the waste water source reduction methods for various industries. Of Cog Analyzing phenomena Cog MASTE WATER CHARACTERISTICS 9 Domestic and industrial wastewater, types, sources and effects of water pollutants, Waste water quality standards: APHA, ICMR, WHO, MPCB and CPCB. II WASTE WATER TREATMENT PLANT 9 Classification of t						5	U	U			
COURSE OUTCOMES: Course Outcomes Domain Level After the completion of the course, students will be able to CO1: Summarize the characteristics of waste water and its determination. Cog Understanding CO2: Outline the steps involved in waste water treatment Cog Analyzing CO3: Explain environmental impacts of waste water and pollution prevention. Cog Analyzing CO4: Differentiate and Explain various methods for waste water minimization Cog Analyzing CO5: Outline and follow the waste water source reduction methods for various industries. Cog Analyzing Obmestic and industrial wastewater, types, sources and effects of water pollutants, Waste water characteristics-DO, BOD, COD, TOC, total suspended solids, colour and odour, bacteriological quality, oxygen deficit, determination of BOD constants, heav metals, Water quality standards: APHA, ICMR, WHO, MPCB and CPCB. 9 II WASTE WATER TREATMENT PLANT 9 Classification of treatment processes- preliminary treatment, primary treatment, secondary or biological treatment, Aerobic and Anaerobic treatment processes- Activated sludge, Aerated lagoons, sequencing batch reactors, Aerobic digestion - Aerobic attached growth treatment processes- trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Pond treatment process trickling filter, towers, rotating dustewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay		LKEQ	20151	1 E: Basic chemistry, Bioprocess engineerii	ıg						
Course OutcomesDomainLevelAfter the course, students will be able toCO1: Summarize the characteristics of waste water and its determination.CogUnderstandingCO2: Outline the steps involved in waste water treatmentCogAnalyzingCO3: $Explain$ environmental impacts of waste water and pollution prevention.CogUnderstandingCO4: Differentiate and Explain various methods for waste water minimizationCogAnalyzingCO5: Outline and follow the waste water source reduction methods for various industries.Aff phenomena AnalyzingReceiving phenomena AnalyzingIWASTE WATER CHARACTERISTICS9Domestic and industrial wastewater, types, sources and effects of water pollutants, Waste water characteristics-DO, BOD, COD, TOC, total suspended solids, colour and odour, bacteriolical quality, oxygen deficit, determination of BOD constants, heavy metals, Water quality stardards: APHA, ICMR, WHO, MPCB and CPCB.9IIWASTE WATER TREATMENT PLANT9Classification of treatment processes- peliminary treatment, primary treatment, secondary or biological treatment, Aerobic and Anaerobic treatment processes- Activated sludge, Aerated 	COI	URSE	C OUI	COMES:							
After the completion of the course, students will be able toCO1: Summarize the characteristics of waste water and its determination.CogUnderstandingCO2: Outline the steps involved in waste water treatmentCogAnalyzingCO3: Explain environmental impacts of waste water and pollution prevention.CogAnalyzingCO4: Differentiate and Explain various methods for waste water minimizationCogAnalyzingCO5: Outline and follow the waste water source reduction methods for various industries.Aff phenomena CogReceiving phenomena AnalyzingIWASTE WATER CHARACTERISTICS9Domestic and industrial wastewater, types, sources and effects of water pollutants, Waste water characteristics-DO, BOD, COD, TOC, total suspended solids, colour and odour, bacteriological quality, oxygen deficit, determination of BOD constants, heavy metals, Water quality stardards: APHA, ICMR, WHO, MPCB and CPCB.9IIWASTE WATER TREATMENT PLANT9Classification of treatment processes- preliminary treatment, primary treatment, secondary or biological treatment, Aerobic and Anaerobic treatment processes- Activated sludge, Aerated lagoons, sequencing batch reactors, Aerobic digestion- Aerobic attached growth treatment process- trickling filter, towers, rotating discs, rotating drums, oxidation ditc. Pond treatment process. Tritary treatment.9Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution– Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.9	A. C.	.1	Domain		L	evel					
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CO3: Explain pollution prevention.CogUnderstanding understandingCO4: Differentiate and Explain 		2. Ou	une u	ne steps involved in waste water treatment	Cog		Ana	iyzin	g		
pollution prevention.Image: CO4: Differentiate and Explain various methods for waste water minimizationCog Understanding UnderstandingCO4: Differentiate and Explain various methods for waste water minimizationCog UnderstandingCO5: Outline and follow the waste water source reduction methods for various industries.Aff Cog Phenomena AnalyzingOut Sources and follow the waste water source reduction methods for various industries.Aff Cog Phenomena AnalyzingImage: Cost of water water characteristics-DO, BOD, COD, TOC, total suspended solids, colour and odour, bacteriological quality, oxygen deficit, determination of BOD constants, heav metals, Water quality standards: APHA, ICMR, WHO, MPCB and CPCB.IIWASTE WATER TREATMENT PLANT9Classification of treatment processes- preliminary treatment, primary treatment, secondary or biological treatment, Aerobic and Anaerobic treatment processes- Activated sludge, Aerated lagoons, sequencing batch reactors, Aerobic digestion- Aerobic attached growth treatment process. Tertiary treatment.9Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution – Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.	CO3	B: Exp	olain e	environmental impacts of waste water and	Cog	U	nder	stand	ling		
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requirements – generation rates – characterization – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution– Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.	Sour	rces	and t	ypes of industrial wastewater - Enviro	nmental impac	ts -	- R	egula	atory		
Control of Industrial Pollution– Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.	requ	ireme	nts – g	generation rates – characterization – Toxicity	and Bioassay te	ests.	Prev	entic	on vs		
pollution prevention options.	Con	trol o	f Indu	strial Pollution- Source reduction technique	es – Waste Au	dit-	Eval	uatio	on of		
	pollu	ution	prever	ntion options.							

IV	WASTE WATER REUSE AND RESIDUAL MANAGEMENT	9
Individual a	and Common Effluent Treatment Plants - Joint treatment of industrial	wastewater -
Zero efflue	ent discharge systems, Quality requirements for Wastewater reuse	e - Industrial

reuse. Disposa	1 0	n water and land - l	Residuals of industrial	wastew	ater treatment -				
Quantification and characteristics of Sludge - Thickening, digestion, conditioning, dewatering									
and disposal of sludge - Management of RO rejects.									
V	IN	DUSTRIAL WASTE	WATER TREATMENT	Г	9				
Industrial manu	fact	uring process description	n, wastewater characteris	tics, sou	rce reduction				
options and was	ste ti	reatment flow sheet for T	Textiles – Tanneries – Pu	lp and p	aper – metal				
finishing – Oil	Refi	ning–Pharmaceuticals–S	bugar and Distilleries.						
LECTURE		TUTORIAL	PRACTICAL		TOTAL				
45		0	0		45				
TEXT BOOKS	5:								
1. U	J.Sa	thyanarayana, Biotechno	ology, Uppala author-pub	olisher ir	nterlinks, 2010.				
2. I	Davi	s, Mackenzie Leo, and S	Susan J. Masten. Principle	es of env	vironmental				
engineering	g an	d science. New York: M	cGraw-Hill, 2004.						
REFERENCE	S:								
1 Dalvanfalda		VW (1000) In descent of V	Watan Dallystian Control		McCrory II:11				
1. Eckenielde	er, v	(1008) We decrease $T_{\rm m}$	water Pollution Control,	(Sra Ea)	MCGraw-Hill.				
2. Arceivala,	5.J.	, (1998). Wastewater 1re	eatment for Pollution Cor	itrol (2n	d Ed), McGraw-				
Hill, 1998.			· · · · · · · · · · · · · · · · · · ·	1 (17 1) 1					
3. Frank Woodard, (2001). Industrial waste treatment Handbook, (1st Ed) Butterworth									
Heinemann New Delhi.									
E REFERENCES:									
1. nptel.ac.	.in/c	ourses/105105048/							

COs Vs Pos

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

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

					L	Т	Р	С		
XF	BT 7()5C			3	0	0	3		
			BIORESOURCE TECHNOLOGY							
С	P	Α			L	Т	Р	Η		
3	0	0			3	0	0	3		
PR	ERE	QUIS	SITE: -XBT 207 Fundamentals of Biotechnolo	gy						
CO	URS	E OU	JTCOMES:							
			Course Outcomes	Doma	ain		Level			
On	the s	ucces	ssful completion of the course, students will be a	ible to						
CO	1: C	hoose	and outline various renewable energy	Cog	5	Re	memberi	ng		
sou	rces					Un	derstandi	ing		
CO	2: <i>E</i>	xplaiı	<i>n</i> and <i>construct</i> the bioconversion techniques	Cog	2	Un	derstandi	ng		
for	enha	nced	fuel production			1	Applying	,		
CO	3: C	ompa	re and contrast the biogas production from	Cog	5	Un	derstandi	ng		
vari	ious	oio-re	sources.		Analyzi					
CO	4: O	utlin	e and <i>distinguish</i> between the processes	Cog	3	Un	derstandi	ng		
inv	olvec	l in bi	oethanol and butanol production.			Analyzing				
CO	5: <i>E</i> .	xplaiı	<i>i</i> and <i>choose</i> a mechanism involved in	Cog	5	Understanding				
bio	diese	l proc	luction			Evaluating				
Ι]	RENI	EWABLE ENERGY SOURCE				9			
Hydı	opov	ver, g	geothermal power, solar power, wind power,	Biofue	el -Bi	omass	- Feed	stocks		
(agri	cultu	ral cr	ops, bioenergy crops, agricultural waste residues,	, wood	resid	ues, wa	aste strea	ım)		
I		FUEL	L TECHNOLOGY AND BIOCONVERSION				8			
His	tory	- Defi	inition of biofuel, applications of biofuel (transpo	ort, diı	ect el	ectrici	ty genera	tion,		
hon	ne u	se an	d energy content of biofuel) - Bioconversion	n of l	ignoc	ellulos	ics, cell	ulose		
sac	chari	ficatio	on, pretreatment technologies (air separation pro	cess, n	necha	nical s	ize reduc	ction,		
auto	ohydi	rolysi	s) - Pulping and bleaching , Enzymatic deinkin-,	Micro	bial f	uel pro	duction			
						[
II	[]	BIOG	AS				7			
Bio	Biogas plant, feed stock materials, biogas production, factors affecting methane formation -									
Rol	Role of methanogens ,Biohydrogen production - Oxygen sensitivity problems in									
hyd	roge	nenas	es							

IV	BIO ETHANOL AND BUTANOL	9
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Advantages of ethanol over fossil fuels, production of ethanol from cellulosic materials,											
ethanol r	ecovery	- Bioł	outanol	produc	tion, en	ergy c	ontent a	nd effe	cts on t	fuel econ	nomy -
Octane ra	ating, a	ir fuel	ratio, sj	pecific	energy,	viscos	ity, heat	of vap	orizatio	n -Butar	nol fuel
mixtures											
V B	IODIE	SEL								12	
Productio	n of bi	odiesel,	oil ext	raction	from alg	gae by	chemica	al solver	nts, enz	ymatic, e	xpeller
press - Osmotic shock and ultrasonic assisted extraction - Applications of biodiesel,											
environmental benefits and concerns											
LECTURE TUTORIAL PRACTIC TOTAL											
	AL IOINI										
45 0 0 45											
TEXT BOOKS											
1. A	lain A.V	/., Bion	nass to l	oiofuels	strategi	es for g	global In	dustries	John W	/iley & s	ons ltd,
1s	tEdition	n, 2010.									
2. Ty	widell.,	J & We	ir., T., l	Renewa	ble ener	gy reso	ources, T	aylor &	Francis	2nd Edit	tion,
20	<u>)06.</u>										
REFERE	ENCES	•									
1. Lu W	uque, R. 'oodhea	., Camp d publis	, J., Haı shing lto	nd book 1., 1st E	of biofu dition, 2	uel proc 011.	luction p	processe	s and tee	chnologi	es,
E REFE	RENCE	ES									
1. ht	tp://npt	el.ac.in/	bioreso	urce/							
COs Vs	PO s										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	1				1	3				
CO 2	1	3	2			1	3				1
CO3	1	2	1	3		1	2		1		1
CO4	1	2	1	2		1	3		1		1
CO5	1	2	2	1		1	3				
	6	10	6	6	0	5	14	0	2	0	3
Subject V	Vs Pos										
	PO1	PO2	PO3	PO4	PO5	PO	5 PO7	PO8	PO9	PO10	PO11
Original	6	10	6	6	0	5	14	0	2	0	3

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

value Scaled to

XU	M 7	06			3	0	0	0					
			CYBER SECURITY			•							
С	Р	Α			L	Τ	P	Η					
3	0	0			3	0	0	3					
PRE	CRE	QUIS	SITE: - Nil		1			1					
COU	JRS	ĒOU	JTCOMES:										
			Course Outcomes	Domain		Le	evel						
On t	he si	ucces	sful completion of the course, students will be able t)									
CO1	l: To	o lear	\boldsymbol{n} the basic concepts of networks and cyber-attacks.	Cog	Remembering								
CO2	Ur	nders	stand	ing									
the s	canr	ling t	0018		I Ir	ndara	tond	ling					
used	to d	etect	and quarantine network attacks.			luers		.mg					
CO4	l: To	lear	<i>n</i> the different tools for scanning.	Cog	Re	emer	nber	ing					
CO5 crim	5: To e inv	o <i>ider</i> vestig	<i>ntify</i> the types of cybercrimes, cyber laws and cyber ations.	er- Cog	Ur	nders	stand	ing					
Ι]	INTRODUCTION 9 hrs											
		Inforn Web assess in N Organ review netwo Techn	mation Systems, Need for Distributed Information Sy Services. Information System Treats and attacks, Cl sing Damages Security in mobile and Wireless Com Iobile Devices, authentication service Security, nizations, Laptops security Concepts in Internet and w of Internet Protocols TCP/IP, IPV4, and IP orking components-routers, bridges, switches, hub, niques.	stems: Ro assification puting-Security World W /6. Functor gateway	le of on of curity Imp Vide tions and	Inte Thr y Ch olica Web of Mo	ernet reats naller tion c: E var odula	and and nges for Brief ious ttion					
II	;	SYST	TEMS VULNERABILITY SCANNING			9 ł	nrs						
		Overv Versi Open under Recor	view of vulnerability scanning, Open Port / Servic on check, Traffic Probe, Vulnerability Probe, VAS, Metasploit. Networks Vulnerability Sca rstanding Port and Services tools - Datapipe, F nnaissance – Nmap, THC-Amap and System to tion tools – Tcpdump and Windump, Wireshark, Etter	ce Identifi Vulneral nning - pipe, Win ools. Netw cap, Hping	icatio pility Ne nRela vork g Kis	on, I Ezetcat ay, Snif	Bann xamj , So Netv ffers	er / ples, pcat, vork and					
III		NET	WORK DEFENCE TOOLS			9h	rs						
	Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless VsStateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System, Cryptool.												
IV		100	LS FOR SCANNING			9	hrs						
	5	Scanr Curl,	ning for web vulnerabilities tools: Metasploittool,Ni OpenSSL and Stunnel, Application Inspection to	kto, W3af ools – Ze	, HT d A	TP u ttack	utilit x Pr	ies - oxy,					

	Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools - John the										
	Ripper, L0htcrack, Pwdump, THC-Hydra.										
V	INTRODUCTION TO CYBER CRIME AND LAW 9hrs										
	Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and										
	Criminal Behavior, Clarification of Terms, Traditional Problems Associated with										
	Computer Crime, Introduction to Incident Response, Digital Forensics, Computer										
	Language, Network Language, Realms of the Cyber world, A Brief History of the										
	Internet, Recognizing and Defining Computer Crime, Contemporary Crimes,										
	Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT										
	2000.Introduction to Cyber Crime Investigation:Password Cracking, Key loggers and										
	Spyware, Virus and Worms, Trojan and backdoors, Steganography, DOS and DDOS										
	attack, SQL injection, Buffer Overflow, Attack on wireless Networks L- 45 hrs Total – 45 hrs										
	L- 45 hrs Total – 45 hrs										
Text b	oooks										
1.	Nina Godbole, "Information Systems Security: Security Management, Metrics,										
	Frameworks and Best Practices, w/cd", Wiley Publications, 2008, ISBN 10:										
	8126516925, ISBN 13 :9788126516926										
2.	Thomas J. Mowbray, "Cybersecurity: Managing Systems, Conducting Testing and										
	Investigating Intrusions", Wiley Publications, 2013, Kindle Edition, ISBN 10:										
	812654919X, ISBN 13 :9788126549191										
3.	D.S. Yadav, "Foundations of Information Technology", New Age International										
	publishers, 3 rd Edition, 2006, ISBN-10: 8122417620, ISBN-13: 978-8122417623										
Refere	ences										
1.	Mike Shema, "Anti-Hacker Tool Kit", McGraw Hill Education, 4 th edition, 2014,										
2.	Nina Godbole, SunitBelapure, "Cyber Security Understanding Cyber Crimes,										
	Computer Forensics and Legal Perspectives", Wileypublications, 2013, ISBN 10:										
	8126521791, ISBN 13:9788126521791.										
3.	Corey Schou, Daniel Shoemaker, "Information Assurance for the Enterprise: A										
	Roadmap to Information Security (McGraw-Hill Information Assurance & Security)",										
	Tata McGraw Hill, 2013, ISBN-10: 0072255242, ISBN-13: 978-0072255249.										
4.	VivekSood, "Cyber Laws Simplified", McGraw Hill Education (INDIA) Private										
	Limited in 2001, ISBN-10: 0070435065, ISBN-13: 978-0070435063.Steven M.Furnell,										
	"Computer Insecurity", Springer Publisher, 2005 Edition.										

E-references

- 1. https://www.cryptool.org/en/
- 2. https://www.metasploit.com/
- 3. http://sectools.org/tool/hydra/
- 4. http://www.hping.org/
- 5. http://www.winpcap.org/windump/install/
- 6. http://www.tcpdump.org/

- 7. https://www.wireshark.org/
- 8. https://ettercap.github.io/ettercap/
- 9. https://www.concise-courses.com/hacking-tools/top-ten/
- 10. https://www.cirt.net/Nikto2
- 11. http://sqlmap.org/

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1
CO1	3	3	3	2	1	1	1	1	1	0	0
CO2	2	1	1	1	1	1	1	1	1	0	0
CO3	2	2	2	1	1	1	1	1	1	0	0
CO4	1	1	1	1	0	0	0	0	0	0	0
CO5	1	1	1	2	2	1	1	2	2	0	0
	9	8	8	7	5	4	4	5	5	0	0

Mapping of COs with POs

1 - Low, 2 - Medium, 3 - High

			L	Т	Р	С			
X	BT 7	07			0	0	2	2	
			PROJECT PHASE-I						
С	Р	Α			L	Т	Р	Η	
1.5	0.5	0.5			0	0	2	4	
PRE	REQ	UISI	TE: - Nil						
COU	JRSI	E OUI	COMES:						
			Course Outcomes D	omaiı	ain Level				
On t									
CO1	. <i>I</i> . ii	Cog		Analyze					
CO2		nterpr	<i>et</i> and infer literature survey for its worthiness.	Cog		Analyze Apply			
CO3	A tl	nalys ne prol	<i>e</i> and <i>identify</i> an appropriate technique for solve C blem.	Cog		Analyze			
CO4	ŀ	Perform	<i>n</i> experimentation F	Phy	0	Comp). Ov	rert	
	/:	Simula	ation/Programming/Fabrication, <i>Collect</i> and	Cog		Re	esp.,		
	i	nterpr	et data.		C	reate	e, Ap	ply	
CO5	5 K	Record	and report the technical findings as a document.	Cog]	Rem	emb	er,	
					1	Unde	ersta	nd	
CO6	5 <i>L</i>)evote	oneself as a responsible member and <i>display</i> as a	٩ff	Value,				
	16	eader i	n a team to manage projects.	Cog	C	Organization Create			
CO7		espon	<i>ding</i> of project findings among the technocrats.	Aff	Responding			ng	

Mapping of COs with POs

	CO1	CO2	CO3	CO4	CO5	CO6	CO7	Total
PO1	3	2	1	2	1	-	1	10
PO2	3	2	1	2	1	-	1	10
PO3	-	-	1	3	1	-	-	5
PO4	-	1	2	3	1	2	2	11
PO5	-	-	2	3	1	-	-	6
PO6	1	-	1	1	-	3	3	10
PO7	1		1	1	-	1		4
PO8	1	-	1	1	-	3	-	6
PO9	-	-	-	-	2	3	1	6
PO10	-	-	-	-	3	3	3	9
PO12	_				2	2	2	6
PO12	1				3	3	1	8

1 – Low, 2 – Medium, 3 – High

		L	Т	Р	С								
X	GS 708	3			0	0	0	0					
			CAREER DEVELOPMENT SKILLS										
С	Р	Α			L	Т	Р	Η					
1.8	0.8	0.4			0	0	1	1					
PRE	REQU	ISIT	E: - Nil			1		1					
COU	RSE O	OUT	COMES:										
			Course Outcomes D	omain	l	L	evel	l					
On th	he succ	essfu	l completion of the course, students will be able to										
C01	Kno diff	owlee ferent	dge on a career related communication and learning the t formats of CV	Cog	5	Res	spon	se					
CO2	Prej inte	pare erviev	how to face an interview and to learn how to prepare for an N	Psy			Set						
CO3	Aff		Res	spon	se								
COU	RSE C	CON	ГЕNT										
I	CV	CV WRITING 10 hrs											
п	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. I TECHNICAL SKILLS 10 hrs												
	Inte lang free	ervie guag quent	w skills; tips for various types of interviews. Types of e, etiquette and dress code in interview, interview mistakes ily asked questions. Planning for the interview.	questic , telepl	ons honi	aske c int	d; b ervie	ody ew ,					
III	WO	ORK	SHOP		1	0hrs							
	Mo	ock ir	terviews - workshop on CV writing – Group Discussion										
			L-20 hrs Workshop - 2	l0 hrs	To	otal =	= 30	hrs					
Text	books												
1.	. Paul Guid	McC le to '	Gee, How To Write a CV That Really Works: A Concise, Cle Writing an Effective CV, Hachette UK, 2014	ar and	Con	nprel	nens	ive					
2.	. Mary 2012	y Elle	en Guffey, Dana Loewy Essentials of Business Communicati	on,Cer	ngag	e Le	arnir	1g,					
3.	. Mich the to	nael S ough	Spiropoulos, Interview Skills that win the job: Simple technic questions, Allen &Unwin, 2005	jues fo	r ans	swer	ing a	ıll					
4.	. Willi <u>Aca</u> d	iam I lemic	L. Fleisher,Effective Interviewing and Interrogation Technique Press, 2010.	ies, Na	than	J. C	ford	on,					
E-ref	ference	S											
1. ht	ttp://wv	vw.u	tsa.edu/careercenter/PDFs/Interviewing/Types%20of%20Int	erview	s.pd	f							
$\begin{vmatrix} 2. \\ h \end{vmatrix}$	<u>ttp://wv</u>	ww.a	mu.apus.edu/career-services/interviewing/types.htm										
3. ht	ttp://wv	ww.ca	areerthinker.com/interviewing/types-of-interview/										

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1										2		
CO2				1								
CO3										2		
CO4				1			1			1		
CO5										2		
				2			1			7		

1 - Low, 2 – Medium, 3 – High

-								
					L	Т	P	С
2	XBT 70	9			0	0	0	2
			INPLANT TRAINING - III				11	
С	Р	Α			L	Т	Р	Н
1 33	1 33	1 33			0	0	-	0
1.55	1.55	1.55			U	U	U	U
PREI	REQUI	SITE:	- Nil					
COU	RSE O							
		Dom	ain	Level				
On th	e succe	essful co	ompletion of the course, students will be able to					
CO1	Rela	<i>te</i> class	broom theory with workplace practice	Cog		Understand		
CO2	Con prac	<i>nply</i> wit ctices.	h factory discipline, management and business	Af	f	Re	espon	se
CO3	Den	nonstra	tes teamwork and time management.	Af	f		Value	e
CO4	Des	<i>cribe</i> an	d <i>display</i> hands-on experience on practical skills	Phy	/	Per	rcepti	ion
	obta	-			Set			
CO5	Sun	ımarize	the tasks and activities done by technical	Cog	z	E	valua	te
	doc	uments	and oral presentations.		-			

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	2											
CO2							1	3			1	
CO3									3	1	3	1
CO4		1	2	1	3							3
CO5				3						3		1
	2	1	2	4	3		1	3	3	4	4	5

1 - Low, 2 – Medium, 3 – High

XB	ST 802	2 A		-	L 3	Т 0	P 0	C 3			
	1 002		ADVANCED MICROBIOLOGY		0	v	U	0			
С	Р	Α		-	L	T	P	Н			
3	0	0			3	0	0	3			
PRE	REQ	UISI	TE: Microbiology, cell biology								
τοι	JRSE	COUT	COMES:								
			Course Outcomes	Domain]	Level	l			
After	After the completion of the course, students will be able to										
CO1	I	Jnde	rstan	ıding							
CO2		An	alyzi	ng							
CO3	τ	Jnde	rstan	iding							
CO4	EX	<i>plain</i> bes.	the importance and disadvantages of aquatic	Cog	τ	Jnde	rstan	ıding			
CO5 a	S: Su	<i>mmar</i> ations	<i>ize</i> the various microorganisms in soil and their .	Cog	τ	Jnde	rstan	ıding			
	Ι		DIVERSITY OF THE MICROBIAL WORLD				9				
Mic	robia	l Evo	olution and diversity – Microbial taxonomy: var	ious charad	cteris	tics	used	d for			
taxo	onom	y – c	lassification of archaea - Types and applications of	of proteoba	cteri	a –	Stru	cture,			
nutr	rition,	met	abolism and reproduction of fungi and virus	ses – Alg	gae:	dis	tribu	ıtion,			
cha	racte	rizati	on and nutrition.								
	II		MICROORGANISMS AS A SOURCE OF RENI ENERGY	EWABLE			9				
Scop	e an	d im	portance Renewable sources - Energy from wa	ste materia	ls: 1	Prod	uctic	on of			
nonc	onver	ntiona	l fuels - methane (biogas) and hydrogen - Use of	microorgan	isms	in	petro	oleum			
augmentation and recovery - bio-diesel from microbial sources - Microbial fuel cells -											
biod	egrad	able p	lastics from microbes.								
	III		MICROBES AND THE ENVIRONMENT				9				
Micr huma and e	Microbial ecology – Interactions among microorganisms: plant – microbe, animal – microbe and human-microbe interactions – Microenvironment: biofilms and microbial mats – microorganism and ecosystem - Degradation of xenobiotic compounds – Bioremediation - Microbial leaching.										

Aquatic environment and microorganism: gases, nutrients and nutrient cycle – Microbial community: marine microorganism – carbon cycling in ocean environment – fresh water microorganism – water borne pathogens, diseases and their control – sanitary analysis of water –

9

AQUATIC MICROBES

IV

• , , • •	• • • • • •							
Important microbes in waste water treatment.								
V	VTERRESTRIAL MICROBES9							
Soil as an environ	ment for microbes – Imp	ortant Nutrients and composition	ition of so	oil - Microbes at				
tropical, temperate	e, cold mist area and des	sert soils – Soil microorgania	sms in va	rious association				
with vascular plan	nts – subsurface biosphere	e – soil microorganism and hu	uman dise	eases – beneficial				
microorganisms fi	om soil: biofertilizers.							
LECTURE	TUTORIAL	PRACTICAL		TOTAL				
45	0	0		45				
TEXT BOOKS:								
1. Michael J.	Pelczar, E.C.S. Chan,	Microbiology (An Application	on Based	Approach) Tata				
McGraw Hill; 1s	t edition, 2010.							
2. Tortora, C	J.J., Funke, B.R. and C	ase, C.L., Microbiology: A	n Introdu	ction, Benjamin				
Cummings, 10th	Edition, 2009.							
REFERENCES:								
1. Young, M	I.Y., Comprehensive Bio	otechnology, Vol 1-4, Perg	amon Pre	ess, Oxford, 1st				
Edition, 1985.								
2. Rittman, E	and McCarty, P.L., Envi	ironmental Biotechnology: Pr	rinciples a	and Applications,				
McGraw- Hill, 2nd Edition, 2000.								
3. Glazer, A.N. and Nikaido, Microbial Biotechnology, Freeman and company, 2nd Edition,								
2007.								
E REFERENCES:								
1. http://www	v.austincc.edu/rohde/noter	ref.htm						
2. http://www	v.microrao.com/mypgnote	es.htm						

2. http://www.microrao.com/mypgnotes.htm

COs Vs Pos

	PO1	PO 2	PO 3	PO 4	РО 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2			1	2	1					1
CO 2	2		2	2	1	3	2	1	1	2	1
CO 3	2			1	1	3	2			1	

CO 4	1			2		2	1			1	1
CO 5	2			1	1	2	2			1	
	9	0	2	7	5	11	7	1	1	5	3

Subject Vs Pos

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
Original	9	0	2	7	5	11	7	1	1	5	3
Scaled	2	0	1	2	1	3	2	1	1	1	1
to 0,1,2,3 scale											

								С			
XB	ST 80 2	2 B			3	0	0	3			
C	D	•	INSECT BIOTECHNOLOGY		т	т	р	тт			
3	P 0	A 0	-		L 3	1	r 0	<u>п</u> 3			
5											
PRE	CREQ	UIS	ITE: Microbiology, Genetic Engineering								
COU	COURSE OUTCOMES:										
			Course Outcomes	Domain			Leve	1			
Afte	r the o	comp	letion of the course, students will be able to								
CO1	l: Def	<i>ine</i> t	he classification and morphology of insects.	Cog		Rem	embe	ering			
CO2	2: And	alyze	the effect of environment on insects and <i>classify</i> the	Cog		An	alyzi	ng			
V	variou	s ber	neficial insects.								
CO3	8: Ap	<i>ply</i> t	he insect cell culture technique and <i>construct</i> the	Cog		Aj	plyi	ng			
e	expres	sion	vector system.								
CO4	1: Un	derst	ands the mechanism involved in transgenic animal	Cog	1	Understanding					
ľ	orodu	ction	and its <i>applications</i> .			Aj	oplyi	ng			
COS	5: App	olicat	<i>tion</i> of the insect biotechnology in various fields.	Cog		Aj	oplyi	ng			
		<u> </u>		Aff							
	Ι		INTRODUCTION TO INSECTS				9				
Histo	ory ar	nd de	velopment of Entomology - Hierarchy of insects, spec	ies concepts	s - C	lassi	ficati	on of			
insec	ets up	to of	der level, habits, habitats and distinguishing features of	of different	Orde	er and	1				
1mpc Butt	ortant	Fam	ndia morphology biology Ecology and Behaviour	Butterflies:	Swa	llOW	of I	arval			
Popu	ilatio	, III I 1.	india morphology, biology, Leology and Denaviour,	Seasonal I I	uctu	ation	01 L	aivai			
	Π		INSECTS AND ENVIRONMENT				9				
Lace	wing	: Sys	stematics and Ecology – biological control - Termites	as Model O	rgan	isms	- Ho	oney			
Bees	s - Eco	ologi	cal Importance - Bioindicators of Environmental Mon	itoring - Di	rect a	and I	ndire	ect			
Effe	Effects of Genetically Modified Plants on the Honey Bee - Beneficial insects – Predators, parasites,										
pollinators: ground beetles, Tachinid flies, lady bird beetle, Silk worm, Honey bee and Lac insects.											
IIIGENETIC ENGINEERING OF INSECTS9											
Introduction of Insect Gene Transfer technology - Insect cell lines development, maintainance and											
chara	characterization - Cloning and expression of vectors: Insect cell baculovirus expression vector										
syste	em (I	С-	BEVS) - Insect gene Libraries and Their Screening	ig - Denso	nucle	eosis	Vir	us as			
Tran	sduci	ng V	Vectors- Transposable-Element Vectors, Sindbis V	virus Expre	essio	n S	ysten	ns in			
Mos	quitoe	es - F	Retrotransposons and Retroviruses.								

IV	TRANSGENIC INSECTS	9
Site-specific	Recombination for the Genetic Manipulation of Transgenic Inse	cts - Transgenic
Selection - E	ye Color Genes - Protein (GFP) as a marker for Transgenic Inse	ects - Transgenic

Silkworm – production of human type III procollagen Silkworm – Transgenic silk worm, spiders										
for silk production	for silk production.									
V A	PPLICATIONS			9						
Application of 1	Application of insect biotechnology: Agriculture, medicine – Insect cell baculovirus expression									
vector system f	or Cell and tissue enginee	ering, recombinant vaccine p	roduction, gene th	neraphy,						
protein display	analysis and drug develo	opment - Insects used as dr	ugs, food, orna	ments -						
pheromone prod	uction of social insects - In	sect diversity Conservation.								
LECTURE	TUTORIAL	PRACTICAL	TOTAL							
45	0	0	45							
TEXT BOOKS	, ,									
1. Alfred Handle	r, Anthony James, Insect T	ransgenesis: Methods and Ap	plications, CRC Pr	ress,						
2000.										
2. David Grimal	di and Michael S. Engel Mi	ichael S. Engel, Evolution of t	he Insects ,2005.							
REFERENCES	:									
1. Stewart, Ala	n JA, Timothy R. New, a	nd Owen T. Lewis, eds. Inse	ect Conservation I	Biology:						
Proceedings	of the Royal Entomologica	l Society's 23nd Symposium.	CABI, 2007.							
2. Devillers, Ja	mes, and Minh-Hà Pham-I	Delègue, eds. Honey bees: esti	mating the enviro	nmental						
impact of chemicals. CRC Press, 2003.										
3. 3Lal, Uttam. "Environmental constraints and development processes in a mountain ecosystem										
of Western Himalaya: a case study of Kinnaur",2009.										
E REFERENCES:										
1. https://yeastv 2009.pdf	vonderfulworld.files.wordp	press.com/2017/01/biotechnolo	gy-smith-5th-edit	ion-						

COs Vs Pos

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2			2		2	1			1	1
CO 2	2		2	1	2	3	2	2	1	1	2
CO 3	3	2	1	2	2	1			1	2	
CO 4	3	3	2	2	2	1		1			
CO 5	2	2	1	1		2	2	1			2
	12	7	6	8	6	8	5	4	2	4	5

Subject Vs Pos

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	РО 7	PO 8	PO 9	PO 10	PO 11
Original value	12	7	6	8	6	8	5	4	2	4	5
Scaled to 0,1,2,3 scale	3	2	2	2	2	2	1	1	1	1	1

XB	ST 80	2 C	IICS	L T P C 3 0 0 3					
С	P	Α			L T P H				
2.0	0	0.5							
PRE	REQ	UISI	FE: Bioinformatics, Genetics and Protein E	ngineering.					
COU	COURSE OUTCOMES:								
			Domain	Level					
After	r the o	comple	etion of the course, students will be able to						
C01	:Des	cribes	the various concepts of databases and	Cog	Remember,				
knov	vs the	techn	iques required for genetic analysis	COg	Understand				
CO2	2: Con	npare	s the different techniques of micro array.	Aff	Organization				
CO3	B: Exp	olain t	he protein sequence databases and <i>describes</i>	Cog	Remember,				
the t	ool ar	nd tech	iniques used in proteomics	-	Understand				
CO4	: And	<i>alyze</i> t	he phylogenetic constructions using	Cog					
diffe	rent r	nethoo	lology		Analyzing				
CO5	5: App	olying	the modern approaches in the drug	Cog					
disco	overy	and de	evelopment		Applying				
	Ι		GENOMICS		9				
Goal	s of t	he Hu	man Genome Project, cloning vectors, concep	t of maps, ph	ysical maps, shotgun				
libra	ries, I	DNA	polymorphism, nucleotides, DNA sequences.	Sequence da	tabases. Polymerase				
chair	n reac	tion p	rimer selection for PCR, BLASTn, application	n of BioEdit;	Genome information				
and	speci	al feat	tures, coding sequences (CDS), untranslated	regions (UT	R's), cDNA library,				
expr	essed	seque	nce tags (EST).						
	II		DNA MICROARRAY		8				
Intro	ducti	on, B	asic steps for gene expression, concept	of microarra	ays; spotted arrays,				
oligonucleotide arrays, designing the experiment, Two-color microarray experiments. Tools for									
microarray analysis; soft-finder, xCluster, MADAM, SAGE, Microarray design, microarray									
experimentation, fabrication computational analysis of Microarray data, Applications of									
micr	microarray technology.								
	III		PROTEOMICS		10				
Prote	ein S	equen	ce Databases And Analysis-Protein sequence	ce informatio	on, composition and				
prop	erties	, phys	sicochemical properties based on sequence	, sequence c	omparison; Primary				
datal	bases,	Seco	ndary databases. Protein Microarray- Prote	eomics classi	fication; Tools and				
techi	nique	s in p	roteomics; Tryptic digestion and peptide fing	gerprinting (F	MF), Protein Micro				
array	inpr	otein e	expression, profiling and diagnostics, drug targ	get discovery.	Database searching-				
3-dir	3-dimensional structure determination by X-ray and NMR.								

IV	PHYLOGENETIC ANALYSIS	9
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Evolution, elements of phylogeny, methods of phylogenetic analysis, Phylogenetic tree of life, comparison of genetic sequence of organisms, phylogenetic analysis tools-Phylip, ClustalW; Comparative Transcriptomics- Differential Gene expression, Transplastomics.

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v
•

PHARMACOGENETICS

9

High Throughput Screening for Drug Discovery-Identification of Drug targets, Pharmacophore, Pharmacogenetics and Drug development. ADME Properties, Metabolome and Metabolomics. Systems Biology-Model systems. Global databases and analysis and statistical Modeling; Drug Discovery And Computer-Aided Drug Designing

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT BOOKS:

- 1. C. Cantor and C.L Smith, Wiley-Interscience. NewYork, Genomics: The Science and technology behind the human genome project (2000).
- 2. Atwood, T. K. and Parry-Smith, D. J, Introduction to Bioinformatics.

REFERENCES:

- 1. Genome Analysis- A practical Approach(19995)by J.M Davis, Oxford University press, Oxford
- 2. Genome Mapping A practical Approach(1997) by P.H Dear, Oxford University press, Oxford.
- 3. C. Stain Tsai, A. John Wiley and Sons, Inc., publications, An introduction to Computational Biochemistry.

E-REFERENCES:

1. https://bmcresnotes.biomedcentral.com/articles/sections/genomics.

Cos Vs Pos

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

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

					L	Τ	P	C				
XBT	803	A			3	0	0	3				
			TISSUE ENGINEERING									
C I	P	Α			L	Т	P	Η				
3	0	0			3	0	0	3				
PREF	REÇ	QUIS	SITE: Basics in Cell biology									
COU	RSE	Ε ΟΙ	JTCOMES:									
			Course Outcomes	Domain	Level							
After	After the completion of the course, students will be able to											
CO1:	Re	emer	nber	ing,								
applic	catio	ns o	f tissue engineering		Ur	nders	stand	ling				
CO2:	Re	call	and Outline the cell signalling, cellular junctions,	Cog	Un	ders	tand	ling,				
source	Re	emei	nber	ring								
CO3:	CO3: <i>Define</i> and <i>Summarize</i> the need of biomaterials for tissue Cog											
engine	eerii	ng,	their mechanical properties, compatibility,		I Ir	nder	stand	ling,				
degrad	datio	on, a	nd classification			luci	stanc	ing				
CO4:	Re	call	and Outline the bioreactor design and its various	Cog	Understanding,							
types	base	ed or	application		Re	emei	nber	ring				
CO5 :	Te	<i>ll</i> th	e concept related to tissue fabrication technology	Cog	Understanding							
includ	ling	Sca	ffold based methods and Scaffold free methods of		Remembering							
fabrica	atio	n						8				
	Ι		INTRODUCTION				8					
Basic	def	finiti	on - Scope of tissue engineering - Design princip	ples for tissu	e er	ngino	eerin	ng –				
Buildi	ing l	bloc	ks of tissue engineering – Structural and organization of	of tissues: Tiss	sue (Com	pone	ents,				
Tissue	e typ	pes –	Tissue Dynamics – Tissue repair.									
	II		CELLS IN TISSUE ENGINEERING				10					
Cells	anc	d tis	ssue engineering – Cell signalling: Endocrine sig	nalling, Para	crine	e sig	gnall	ling,				
Autoc	rine	e sig	nalling and Direct cell-to-cell signalling – Cellula	ar junctions:	Tigl	nt ju	incti	ons,				
Adher	rens	jun	ctions, Desmosome junctions and Gap junctions – C	ell sourcing:	Ani	mal	deri	ved,				
Huma	n de	erive	ed, Cell lines derived and Stem cells derived – Cell of	culture proces	s: C	ell i	solat	tion,				
Cell a	ttac	hme	nt and Sub-passing of cells.									
	III		BIOMATERIALS FOR TISSUE ENGINEERIN	G			9					
Defini	itior	1 –	Tensile properties - Biomaterials degradation - H	Biomaterials	bioc	omp	atibi	lity:				
Immu	ne r	respo	onse – Biomimetic biomaterials: Natural polymers, RG	D linked synt	hetio	c pol	lyme	ers –				
Classi	ifica	tion	of biomaterials: Natural vs synthetic, Degradable v	vs non-degrad	dable	e, M	[etals	s vs				
ceram	ics	vs po	olymers – Idealized biomaterials.									
	IV		BIODEACTORS FOR TISSUE ENCINEEDING	2			9					

IV	IV BIOREACTORS FOR TISSUE ENGINEERING							
Definition – Cla	ssification: Bioreactors for cell culture and cell expansion, Bioreactor	ors for scaffold						

fabrication, Bioreactors for scaffold cellularization, Bioreactors for stretch, Bioreactors for											
pe	rfusion and Bioreactor	s for electric stimulation – Bio	preactors design considera	ations.							
	V TISSUI	E FABRICATION TECHNO	DLOGY	9							
Int	roduction – Scaffold fi	ree methods - Cell patterning	techniques - Scaffold bas	sed methods –							
Ra	Rapid prototyping technology – Printing technology – Organ-on-a-chip model.										
	LECTURE	TUTORIAL	PRACTICAL	TOTAL							
	45	0	0	45							
TI	TEXT BOOKS:										
1.	Robert Lanza, Robert	t Langer, Joseph P. Vacanti. P	rinciples of Tissue Engine	eering. Academic							
	Press, 2013.										
2.	Birla, R. Introduction	to tissue engineering: applica	ations and challenges. Joh	n Wiley & Sons,							
	2014.										
RI	EFERENCES:										
1.	Lanza, R., Langer, R. press, 2011.	, & Vacanti, J. P. (Eds.). Prin	ciples of tissue engineerin	g. Academic							
2.	Ikada, Y. Tissue engi	neering: fundamentals and ap	plications (Vol. 8). Acade	emic Press, 2011.							
3.	Micou, M. K., and Ki	ilkenny, D. A Laboratory Cou	rse in Tissue Engineering	g. CRC Press,							
	2012.										
E-	E-REFERENCES										
1. https://ocw.mit.edu/courses/health-sciences-and-technology/hst-535-principles-and-practice-											
of-tissue-engineering-fall-2004/lecture-notes/											
2. http://nptel.ac.in/courses/113108071/											
3.	http://nptel.ac.in/cour	ses/113104009/									

os	Vs	Pos
US	V S	LO2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3										
CO 2	3				1						
CO 3	3	2		1	1		2		1		1
CO 4	3	2		1	1		2		1		1
CO 5	3	3	3	3			3		2		1
	15	7	3	5	3	0	7	0	4	0	3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	15	7	3	5	3	0	7	0	4	0	3
Scaled to 0,1,2,3 scale	3	2	1	1	1	0	2	0	1	0	1

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

		L	Т	P	C							
XBT 80.	3 B		MARINE BIOTECHNOLOGY		3	0	0	3				
C P	A	L			L	Т	P	Η				
2.5 0	0.	5			3	0	0	3				
PRERE	QUI	SIT	TE: Microbiology and rDNA technology									
COURS	E O	UT	COMES:									
			Course Outcomes	Domain		Lev	el					
After the	com	ple	etion of the course, students will be able to									
CO1: Un	nders	star	<i>ud</i> microbial diversity in the ocean	Cog	Understanding							
CO2: Su	CO2: Summarize the various types of marine cultures. Cog											
CO3: Ex	Unde	ersta	nd	ing								
CO4: <i>Di</i>	Ar	nalyz	zin	g								
of bacter	Und	ersta	nd	ing								
CO5: Un	Receiving											
spillage and bioremediation Aff								phenomena				
		Ar	ıalyz	zin	g							
I	I INTRODUCTION TO MARINE MICROBES IN THE 9											
Proximit	y to	the	e ocean surface or sediments: Euphotic -Mesopela	gic - Bathope	elagic	- B	ent	hos				
(sedimen	ts)-C	Con	centration of nutrients and required growth	n substrates	: Oli	gotr	op	hic,				
Mesotrop	ohic,	Εı	trophic - interactions between marine microbes: s	symbiosis and	d path	oger	ies	is -				
Metaboli	c cap	pab	ilities of marine microbes: adapting to extreme envi	ronments - A	lgal bl	oom	is.					
II		F	ISH AND MARINE CULTURES			10						
Fish Phy	siolo	ogy	- reproductive genetics: gynogenesisv androgensis	s, polyploidy	, cont	rol c	of s	sex,				
artificial	inse	emi	nation, eye stalk ablation - Development of H	Healthy Fish	Diets	, D	ise	ease				
Preventio	on in	Fi	sh, and GM fish and shellfish- Disease resistance	in marine an	imals	and	D	NA				
Vaccine	dev	elo	pment for aquacultured fish - gene banks, Cry	opreservation	n. Isol	atio	n	and				
character	izati	on	of biosynthetic gene clusters, mariculture a	nd aquacult	ure o	of r	nai	rine				
invertebr	ates	suc	ch as bryozoans, Sponges, and tunicates.									
III	III BIOMEDICAL IMPORTANCE OF MARINE 8											
Microalg	ae a	s a	Source of Bioactive Molecules- New Antibiotics	and Medicin	nes fro	m N	Лa	rine				
Organisn	ns- F	ote	entialities in the treatment of Infectious Diseases, G	Osteoporosis	and A	lzhe	im	er's				
Disease	Cya	not	bacterial Biotechnology -The Secondary Metabol	ites and Bio	osynth	etic	G	ene				
Clusters	of M	ari	ne Cyanobacteria.									
IV		M	IARINE BIOMATERIALS			10						
Polymers	&	bi	omaterials form marine source: agarose, agar, a	alginates, car	rragea	as,	chi	itin,				
chitosan, carotene, heparin, marine flavourants - environmentally friendly antifouling compounds												

Biopotential	uses	of	halophilic	organisms.	Role	of	halophilic	bacteria	and	artemia	in	salt
purification.												

V ENVIRONMENTAL IMPACTS OF MARINE BIOTECHNOLOGY

8

Control of oil spills and bioremediation- superbugs. Genetically Engineered Marine Organisms: Environmental, Economic Risks and Benefits.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT BOOKS:

- 1. T.Scheper, Y.Le.Gal, Ulber.R, Marine Biotechnology II, Springer, 2005.
- 2. Attaway, D. H., Zaborsky, O. R. (Ed.). Marine Biotechnology: Volume I, Pharmaceuticals and Bioactive Natural Products. New York, USA, 1993.

REFERENCES:

- 1. Song Qin, W. E. G. Müller, and Edwin L. Cooper, Marine Biotechnology, Hindawi Publishing Corporation, 2011.
- 2. Querellou, Joel, et al. "Marine Biotechnology." Introduction to Marine Genomics. Springer Netherlands, 2010. 287-313.
- 3. Proksch, Peter, and Werner EG Müller, eds. Frontiers in marine biotechnology. Wymondham, UK: Horizon Bioscience, 2006.

E REFERENCES:

1. nptel.ac.in/courses/102103013/36

Cos Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2				2	1	1		1		1
CO 2	3		2	1	2	1	1	2		1	
CO 3	1	2	3	2	2	2		2		2	1
CO 4	2	2	3	1	2	2	2	1		1	
CO 5	1	1	2	1		2	3				
	9	5	10	5	8	8	7	5	1	4	2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	9	5	10	5	8	8	7	5	1	4	2
Scaled to 0,1,2,3 scale	2	1	2	1	2	2	2	1	1	1	16

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

					L	Т	P	С				
XB	T 80	3 C	NANOBIOTECHNOLOGY		3	0	0	3				
C	Р	Α			L	Т	Р	H				
2.5	0	0.5			3	0	0	3				
PRE	RE	QUIS	ITE: Instrumental methods of analysis									
τοι	JRS	E OU'	TCOMES:									
			Course Outcomes	Domain		L	evel					
After	r the	comp	letion of the course, students will be able to									
CO1	:Re	<i>call</i> th	he basic concepts characterization techniques	Cog	R	emei	nber	ing				
and i	illusi	t rate ti	he methods of nanoparticles synthesis.		U	nder	stand	ling				
CO2	: Co	nstru	Cog	С	reati	ng						
adva	ntag	es.		U	nder	stand	ling					
CO3	8: De	esign a	Cog	C	reati	ng						
CO4	: Oı	ıtlines	the environmental applications of	Cog	U	nder	stand	ling				
nano	parti	icles										
CO5	: Un	idersta	ands the Fundamentals of Nanocarriers and	Aff	R	eceiv	ving					
desig	gn a	drug d	lelivery system.	Cog	Pl	neno	men	а				
					С	reati	ng					
I		INT CHA	RODUCTION TO NANOPARTICLES SYNT ARACTERIZATION	THESIS AND			9					
Nano	opart	icles-	physical, chemical and biological properties- S	ynthesis- Physic	al n	netho	ods:	laser				
vapo	rizat	ion,	laser Pyrolysis, ion implantation. Chemic	al methods for	or	synt	nesis	of				
Nano	omat	erials:	sol-gel method. Biological synthesis: using	microorganism	s, p	lant	extr	acts.				
Char	acte	rizatio	n techniques: UV- Spectroscopy, Dynamic	Light Scattering	, Z	eta	potei	ntial,				
Ener	gy D	Dispers	sive X-Ray Analysis (EDX), Selected Area Diffr	action Pattern (S	AEI	D).						
II		MIC. DEV	ROFLUIDICS MEETS NANO: LAB-ON-A-C ICES	CHIP			9					
Cond	cepts	and	advantages of microfluidic devices - Fluid tra	nsport – Stacki	ng a	and	seali	ng –				
Mate	erials	s and r	nethods for the manufacture of microfluidic con	ponent, fluidic s	struc	ture	s, su	rface				
mod	ifica	tions.										
II			9									
Ther	anos	stic ag	ents- properties- advantages- Carbon dots and	l Quantum dots	- ab	ility	to o	cross				
acros	ss B	lood I	Brain Barriers- theranostic approach for Cancer	treatment and r	neur	odeg	ener	ative				
disor	disorders- Alzheimer's, Parkinson's disease.											
IV	7	ENV	IRONMENTAL APPLICATIONS OF NANC	DPARTICLES			9					
Role	of i	ron oy	kide, biopolymers and metal nanoparticles in W	aste water treatn	nent	- hea	vy r	netal				
remo	oval,	nano	tilter devices. Role of antimicrobial coating	in infectious di	seas	e pr	even	tion.				

Nanobio	sensors for env	ironmental monitoring.			
V	NANOPART SYSTEMS	TICLES AND NOVEL I	DRUG DELIVERY		12
Fundame	entals of Na	anocarriers - Size, S	Surface, Magnetic and	l Opti	ical Properties,
Pharmac	okinetics and	Pharmacodynamics of	Nano drug carriers. D	orug de	elivery systems-
microca	osules and mic	crospheres- hydrogels- F	Polymers - Dendrimers-	Dendri	tic Nanoscafold
system.	pH based targ	eted delivery- chitosan	and alginate. Copolyme	rs- PLA	A, PLGA. Lipid
Based N	anocarriers - Li	posomes, niosomes- Cub	osomes. Hydrophobic dr	ug deliv	very.
LE	CTURE	TUTORIAL	PRACTICAL		TOTAL
	45	0	0		45
TEXT F	BOOKS:			L	
1. Nien	neyer, Christof	M., and Chad A. Mirkin	. Nanobiotechnology: con	ncepts,	applications and
persp	pectives. Vol. 1	. John Wiley & Sons, 200)4.		
2. Mirk	in, Chad A., an	nd Christof M. Niemeyer	, eds. Nanobiotechnology	y II: mo	ore concepts and
appli	cations. John V	Viley & Sons, 2007.			
REFER	ENCES:				
1. Good	lsell, David S.	Bionanotechnology: lesso	ons from nature. John Wil	ley & S	ons, 2013.
2. Freit	as Jr. R.A., "Na	anomedicine", First Editio	on, Volume IIA, Landes I	Bioscier	nces, 2004.
E- REF	ERENCES:				
1. http://	//www.chem.la	tech.edu/~ramu/msnt505/	/lec_notes/Ji/MSNT505	Ji_notes	s.htm
2. http:/	//nptel.ac.in/cou	urses/118107015/			

COs Vs Pos

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

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

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

				L	Т	Р	С
		•			•	10	10
X	B.I. 9	04		U	U	12	12
			PROJECT PHASE-II				
С	Р	Α		L	Т	Р	Η
6	3	3		0	0	12	24
PRE	REQ	UISI	ГЕ: - Nil				
COU	IRSE	C OUI	COMES:				
			Course Outcomes Dom	ain		Level	l
On th	he su	ccessf	ul completion of the course, students will be able to				
CO1	Id	entify	the Engineering Problem relevant to the Co	g		halv	70
	do	main	interest.		ſ	Anaryz	LC
CO2	In	terpret	and Infer Literature survey for its worthiness.	g	A	Analyz	ze
						Apply	/
CO3	A	nalyse	and identify an appropriate technique for solve Co	g	A	Analyz	ze
	the	e prob	lem.			Apply	/
CO4	Pe	rform	experimentation Ph	у	Co	mp. O	vert
	/ S	imulat	ion/Programming/Fabrication, Collect and Co	g		Resp.	,
	in	terpret	data.		Cre	ate, A	pply
CO5	Re	ecord a	and Report the technical findings as a Co	g	Re	memt	ber,
	do	cume	nt.		Ur	ndersta	and
CO6	De	evote	oneself as a responsible member and display as Af	f		Value	,
	a l	eader	in a team to manage projects. Co	g	Org	aniza	tion,
						Create	e
CO7	Re	espond	ling of project findings among the technocrats. Af	f	Re	spond	ing

Mapping of COs with Pos

	CO1	CO2	CO3	CO4	CO5	CO6	CO7	Total
PO1	3	2	1	2	1	-	1	10
PO2	3	2	1	2	1	-	1	10
PO3	-	-	1	3	1	-	-	5
PO4	-	1	2	3	1	2	2	11
PO5	-	-	2	3	1	-	-	6
PO6	1	-	1	1	-	3	3	10
PO7	1		1	1	-	1		4
PO8	1	-	1	1	-	3	-	6
PO9	-	-	-	-	2	3	1	6
PO10	-	-	-	-	3	3	3	9
PO11	-				2	2	2	6
PO12	1				3	3	1	8

1 - Low, 2 – Medium, 3 – High

	С	Р	Α	P01	PO2	PO3	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2	L:T:P:C
Core Subjects																		
XBT 207				15	11		1			6	1			9				0:0:0:0
XBT 302				5	6	3	12					10	2	6				3:1:0:4
XBT 303				11	9	9	9	6			10		13	10		10	10	3:0:1:4
XBT 304	\checkmark			11	9	9	9	6			10		13	10		10	10	3:1:1:5
XBT 402	\checkmark	\checkmark		7	7	5	2	7	2		3	1	3					3:0:0:3
XBT 403				2	6	4	1	6	7		2	1	4	3				3:0:1:4
XBT 404			\checkmark	5	5	10		5			5	5	5	5				3:1:1:5
XBT 405				12	0	14	12	0	0	0	0	10	0	9				3:1:0:4
XBT 406				2	2	2		2					3	6				3:0:0:3
XBT 501				13	8	11	8	14	9	5	4	8	7	5				2:1:0:3
XBT 502				6	7	8	2	0	0	0	0	1	0	1				2:1:0:3
XBT 503				13	1	14	7	12	4	3	6	1	4	4				3:0:1:4
XBT 504				8	11	8	7	2	0	2	0	4	0	5				3:1:1:5
XBT 602				15	8	10	9	12	5	4	5	6	9	8				3:0:0:3
XBT 603				10	10	9	10	11	6	6	4	5	7	6				3:1:0:4
XBT604				6	7	8	2	0	0	0	0	1	0	1				3:1:1:5

XBT 605			\checkmark	10	10	9	10	11	6	6	4	5	7	6				3:1:0:4
XBT 702			\checkmark	2	9	10	3	13				2						3:0:1:4
XBT 703			\checkmark	11	9	11	7		4	5		5		2				3:1:1:5
Professional Electives	С	Р	A	P01	P02	PO3	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	L:T:P:C
XBT 505A			\checkmark	12	11	12	14	08	11	13	5	8	8	6				3:0:0:3
XBT 505B			\checkmark	10	3	12	9	12	9					5				3:0:0:3
XBT 505C						2		5	6		12	4						3:0:0:3
XBT 606A	\checkmark		\checkmark	6	3	10	4	10	13	3	8	1	1	6				3:0:0:3
XBT 606B				9	7	9	8	10	12	7	4	7	8	5				3:0:0:3
XBT 606C	\checkmark					6	6	5	10		4	3						3:0:0:3
XBT 704A	\checkmark		\checkmark	13	10	8	11	11	6	4	2	5	5	5				3:0:0:3
XBT 704B				13	10	8	11	11	6	4	2	5	5	5				3:0:0:3
XBT 704C				11	7	3	9	0	9	11	0	0	0	4				3:0:0:3
XBT 705A				10	6	13	9	12	14	10	6	7	9	6				3:0:0:3
XBT 705B				7	5	8	6	5	11	13	2	1	2	4				3:0:0:3
XBT 705C				6	10	6	6	0	5	14	0	2	0	3				3:0:0:3
XBT 802A				9	0	2	7	5	11	7	1	1	5	3				3:0:0:3
XBT 802B	\checkmark			12	7	6	8	6	8	5	4	2	4	5				3:0:0:3
XBT 802C				9	7	9	8	10	12	7	4	7	8	5				3:0:0:3

XBT 803A	\checkmark			15	7	3	5	3	0	7	0	4	0	3				3:0:0:3
XBT 803B	\checkmark			9	5	10	5	8	8	7	5	1	4	2				
XBT 803C	\checkmark			8	12	7	5	12	10	7	1			5				
Projects and Internship	C	Р	A	P01	P02	P03	PO4	P05	P06	P07	P08	PO9	P010	P011	P012	PSO1	PSO2	L:T:P:C
XBT 308	\checkmark	\checkmark	\checkmark	1	1	2	1	1	0	1	1	1	1	1		1		0:0:0:1
XBT 508	\checkmark			2	1	2	4	3		1	3	3	4	4	5			0:0:0:1
XBT 709	\checkmark			2	1	2	4	3		1	3	3	4	4	5			0:0:0:2
XBT 707				10	10	5	11	6	10	4	6	6	9	6	8			0:0:2:2
XBT 804				10	10	5	11	6	10	4	6	6	9	6	8			0:0:12:12
Humanities and Basic Sciences	С	Р	Α	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	L:T:P:C
Humanities and Basic Sciences XGS 105	C √	Р	A √	P01	P02	P03	PO4 4	P05	P06	P07	P08	P09	P010 6	P011 2	P012	PSO1	PSO2	L:T:P:C 1:0:0:1
Humanities and Basic Sciences XGS 105 XGS 206	C √ √	P √ √	A √ √	P01	P02	P03	PO4 4 4	P05	P06	P07	P08	P09	P010 6 6	P011 2 2	P012 2 2	PS01	PSO2	L:T:P:C 1:0:0:1 1:0:0:1
Humanities and Basic Sciences XGS 105 XGS 206 XGS 307	C √ √ √	P √ √	A √ √	P01	P02	P03	PO4 4 4 2	P05	P06	P07	P08	P09	P010 6 6 6	P011 2 2 2 2	P012 2 2	PSO1	PSO2	L:T:P:C 1:0:0:1 1:0:0:1 0:0:0:0
Humanities and Basic Sciences XGS 105 XGS 206 XGS 307 XGS407	C √ √ √ √ √	P √ √	A √ √	P01	P02	P03	PO4 4 4 2 2 2	P05	P06	P07	P08	P09	 P010 6 6 6 6 6 	P011 2 2 2 2 2 2	P012 2 2	PSO1	PSO2	L:T:P:C 1:0:0:1 1:0:0:1 0:0:0:0 1:0:0:1
Humanities and Basic Sciences XGS 105 XGS 206 XGS 307 XGS 407 XGS 507	$\begin{array}{c} \mathbf{C} \\ \mathbf{} \end{array}$	P √ √	A √ √	P01	PO2	PO3	PO4 4 4 2 2 2 2	P05	P06	P07	P08	P09	 P010 6 6 6 6 0 	P011 2 2 2 2 0	P012 2 2	PSO1	PSO2	L:T:P:C 1:0:0:1 1:0:0:1 0:0:0:0 1:0:0:1 1:0:0:1
Humanities and Basic Sciences XGS 105 XGS 206 XGS 307 XGS 407 XGS 507 XGS 507	$\begin{array}{c} \mathbf{C} \\ \mathbf{} \end{array}$	P √ √ √	A √ √ √	P01 2 1	PO2	PO3	PO4 4 4 2 2 2 4 4	P05	P06	P07	P08	P09 5 1	P010 6 6 6 0 8	P011 2 2 2 2 0 2	P012 2 2 6	PSO1 1 1 2	PSO2	L:T:P:C 1:0:0:1 1:0:0:1 0:0:0:0 1:0:0:1 1:0:0:1 0:0:0:0

XMA101				15	6			2					5	3	6			3:1:0:4
XMA 201				15	6	0	0	2	0	0	0	0	3	3	6			3:1:0:4
XMA301				15	6	2					5	6		3				3:1:0:4
XPS401				15	6	0	0	2	0	0	0	0	5	3	6			3:0:0:3
XAP 104				15	6	9	6	4				3			5			3:1:1:5
XAC 204				13	12	9	5	5	5	7	3	5	3	6				3:1:1:5
Engineering Sciences	С	Р	A	P01	P02	PO3	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	L:T:P:C
XEM 202				8	12	1	5					2			1			3:1:0:4
XBE103				15	6	4	6	5				3			5			3:1:1:5
XCP102				15	10	3	4	10			1			2	10			3:0:1:4
XBW203				5	6		5	5	1									3:1:1:5
XEG205				15	10	7	5	5							5			2:1:0:3
XES 305				3	1	1		2	3	3	2	1	2			2		3:0:0:3
Management	С	Р	A	P01	PO2	PO3	PO4	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2	L:T:P:C
XEP306				3	1	1		2	3	3	2	1	2			2		2:0:0:2
XTQ506				7			7	7	7	5	7	4	7		4			3:0:0:3
UGC Mandatory	С	Р	A	P01	P02	PO3	PO4	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	L:T:P:C
XUM106									6	5	9	9	7					1:0:0:1

XUM607	 \checkmark	\checkmark	9	11	5	5	10	14	15	5	5	5	5				0:0:0:0
XUM706			9	8	8	7	5	4	4	5	5	0	0	5			3:0:0:0
Total			528	377	355	348	326	272	218	177	192	241	224	89	29	20	
Scaled			9.2	6.6	4.7	4.5	3.5	3.2	2.9	2.9	2.9	3.6	2.5	3.9	3.9	3.2	

Guidelines for UG Engineering & Technology Curriculum 2015-16

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

S. No	Category	AICTE	PMU adoption	PMU credits	Deviation %	Number of
110.		dation %	%	creats		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/Mechani cal/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);	-	-	-	-	3
	Non-Credit 8 units					
	(UGC Mandatory)*					
10.	Non Credit Course – ELS	-	-	-	-	3
11.	NCC/NSS/YRC/RRC/Sports	-	-	-	-	1
			100%	176		57

SEMESTER I

Branch	C1	C2	С3	C4	C5	C6
Aero	MA-I	EM	BE-I	AP	SS	U-MAN-I
Bio	MA-I	СР	BE-I	AP	SS	U-MAN-I
Civil	MA-I	EM	BE-I	AP	SS	U-MAN-I
Chem	MA-I	СР	BE-I	AP	SS	U-MAN-I
ECE	MA-I	EM	BE-I	AP	SS	U-MAN-I
CSE	MA-I	СР	BE-II	AC	SS	U-MAN-I
EEE	MA-I	СР	BE-II	AC	SS	U-MAN-I
IT	MA-I	СР	BE-II	AC	SS	U-MAN-I
Mech	MA-I	СР	BE-II	AC	SS	U-MAN-I

S No	Description	cription Courses		Cre	dits		Hours						
5. NO.	Description	Courses	L	Т	Р	Total	L	Т	Р	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		
	СР	Computer Programming	3	0	1		3	0	2	0	5		
3.	BE-I/BE-II	Electrical and Electronics Engineering Systems (BEE Lab included)	3	1	1		3	2	2				
		Mechanical and Civil Engineering Systems (Workshop Practice included)	3	1	1	5	3	2	2	0	7		
4.	AP/AC	Applied Physics (Physics Lab included)	3	1	1	F	3	2	2	0	7		
		Applied Chemistry (Chemistry Lab included)	3	1	1	5	3	2	2	0	/		
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
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SEMESTER II

Branch	C1	C2	C3	C4	C5	C6
Aero	MA-II	СР	BE-II	AC	EG	SC
Bio	MA-II	BT	BE-II	AC	EG	SC
Civil	MA-II	СР	BE-II	AC	EG	SC
Chem	MA-II	EM	BE-II	AC	EG	SC
ECE	MA-II	СР	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		Cr	edit	5	Hours				
5. NO.	Description	courses	L T P 7			Total	L	Т	Р	Total	
1.	MA-II	Calculus and Laplace Transforms	3	1	0	4	3	2	0	5	
2.	EM	Engineering Mechanics	3	1	0		3	2	0		
	BT	Basic Thermodynamics	3	1	0	4	3	2	0	5	
	СР	Computer Programming	Computer Programming 3 0 1						2		
3.	BE-I/BE-II	Electrical and Electronics Engineering Systems (BEE Lab included)	3	1	1		3	2	2		
		Mechanical and Civil Engineering Systems	3	1	1	5	3	2	2	7	
		(Workshop Practice included)									
4.	AP/AC	Applied Physics (Physics Lab included)	3	1	1		3	2	2		
		Applied Chemistry (Chemistry Lab included)	3	1	1	5	3	2	2	7	
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	

SEMESTER III

Branch	C1	C2	C3	C4	C5	C6	C7	C8
Aero	MA-III	СТ	СР	СТР	MS/EM	MNGT-I	IPC	IPT-I
Bio	MA-III	СТ	СР	СТР	MS	MNGT-I	IPC	IPT-I
Civil	MA-III	СТ	СР	СТР	MS	MNGT-I	IPC	IPT-I
Chem	MA-III	СТ	СР	СТР	MS/EM	MNGT-I	IPC	IPT-I
ECE	MA-III	СТ	СР	СТР	MS	MNGT-I	IPC	IPT-I
CSE	MA-III	СТ	СР	СТР	MS	MNGT-I	IPC	IPT-I
EEE	MA-III	СТ	СР	СТР	MS	MNGT-I	IPC	IPT-I
IT	MA-III	СТ	СР	СТР	MS	MNGT-I	IPC	IPT-I
Mech	MA-III	СТ	СР	СТР	MS/EM	MNGT-I	IPC	IPT-I

S. No.	Description	Courses	Credits					Hours					
			L	Т	Р	Total	L	Τ	Р	S.S .	Total		
1.	MA-III	Transforms and Partial Differential Equations / Discrete Mathematics	3	1	0	4	3	2	0	0	5		
2.	СТ	Core with Tutorial	3	1	0	4	3	2	0	0	5		
3.	СР	Core with PRACTICAL	3	0	1	4	3	0	2	0	5		
4.	СТР	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
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SEMESTER IV

Branch	C1	C2	С3	C4	C5	C6	C7	C8
Aero	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
Bio	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
Civil	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
Chem	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
ECE	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
CSE	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
EEE	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
IT	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC
Mech	MA-IV	С	СР	СТР	СТ	MNGT-II	TC	EC

S. No.	Description	Courses		Cr	edit	s	Hours				
	r r		L	Т	Р	Total	L	Т	Р	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.	С	Core	3	0	0	3	3	0	0	3	
3.	СР	Core with PRACTICAL	3	0	1	4	3	0	2	5	
4.	СТР	Core with Tutorial and PRACTICAL	3	1	1	5	3	2	2	7	
5.	СТ	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.	ТС	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

SEMESTER V

Branch	C1	C2	C3	C4	C5	C6	C7	C8
Aero	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
Bio	С	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
Civil	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
Chem	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
ECE	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
CSE	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
EEE	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
IT	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II
Mech	MA-IV	СТ	СР	СТР	PE-I	C-TQM	BC	IPT-II

S. No.	Description	Courses	Credits				Hours			
			L	Т	Р	Total	L	Т	Р	Total
1.	MA-V	Numerical Methods	2 1 0 3		3	2	2	0	4	
	С	Core (Biotech)								
2.	СТ	Core with Tutorial	2	1	0	3	2	2	0	4
3.	СР	Core with PRACTICAL	3	0	1	4	3	0	2	5
4.	СТР	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

SEMESTER VI

Branch	C1	C2	С3	C4	C5	C6	C7	C8
Aero	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
Bio	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
Civil	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
Chem	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
ECE	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
CSE	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
EEE	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
IT	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW
Mech	OE-I	С	СР	СТР	СТ	PE-II	U-MAN-II	AW

S. No.	Description	Courses		Cr	edit	S	Hours			
			L	Т	Р	Total	L	Т	Р	Total
1.	OE-I	Open Elective - I	3	0	0	3	3	0	0	3
2.	С	Core	3	0	0	3	3	0	0	3
3.	СР	Core with PRACTICAL	3	0	1	4	3	0	2	5
4.	СТР	Core with Tutorial and PRACTICAL	3	1	1	5	3	2	2	7
5.	СТ	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

SEMESTER VII

Branch	C1	C2	С3	C4	C5	C6	C7	C 8	С9
Aero	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Bio	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Civil	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Chem	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
ECE	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
CSE	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
EEE	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
IT	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III
Mech	OE-II	СР	СТР	PE-III	PE-IV	U-MAN-III	P-I	CDS	IPT-III

S. No.	Description	Courses	Credits				Hours				
			L	Т	Р	Total	L	Т	Р	Total	
1.	OE-II	Open Elective - II	3	0	0	3	3	0	0	3	
2.	СР	Core with practical	3	0	1	4	3	0	2	5	
3.	СТР	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	0	0	0	0	0	0	1*	1	

		course)								
9.	IPT-III	In-plant Training - III	-	-	-	2	-	-	-	-
		Total	15	1	4	22	18	2	9	29

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	Т	Р	Total	L	Т	Р	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	

Semester	Total Credits	Total Hours / Week	No. of courses
Ι	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

Summary of the credits and hours

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		Cr	edits		Contact Hours					
	L	Т	Р	Total	L	Т	Р	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).

terlya Napat, Valtare Thorpisvar - 613 403, Tamil Nadu, India Note +411 - 4382 - 264600 Faic +814 4362 - 264800 Inel Nodbio@preuxedu Wetti www. preu 6du I U I V I V L IV.J I I I I (Solar Inc. 2 of DECAR, WIN) NA AC ACCREDITED

Minutes of Board of Studies meeting held on 6th October 2015

Agenda

To review and approve the syllabi for B.Tech Biotechnology Program from I & IV semesters Regulation 2015.

Members

0	Name & Address	Designation	Signature
	Dr.K.Rajendran Associate Professor & Head Department of Biotechnology	Chairperson	RA
	Dr.Muniasamy Neerthalingam, Director, Protein Technology Group, C-CAMP, Bengaluru	External Member (Academic Expert)	Apertin
	Dr.Tulip Nuwal, Manager – Business Development Aurigene Discovery Technologies, Dr.Reddy's Laboratories, Hyderabad.	External Member (Industry)	
	Ms. S.Rajasrce CoRx Life Science and Pharmaceutical Pvt Ltd Trichy	Extrenal Member (Alumni)	S. Rajasur
	Mr.G.Prabhakaran CEO,Biocline Thanjavur	Extremal Member (Alumni)	-S. Patrik
	Ms.K.Rajarathi CEO Mullai Via Bio, Thanjavur	Extrenal Member (Alumni)	@ Their
	Ms.A.V.Snchya	Convenor	A lipetis
Ī	Ms.M.Shanthi	Convenor	MStatio
	Dr.S.Kumaran	Member	S. Shmaami loch
	Dr.R.Kumaresan	Member	Mumale falsely
	Dr.T.Muthukumaran	Member	1 Colores terr
T	Mr.M.Karthikeyan	Member	Nearthikengerete
	Mr.R.John	Student member	Represe

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Minutes Discussed

- Meeting started with a welcome note by Dr.K. Rajendran, HOD Biotechnology ,he has introduced the BOS External member, Dr.Muniasamy Neerthalingam (Director, c-CAMP, Bengaluru) and all our distinguished alumini and special invitees.
- The internal and external BOS members discussed the curriculum of B.Tech Biotechnology Programme from I to VIII semesters and syllabi for I to IV semesters (Outcome Based Education), Regulation 2015.
- Dr.Muniasamy Neerthalingam, insisted to changing the title of "XBT 207 Introduction to Biotechnology" as "XBT 207 Fundamentals of Biotechnology" in the second semester.
- Board suggested to modify the syllabus of major Subjects such as XBT 304 Cell Biology And Microbiology, XBT 402 Genetics and Molecular Biology, XBT 404 Biochemistry, XBT 504 Bioprocess Engineering and XBT 603 Immunology as per GATE syllabus for improving the GATE Scores.
- All the members shared their perspective of studying mathematics for science background students till fifth semester. So it was decided to have a core paper XBT 501 Plant Biotechnology in the fifth semester.
- Fourth semester subject XBT401 Probability and statistics can be refined as Biostatistics. It will be useful for improving the research.
- The subject Genetic Engineering subjects was modified to XBT 503 Recombinant DNA Technology.
- Categorization of core electives by identifying specific areas in the field of Biotechnology.
- All the suggestions given by the board were thoroughly discussed and necessary corrections were made in the curriculum and syllabi.

Dr.K.Rajendran Head/Biotechnology