आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

Course Structure

&

Syllabus

of

B.Tech.
Biotechnology

[Applicable w.e.f. Academic Session - 2022-23]

[As per CBCS guidelines given by UGC]

SCHOOL OF BIOTECHNOLOGY
IFTM UNIVERSITY, MORADABAD

Website: www.iftmuniversity.ac.in

SCHOOL OF BIOTECHNOLOGY

Study and Evaluation Scheme

of

Bachelor of Technology

(Biotechnology)

[IV Year PROGRAM]

Choice Based Credit System (CBCS)

[Academic Session 2022-23]

Summary

Program:	**Bachelor of Technology (Biotechnology)**
Programme Level:	**Degree (Under Graduation)**
Duration:	**Four years (Eight semesters) Full time**
Medium of Instruction:	**English**
Minimum Required Attendance:	**75%**
Maximum Credits:	**216**

IFTM University, Moradabad
Bachelor of Technology (Biotechnology)

Preamble

Education is the first step for people to gain the knowledge, critical thinking, empowerment and skills that make the world a better place to live. Biotechnology has the potential to combine the knowledge of basic biology of the natural diversity and innovative technologies to create or evolve novel processes or novel products beneficial for human welfare. The need for qualified human resource for various biotechnology-based industries is the driving force to design and implement B.Tech. program in Biotechnology.

A sound knowledge of biotechnology is thought to play an important role in the upcoming years to encourage the modern biology driven developmental efforts. There is a need for qualified and competent students with sound knowledge of Biotechnology in general and specialized technology such as recombinant DNA technology, fermentation technology, bioinformatics, cell and tissue culture, etc in particular. The **School of Biotechnology**, **IFTM University** offers the B.Tech. (Biotechnology) course with an outcome-based curriculum emphasizing the Critical, Analytical and Problem Solving skills to equip the students to pursue their academic, scientific and research career with better preparedness and matured professional outlook. The presence of other allied Faculties of the University provides additional exposure to students, the multidisciplinary approach which is emerging as a key differentiator in the success of modern biology and biotechnology-based endeavors. The overall purpose of the course is to impart quality education in the field of biotechnology and to create trained biotechnologist.

Program Objectives: The program aims to achieve the following objectives:

- To develop strong student competencies in biotechnology and its applications in a technology-rich, interactive environment.
- To develop strong student skills in research, analysis and interpretation of problems and information relevant to modern biology.
- To prepare the students to successfully compete for employment in biotechnology-based research and development sectors, industrial sectors and teaching, and to offer a wide range of experience in research methods, data analysis to meet the industrial needs.
- Understand the role of biotechnology in society and has the background to consider ethical problems.

PROGRAM OUTCOMES (PO):

Following Program Outcomes will be achieved:

PO1- Understanding Engineering Fundamentals: Apply the knowledge of engineering fundamentals and principles of basic sciences, engineering and biological sciences to address problems and find solution to the complex issues of biotechnology.

PO2- Knowledge of Molecular Biology and Genetics: Application of knowledge gain in the genetics, molecular biology to address the problems related to disease, health and lifestyles.

PO3- Application of Modern Tools & Techniques: To understand the working principles and operation of instruments use in molecular biology, genetics, biochemistry, immunology, tissue engineering and bioinformatics for the prediction and modeling to complex biological problems.

PO4- Professionalism: To inculcate the students professional and ethical attitude, effective communication, teamwork skills, entrepreneurship skills with multidisciplinary approach and develop an ability to relate engineering issues in biotechnology for the welfare of mankind and environment.

PO5- Process and Product Development: Demonstrate knowledge and understanding of the biotechnology engineering and management principles and apply these to analyze, design and process biotechnology projects and data handling.

PO6- Environment and sustainability: Understand the impact of the technological solutions developed through biotechnology in contexts of society and the environment, and demonstrate the knowledge need for sustainable development in judicious use of biotechnology tools and technique.

PO7- Professional Ethics: Apply ethical principles and commit to follow professional ethics and norms and guidelines in the practice of biotechnology responsibly.

PO8- Leadership and Work efficiency: Having interest and recognize the need for independent and lifelong learning ability to function effectively as an individual and as a member or leader in diverse teams.

PO9- Adaptive thinking: Ability to formulate project proposal, use research-based knowledge and methods including design of experiments, analysis and interpretation of data, for arriving logical and acceptable solutions for the problems.

PO10- Social and Environmental Safety: Apply reasoning for the issues, informed by the contextual knowledge of the problems in hand and assess the risk associated with the societal, health, safety, legal and cultural issues of the problems and the consequent responsibilities relevant to the professional practice of the discipline.

PO11- Communication skills: Having a good knowledge of communicating in English – communication with engineering community and society. Make effective communication on complex biotechnology issues and solutions drawn from biotechnological activities with the scientific community and society.

PO12- Life-long learning: To provide better social and academic environment aware of excellence, leadership, intellectual property rights, written ethical guidelines, and the life-long learning needed for a successful professional career.

1. Eligibility

a. **Admission Criteria:** Admission to this undergraduate course shall be carried out through merit.

b. **Qualifying Examination:** 10 + 2 level with Physics, Chemistry and Maths/ Biology.

c. Marks 45% aggregate for general and OBC category and 40 % aggregate for SC/ST category.

2. Curriculum: B.Tech. courses shall be based on semester system which will be of four years duration, divided into four sessions and eight semesters. Each session shall be of two semesters, Session- I shall comprise of two semesters i.e., semester-I and semester-II; Session-II shall comprise of two semesters i.e., semester-III and semester-IV; Session- III shall comprise of two semesters i.e., semester-V and semester-VI and Session- IV shall comprise of two semesters i.e., semester-VII and semester-VIII. The academic will follow the pattern as mentioned below:

Academic Calendar	Classes
I, III, V and VII Semester	August to December
II, IV, VI and VIII Semester	January to May
Summer Vacation	June and July

3. Cancellation of Admission: If a student at any stage is found to have concealed any information or have furnished false documents or found to be indulged in gross indiscipline/ misconduct, his/ her admission shall be cancelled and fee deposited by the student shall not be refunded in any case.

Evaluation of Performance

1. **Programme:** Evaluation of performance of the students in a programme shall be a continuous process based on their performance in the class test, quizzes, assignments and the end semester examinations.

a.Theory papers in semester system (Maximum Marks: 100)

The evaluation will be done through two class test and one end semester examination. This will be in addition to quizzes, assignments, attendance, etc. Each class test will carry a weightage of 10 marks, and the end semester examination will carry a weightage of 70 marks. The remaining 10 marks will be awarded on the basis of attendance and performance in quizzes and assignments.

b. Practical in semester system (Maximum Marks: 100)

In each practical, the student will be required to carry out the number of experiments as specified in the syllabus. Each practical conducted will be assessed by the teacher based on the experiment done during the lab, submission of the practical file, and understanding of the experiment done, which will carry a weightage of 30 marks. There shall be an end semester practical examination with or without an external examiner which will carry a weightage of 70 marks.

2. **Project, Dissertation, Colloquium etc.:** Project, Seminar, Dissertation, and other learning-oriented activities shall have associated maximum marks and credits, as stated in the syllabus.

3. **Examination:**

a. The minimum Grade required to pass in each Theory & Practical paper is 'GRADE D'.

b. A candidate, in order to pass, minimum CGPA of 4.50 is required in a particular academic year inclusive of both semesters of that academic. And maximum number of carryover paper permissible for promotion to next academic year are 06 theory/ practical / project papers.

c. There shall be no minimum Grade required to pass in General Proficiency (GP). However, Grade obtained in General Proficiency (GP) shall be included in SGPA.

d. In case of audit paper, the minimum Grade required to pass is Grade D. However, the Grade obtained in audit paper shall not be included in SGPA.

Groups of CBCS:

07 Groups of courses have been identified to provide student comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These groups / clusters are as follows:

1. Humanities, Management courses, Language and Literature (HML)
2. Elementary / Fundamental Science courses (FSC)
3. Engineering Core Courses (ECC)
4. Engineering laboratory Courses (ELC)
5. Engineering departmental Elective (EDE)
6. MOOCs/NPTEL/Mandatory Course/Value added courses (VAC)
7. Project/Seminar/Industrial training/General Proficiency (PST)

1. **Humanities, Management courses, Language and Literature (HML):** These courses are actually Ability Enhancement Course (AEC) which is designed to develop the ability of students in communication (especially English) and other related courses where they might find it difficult to communicate at a higher level in their prospective job at a later stage due to lack of practice and exposure in the language, etc. Students are motivated to learn the theories, fundamentals and tools of communication which can help them develop and sustain in the corporate environment and culture. These courses are of 4 credits each.

2. **Elementary / Fundamental Science courses (FSC):**

   These courses include science courses from the disciplines of Physics Chemistry and Mathematics department, crafted for engineering students. These courses are of 4 credits each.

3. **Engineering Core courses (ECC):**

   Core courses of B. Tech. Program will provide a holistic approach to engineering education, giving students an overview of the field, a basis to build and specialize upon. These core courses are the strong foundation to establish technical knowledge and provide broad multi-disciplined knowledge can be studied further in depth during the elective phase.

   The core courses will provide more practical-based knowledge, case-based lessons and collaborative learning models. It will train the students to analyze, decide, and lead-rather

than merely know-while creating a common student experience that can foster deep understanding, develop decision-making ability and contribute to the society at large.

A wide range of core courses provides groundwork in the field of Biochemistry, Cell Biology, Genetic Engineering, Bioprocess engineering etc.

We offer core courses in semester III, IV, V, VI, VII &VIII during the B. Tech-Biotechnology program. There will be 3 or 4 credits for each core course offered depending upon the course content.

4. **Engineering Laboratory Courses (ELC):**

   These courses include various laboratories of Engineering designed to provide the student solid foundation to the domain of engineering. These courses are of 1 credit each.

5. **Engineering Departmental Elective (EDE):**

   The departmental elective course is chosen to make students specialist or having specialized knowledge of a specific domain like Bioenergetics, Fluid Flow and Solid Handling, Modern Analytical Techniques etc. The student will have to choose any one out of the given list of specialization offered. These courses are of 4 credits each.

6. **MOOCs/NPTEL/Mandatory Course/Value added courses (VAC):**

   A Value-Added Course is an on-credit course which is basically meant to enhance general ability of students in areas like soft skills, quantitative aptitude and reasoning ability - required for the overall development of a student and at the same time crucial for industry/corporate demands and requirements. The student possessing these skills will definitely develop acumen to perform well during the recruitment process of any premier organization and will have the desired confidence to face the interview. Moreover, these skills are also essential in day- to-day life of the corporate world. The aim is to nurture every student for making effective communication, developing aptitude and a general reasoning ability for a better performance, as desired in corporate world.

   This is recommended for every student to take at least one MOOC Course throughout the programme. Every student completing a MOOC course through only NPTEL.

7. **Project/Seminar/Industrial training/General proficiency (PST):**

   i. Project with a department faculty.

ii. The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other than their regular classes.

iii. Industrial visit are essential to give students hand-on exposure and experience of how things and processes work in industries. Our institute organizes such visits to enhance students' exposure to practical learning and work out for a report of such a visit relating to their specific topic, course or even domain.

Summary of Credits

B. Tech. Biotechnology: Four-Year (8-Semester) CBCS Programme			
Basic Structure: Distribution of Courses			
S.No.	**Type of Course**	**Credit**	**Total Credits**
1.	**Humanities, Management courses, Language and Literature (HML)**	04 Courses of 4 Credits each (Total Credit 4X4)	16
2.	**Elementary / Fundamental Science courses (FSC)**	12 Courses of 4 Credits each (Total Credit 12X4)	48
3.	**Engineering Core courses (ECC)**	14 Courses of 4 Credits each (Total Credit 14X4)	56
4.	**Engineering Laboratory Courses (ELC)**	20 Courses of 1 Credits each (Total Credit 20X1)	20
5.	**Engineering Departmental Elective (EDE)/ Engineering Open Elective (EOE)**	12 Courses of 4 Credits each (Total Credit 11X4)	48
6.	**MOOCs/NPTEL/Mandatory course/Value added courses (VAC)**	1 Course of 4 Credits (Total Credit 1X4) 3 Courses of 0 Credit each (Total Credit 3X0)	04
7.	**Project/Seminar/Industrial training/General Proficiency (PST)**	08 Courses of 1 Credits each (Total Credit 8X1) 02 Courses of 2 Credits (Total Credit 2X2) 01 Course of 12 Credits (Total Credit 1X12) 01 Course of 0 Credit (Total Credit 1X0)	24
TOTAL			**216**

SCHOOL OF BIOTECHNOLOGY
IFTM UNIVERSITY
(Established under UPGovt.ActNo.24 of 2010 and approved under section 22 of UGC Act 1956)
Lodhipur Rajput, Delhi Road, Moradabad- 244102, U.P.
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SCHOOL OF BIOTECHNOLGY

PROGRAMME: BACHELOR OF TECHNOLOGY (BIOTECHNOLOGY)
CBCS Programme

Course Code	CBCS Basket	Credits			
Humanities, Management courses, language and literature (HML)		**L**	**T**	**P**	**C**
TPSD101/201	Professional Skill Development -I	3	1	0	4
TPSD401	Professional Skill Development –II	3	1	0	4
Elementary/Fundamental Science courses (FSC)					
TEMA-102	Elementary Mathematics-I	3	1	0	4
TEMA-202	Elementary Mathematics -II	3	1	0	4
TEPH-101	Engineering Physics-I	3	1	0	4
TECH-101/201	Engineering Chemistry	3	1	0	4
TEEE-101/201	Electrical Engineering	3	1	0	4
TEEC-101/201	Electronics Engineering	3	1	0	4
TECS-101/201	Computer Fundamentals & Programming	3	1	0	4
TEME-101/201	Engineering Mechanics	3	1	0	4
TEME-102/202	Materials & Manufacturing	3	1	0	4
EBT107T	Elementary Biology-I	3	1	0	4
EBT209T	Elementary Biology-II	3	1	0	4
EBT102T/202T	Introduction to Biotechnology	3	1	0	4
TEPH-201	Engineering Physics-II	3	1	0	4
EBT306T	Biostatistics	3	1	0	4
EBT404T	Data Structure using C	3	1	0	4
Engineering Core Courses (ECC)					
EBT301T	Biochemistry	3	1	0	4
EBT302T	Microbiology	3	1	0	4
EBT303T	Cell Biology	3	1	0	4
EBT401T	Enzymology	3	1	0	4
EBT402T	Immunology	3	1	0	4
EBT403T	Molecular Genetics	3	1	0	4
Engineering Laboratory Courses (ELC)					
TEPH-151/251	Physics Lab	0	0	2	1
TECH-151/251	Chemistry Lab	0	0	2	1
TEEE-151/251	Electrical Engineering Lab	0	0	2	1
TEEC-151/251	Electronics Engineering Lab	0	0	2	1
TEME-151/251	Materials &Manufacturing Lab	0	0	2	1
TECS-151/251	Computer Lab	0	0	2	1
TEME-153/253	Engineering Graphics Lab	0	0	2	1
TEME-151/251	Mechanical Engineering Lab	0	0	2	1
EBT102P/202P	Introduction to Biotechnology Lab	0	0	2	1
EBT301P	Biochemistry Lab	0	0	2	1
EBT302P	Microbiology Lab	0	0	2	1

EBT303P		Cell Biology Lab	0	0	2	1
EBT401P		Enzymology Lab	0	0	2	1
EBT402P		Immunology Lab	0	0	2	1
EBT403P		Molecular Genetics Lab	0	0	2	1
Engineering Departmental Elective (EDE)/ Engineering Open Elective (EOE)						
EBT304T		Bioenergetics	3	1	0	4
EBT305T		Fluid Flow and Solid Handling	3	1	0	4
EBT405T		Modern Analytical Techniques	3	1	0	4
Open Elective	TEME-802 BP303T TEAG712B NCC-01	Non-Conventional Energy Recourses Pharmaceutical Microbiology Human Engineering and Safety NCC General	3	1	0	4
MOOCs/NPTEL/Mandatory Course/Value Added Courses (VAC)						
TECE-101/TECE-201		Environmental Science	3	1	0	4
TEHU-301		Disaster Management	3	0	0	-
MOOC-01		MOOC Program –I (optional)	-	-	-	0
MOOC-02		MOOC Program –II (optional)	-	-	-	0
Project/Dissertation/Seminar/Industrial Training/General Proficiency (PST)						
TGP-101		General Proficiency	-	-	-	1
TGP-201		General Proficiency	-	-	-	1
TGP -301		General Proficiency	-	-	-	1
TGP-401		General Proficiency	-	-	-	1

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SCHOOL OF BIOTECHNOLOGY

S. N.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	FSC	TEMA-102/ EBT107T	Elementary Mathematics-I/ Elementary Biology-I	3	1	0	20	10	30	70	100	4
2.	FSC	TEPH -101	Engineering Physics-I	3	1	0	20	10	30	70	100	4
3.	VAC / FSC	TECE-101/ TECH-101	Environmental Science/ Engineering Chemistry	3	1	0	20	10	30	70	100	4
4.	HML / FSC	TPSD101/ TEME-101	Professional Skill Development-I/ Engineering Mechanics	3	1	0	20	10	30	70	100	4
5.	FSC / FSC	TEEE -101/ TEEC-101	Electrical Engineering/ Electronics Engineering	3	1	0	20	10	30	70	100	4
6.	FSC / FSC	TECS -101/ EBT102T	Computer Fundamentals & Programming/ Introduction to Biotechnology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
7.	ELC	TEPH -151/ TECH-151	Physics Lab/Chemistry Lab	0	0	2	-	-	30	70	100	1
8.	ELC	TEEE -151/ TEEC-151	Electrical Engg. Lab/ Electronics Engg. Lab	0	0	2	-	-	30	70	100	1
9.	ELC	TECS-151/ EBT102P	Computer Lab/ Introduction to Biotechnology Lab	0	0	2	-	-	30	70	100	1
10	ELC	TEME-153/ TEME-151	Engineering Graphics Lab/ Mechanical Engg. Lab	0	0	2	-	-	30	70	100	1
11.	PST	TGP-101	General Proficiency	-	-	-	-	-	100	-	100	1
			Total Credit	**18**	**6**	**8**	**-**	**-**	**400**	**700**	**1100**	**29**

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SCHOOL OF BIOTECHNOLOGY
IFTM UNIVERSITY, MORADABAD
Bachelor of Technology (B. Tech.) Biotechnology

STUDY AND EVALUATION SCHEME
YEAR I, SEMESTER II

S.N.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	FSC	TEMA-202/ EBT209T	Elementary Mathematics-II/ Elementary Biology-II	3	1	0	20	10	30	70	100	4
2.	FSC	TEPH -201	Engineering Physics-II	3	1	0	20	10	30	70	100	4
3.	FSC / VAC	TECH -201/ TECE-201	Engineering Chemistry/ Environmental Science	3	1	0	20	10	30	70	100	4
4.	FSC / HML	TEME-201/ TPSD201	Engineering Mechanics/ Professional Skill Development-I	3	1	0	20	10	30	70	100	4
5.	FSC / FSC	TEEC -201/ TEEE-201	Electronics Engineering/ Electrical Engineering	3	1	0	20	10	30	70	100	4
6.	FSC / FSC	EBT202T/ TECS-201	Introduction to Biotechnology/ Computer Fundamentals & Programming	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
7.	ELC	TECH-251/ TEPH -251	Chemistry Lab/ Physics Lab	0	0	2	-	-	30	70	100	1
8.	ELC	TEEC-251/ TEEE -251	Electronics Engg. Lab/ Electrical Engg. Lab	0	0	2	-	-	30	70	100	1
9.	ELC	EBT-202P/ TECS-251	Introduction to Biotechnology Lab/ Computer Lab	0	0	2	-	-	30	70	100	1
10.	ELC	TEME-251/ TEME-253	Mechanical Engg. Lab/ Engineering Graphics Lab	0	0	2	-	-	30	70	100	1
11.	PST	TGP-201	General Proficiency	-	-	-	-	-	100	-	100	1
			Total Credit	**18**	**6**	**8**	**-**	**-**	**400**	**700**	**1100**	**29**

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STUDY AND EVALUATION SCHEME
YEAR II, SEMESTER III

S. N.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
				L	T	P	Mid Term Exam			External Exam		
							CT	AS+ AT	Total			
1	ECC	EBT301T	Biochemistry	3	1	0	20	10	30	70	100	4
2	ECC	EBT302T	Microbiology	3	1	0	20	10	30	70	100	4
3	ECC	EBT303T	Cell Biology	3	1	0	20	10	30	70	100	4
4	EDE	EBT304T	Bioenergetics	3	1	0	20	10	30	70	100	4
5	EDE	EBT305T	Fluid Flow and Solid Handling	3	1	0	20	10	30	70	100	4
6	FSC	EBT306T	Biostatistics	3	1	0	20	10	30	70	100	4
7	VAC	TEHU-301	Disaster Management (Audit Paper) #	3	0	0	20	10	30	70*	100*	-
PRACTICALS/ PROJECT												
8	ECL	EBT301P	Biochemistry Lab	0	0	2	-	-	30	70	100	2
9	ECL	EBT302P	Microbiology Lab	0	0	2	-	-	30	70	100	2
10	ECL	EBT303P	Cell Biology Lab	0	0	2	-	-	30	70	100	2
11	PST	TGP-301	General Proficiency	-	-	-	-	-	100	-	100	1
TOTAL				**21**	**6**	**6**	**-**	**-**	**400**	**700**	**1100**	**31**

The subject (TEHU-301), Disaster Management will be offered as a compulsory audit course and each student has to pass the subject at the minimum by getting 35 marks out of 100.

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STUDY AND EVALUATION SCHEME
YEAR II, SEMESTER IV

S. N.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
				L	T	P	Mid Term Exam			External Exam		
							CT	AS+ AT	Total			
1	ECC	EBT401T	Enzymology	3	1	0	20	10	30	70	100	4
2	ECC	EBT402T	Immunology	3	1	0	20	10	30	70	100	4
3	ECC	EBT403T	Molecular Genetics	3	1	0	20	10	30	70	100	4
4	FSC	EBT404T	Data Structure using C	3	1	0	20	10	30	70	100	4
5	HML	TPSD401	Professional Skill Development-II	3	1	0	20	10	30	70	100	4
6	EDE	EBT405T	Modern Analytical Techniques	3	1	0	20	10	30	70	100	4
PRACTICALS/ PROJECT												
7	ECL	EBT401P	Enzymology Lab	0	0	2	-	-	30	70	100	2
8	ECL	EBT402P	Immunology Lab	0	0	2	-	-	30	70	100	2
9	ECL	EBT403P	Molecular Genetics Lab	0	0	2	-	-	30	70	100	2
10	PST	TGP-401	General Proficiency	-	-	-	-	-	100	-	100	1
TOTAL				**18**	**6**	**6**	-	-	**370**	**630**	**1000**	**31**

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

Fifth Semester
COURSE STRUCTURE

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total	End Sem Exam		
THEORY											
1.	EBT-501	Bioinformatics	3	1	0	20	10	30	70	100	4
2.	EBT-502	Bioprocess Engineering I	3	1	0	20	10	30	70	100	4
3.	EBT-503	Engineering Principles and calculations	3	1	0	20	10	30	70	100	4
4.	EBT 504/ 504 I-VI	Elective 0A1	3	1	0	20	10	30	70	100	4
5.	EBT-505	Heat and Mass transfer in the Biological Systems	3	1	0	20	10	30	70	100	4
6.	EBT 506/ 506 I-VI	Elective 0A2	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	EBT-551	Bioinformatics Lab	0	0	2	30	20	30	70	100	1
8.	EBT-552	Bioprocess Engineering Lab	0	0	2	30	20	30	70	100	1
9.	EBT-553	Genetic Engineering Lab	0	0	2	30	20	30	70	100	1
10.	GP-501	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	66	66			430	570	**1000**	**28**

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

LIST OF DEPARTMENT ELECTIVES		
S.No.	**Course Code**	**Course Name**
1	EBT-504/ EBT 504 I/ EBT 504 II/ EBT 504 III/ EBT 504 IV/ EBT504 V/ EBT 504 VI	Genetic Engineering / Data Base Management System/ Project Management/ Patent Search and Analysis/ Stress Management/ Biotechnology for Human Welfare/ Molecular & Structural Biophysics
2	EBT-506/ EBT 506 I/ EBT 506 II/ EBT 506 III/ EBT 506 IV/ EBT506 V/ EBT 506 VI	Plant Biotechnology/ Macromolecular Structure & Analysis/ Cyto-genetic Techniques/ Computational Biology/ Introduction to DBMS, Computer Network & Numerical Analysis/Model Organisms in Genome Project/ Advanced Mathematics For Biotechnology

IFTM UNIVERSITY, MORADABAD
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Sixth Semester
COURSE STRUCTURE

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME			End Sem Exam	Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
1.	EBT 601	Advanced Bioinformatics	3	1	0	20	10	30	70	100	4
2.	EBT 602	Animal Biotechnology	3	1	0	20	10	30	70	100	4
3.	EBT 603	Nanobiotechnology	3	1	0	20	10	30	70	100	4
4.	EBT 604/ 604 I-VI	Elective 0A3	3	1	0	20	10	30	70	100	4
5.	EBT 605/ 605 I-VI	Elective 0A4	3	1	0	20	10	30	70	100	4
6.	EHU 601	Human Values and Professional Ethics	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	EBT 651	Advanced Bioinformatics Lab	0	0	2	30	20	30	70	100	1
8.	EBT 652	Fermentation Biotechnology Lab	0	0	2	30	20	30	70	100	1
9.	EBT 653	Food Biotechnology Lab	0	0	2	30	20	30	70	100	1
10.	GP-601	General Proficiency	-	-	-	-	-	-	-	100	1
		Total Credit	18	6	6			430	570	**1000**	**28**

Note: Industrial Training of 4-6 weeks after VI semester which will be evaluated in the VII semester.

LIST OF DEPARTMENT ELECTIVES		
S.No.	**Course Code**	**Course Name**
1	EBT 604/604 I/604 II/604 III/ 604 IV/604 V/ 604 VI	Fermentation Biotechnology/ Cell Culture Technologies/ Technologies For Clean And Renewable Energy Production/ Polymers: concepts, properties, uses and sustainability/Basic Environmental Engineering and Pollution Abatement/ Mathematical modelling and simulation of chemical engineering process/ Bio fuels
2	EBT 605/605 I/605 II/605 III/ 605 IV/605 V/ 605 VI	Food Biotechnology/ Chemical Reaction Engineering/ Biological Inorganic Chemistry NMR spectroscopy for Structural Biology/ Analytical Chemistry/ Organic Chemistry In Biology And Drug Development/ Hazardous waste management

Seventh Semester
COURSE STRUCTURE

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME			End Sem Exam	Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
1.	EBT 031-036	Elective-I	3	1	0	20	10	30	70	100	4
2.	EBT 041-045	Elective-II	3	1	0	20	10	30	70	100	4
3.	EHU-701	Industrial Management	3	1	0	20	10	30	70	100	4
4.	EBT-701	Downstream Processing	3	1	0	20	10	30	70	100	4
5.	EBT-702	Bioethics, Biosafety & IPR	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6	EBT-751	Downstream Processing Lab	0	0	2	20	10	30	70	100	1
7.	EBT-752	Mini-Project	0	0	2	20	10	30	70	100	1
8.	EBT-753	Seminar	0	0	2	50	50	100	-	100	1
9.	EBT-754	Industrial Training (Evaluation & *Viva-Voce)*	0	0	2	50	50	100	-	100	1
10.	GP-701	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	6	8			510	490	1000	**25**

LIST OF DEPARTMENTAL ELECTIVES		
S.No.	**Course Code**	**Course Name**
1	EBT-031/032/033/034/035/036	Vaccine Technology & Immunoinformatics/ Biofuels & Alcohol Technology/Cellular biophysics/Plant Cell Bioprocessing/Introduction to Developmental Biology/ Marine Biotechnology
2	EBT-041/042/043/044/045	Molecular Modeling & Drug Design/ Bioprocess Engineering II/Drug Delivery: Principles and Engineering/Functional Genomics/ Stem Cell Technology

Eighth Semester
COURSE STRUCTURE

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME			End Sem Exam	Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
1.	EBT-801	Environmental Biotechnology	3	1	0	20	10	30	70	100	4
2.	EBT-051-055	Department Elective-IV	3	1	0	20	10	30	70	100	4
3.	EBT-061-064	Department Elective-V	3	1	0	20	10	30	70	100	4
4.	EBT-081-085	DepartmentElective-VI	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
5	EBT-881	Project	0	0	12	-	-	100	200	300	12
6.	GP-801	General Proficiency	0	0	0	-	-	100	-	100	1
		Total Credit	12	4	12			320	480	800	**29**

	LIST OF	DEPARTMENT ELECTIVES	
S.No.	**Course Code**	**Course Name**	
1	EBT-051/052/053/054/ 055/056	Biotechnology in Health Care/ Nanobiotechnology/ Fundamentals of micro and nanofabrication/ Nanotechnology in Biomedical/ Design of Industrial waste water management/ Biosensors and Biomedical devices in Diagnostics	
2	EBT-061/062/063/064/ 065/066	Biomedical Instrumentation/ Genomics and Proteomics/ Introduction to protein Engineering/ Transport Phenomena in Biological Systems/ Phyto chemical Technology/ Environmental Toxicology	
3	EBT-081/082/083/084/085	Non Conventional Energy Resources/ Non Linear Dynamic System/ Product Development/ Automation and Robotics/ Wildlife Ecology/	

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TEMA – 102: Elementary Mathematics – I

Objective: - The main aims of this course calculus are to find the instantaneous rate of change of a function with respect to an independent variable in calculus. Integrals are used to evaluate such quantities as area, volume, work and area of a curve. Coordinate geometry identify a shape within a shape, discriminate *geometric shapes* from one another based on the number of sides and corners.

UNIT I: (12 Sessions)

Calculus: Limits and Derivatives: Derivative introduced as rate of change both as that of distance function and geometrically intuitive idea of limit, Definition of derivative, Relate it to slope of tangent of the curve, Derivative of sum, difference, Product and quotient of functions, Derivatives of polynomial and trigonometric functions.

UNIT II: (10 Sessions)

Continuity and Differentiability: Continuity and Differentiability, Derivative of composite functions, Chain rule, Derivatives of inverse trigonometric functions, Derivative of implicit function, Concept of exponential, logarithmic functions and their derivative, Logarithmic differentiation, Derivative of functions expressed in a parametric forms, Second order derivatives, Rolle's and Lagrange's Mean Value theorems (without proof) and their geometric interpretations.

Applications of derivatives: Applications of derivatives: Rate of change, Increasing /Decreasing functions, Tangents and normals, Approximation, Maxima and minima of one variable (first derivative test motivated geometrically and second derivatives test given as a provable tool), Simple problems (that illustrate basic principles and understanding of the subject as well as real –life situations)

UNIT III: (10 Sessions)

Integrals: Integration as inverse process of differentiation, Integration of a variety of functions by substitution by partial fraction and by parts, Only simple integrals of the type to be evaluated, Definite integrals as a limit of a sum, Fundamental Theorem of calculus (without proof), Basic properties of definite integral and evaluation of definite integrals, Applications of the integrals; Applications in finding the area under simple curves, Lines, Area of Circles/parabola/ellipse (Standard form only), Area between the two curves.

UNIT IV: (10 Sessions)

Differential Equations: Definitions order and degree, General and particular solutions of differential equation, Formation of differential equation whose general solution is given, Solution of differential equations by method of separation of variables, Homogeneous differential equation of first order and first degree, Solution of linear differential equation of the type $\frac{dy}{dx} + Py = Q$, where P and Q are the function of *x*.

UNIT V: (10 Sessions)

Coordinate Geometry: Straight line: Brief recall of 2D from earlier classes; Slope of a line, angle between two lines and Various forms of equations of a line parallel to axes, Point slope form, Slope

intercept form, Two point form, Intercept form and normal form, General equation of a line, Distance of a point from a line.

Conic Sections: Circle, Ellipse, Parabola, Hyperbola, a point, a straight line and pair of intersecting lines as a degenerated case of a conic section, Standard equations and simple properties of parabola, Ellipse and Hyperbola, Standard equation of a circle.

Course Outcomes:

At the end of the course students will able to:

CO1: Understand the concept of partial fraction, logarithms, functions and limits of continuity for skill development.

CO2: Know the concept of matrices and determinant in field of engineering for employability.

CO3: Understand the concept of calculus for skill development.

CO4: Get familiar with the analytical geometry including straight line and integration for skill development, employability and entrepreneurship development.

CO5: Know the concept of differential equations and its applications in the field of engineering for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	2	3	2
CO3	3	2	3
CO4	3	2	3
CO5	3	3	3

Suggested Readings:

1. R.D. Sharma: Mathematics (I& II-XI), Dhanpat rai publication (Pvt.) Ltd. NewDelhi, India.
2. R.D. Sharma: Mathematics (I& II-XII): Mathematics (I& II-XI), Dhanpatraipublication (Pvt.) Ltd. New Delhi, India.
3. Gorakh Prasad: Differential Calculus, Pothishala Private Limited, Allahabad.

4. Gorakh Prasad: Integral Calculus, Pothishala Private Limited, Allahabad.
5. B.S. Grewal Engg.: Mathematics,Khanna publishers, New Delhi.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
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EBT107T ELEMENTARY BIOLOGY-I

Objective: The main objective of this course:

- Emphasize the basic principles that are common to animals, plants and microorganisms as well as high lighting the relationship of Biology with other areas of knowledge.

UNIT I: (10 Sessions)
The Cell: Concept and Cell theory. Structure of prokaryotic cells, eukaryotic cells, plant cells and animal cells. Structure and function cell and cell organelles.

UNIT II: (10 Sessions)
Structural Organization: Tissues in animals and plants. Morphology, anatomy and functions of different parts of plants- Root, stem, leaf, inflorescence, flower, fruit and seed. Concepts of botanical garden, herbaria, zoological park and museums.

UNIT III: (10 Sessions)
Classification of living organisms: Five kingdom classification, major groups and principles of classification in each kingdom. Systematic and binomial system of nomenclature. Concept of animal and plant classification.

UNIT IV: (5 Sessions)
Concept of alleles and genes: Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis.

UNIT V: (5 Sessions)
Plant Physiology: Concept of diffusion, osmosis, imbibitions. Movement of water, food, nutrients and gases. Plant growth and development.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the basics of cell biology, the functioning of various cell organelles in prokaryotic and eukaryotic cells, and the difference between animal and plant cells for skill development.
CO2: Understand the structural organization and functions of different parts of plants along with the basic concept of the botanical garden, herbaria, zoological park, and museums for employability.
CO3: Understand the concept of animal and plant classification for skill development.
CO4: Develop knowledge about genes and Mendelian genetics for skill development, employability and entrepreneurship development.
CO5: Understand the concept of diffusion, osmosis, imbibition in plants, and movement of water, food, and gases for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	2	3
CO5	2	2	3

Suggested Readings:

1. Biology - Textbook for Class XI, NCERT Publication.
2. Biology - Textbook for Class XII, NCERT Publication.
3. Biology by Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos, Susan Singer (Macgraw Hill).
4. Concepts in Biology by E.D. Enger & F.C. Ross, 9th Ed Tata McGraw Hill.

Website Sources:

- https://www.britannica.com/science/fermentation
- https://nptel.ac.in/courses/102/105/102105064/
- https://www.khanacademy.org

IFTM University, Moradabad
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TEPH-101/201: Engineering Physics-I

Objective: The aim of this course is to impart knowledge of statistical mechanics, quantum mechanics, Laser system and their applications. The broad education is necessary to understand special theory of relativity.

UNIT- I **(8 sessions)**

Relativistic Mechanics: Frame of reference, Michelson-Morley Experiment, Lorentz transformation equation, Length contraction & Time dilation, Addition of velocities, Variation of mass with velocity and Mass energy relation.

UNIT- II **(10 sessions)**

Statistical Mechanics: Concept of phase space, Density of states as a function of energy, Maxwell-Boltzmann statistics, Distribution law and its application in case of ideal gas, Energy and velocity distribution.

Bose -Einstein statistics Distribution Law and its application to Black body radiation to obtain Plank's law of radiation.

Fermi –Dirac statistics, Distribution law and its application to electrons in metals, Calculation of Fermi energy and average energy of electrons in metals.

UNIT- III **(10 sessions)**

Quantum Mechanics: De-Broglie Hypothesis, Davisson -Germer Experiment, wave function and its properties, Uncertainty principle. Time Dependent & Time Independent Schrodinger Equation, Particle in one dimensional box, Eigen values and eigen function

UNIT- IV **(8 sessions)**

Laser: Principle of Laser, Stimulated and spontaneous emission, Population inversion, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

UNIT- V **(8 sessions)**

Fibre Optics: Fundamental ideas of optical Fiber, Propagation Mechanism, Numerical aperture, Acceptance angle and Acceptance cone, Single and multi mode fibers, Applications of optical fibres.

Course Outcomes:

The students completing this course will be able to:

CO1: Learn relativistic Mechanics, Frame of reference, Lorentz transformation equation for skill development.

CO2: Understand Statistical Mechanics, Maxwell- Boltzmann statistics and its applications for skill development.

CO3: Study Time Dependent & Time Independent Schrodinger Equation and applications of these

equations for skill development.
CO4: Attain basic knowledge on different types of LASERs and their applications for skill development and employability.
CO5: Gain knowledge of optical fibre, propagation and their applications for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	3
CO2	3	2	2
CO3	3	3	2
CO4	2	2	3
CO5	2	3	3

Suggested Readings:

1. A. Beiser, “Concepts of Modern Physics
2. C. Kittel, “Mechanics”, Berkeley Physics Course, Vol.- I.
3. W.T. Silf vast, “Laser Fundamental” Cambridge University Press (1996).
4. G. Keiser “Optical Fiber Communication” New York.
5. K.M. khanna” Statistical Mechanics”
6. C.Kittel” Elementary Statistical Mechanics”

Website Sources:

- https://web.stanford.edu
- https://sites.google.com
- https://en.wikipedia.org
- https://www.khanacademy.org
- https://www.rp-photonics.com
- https://nptel.ac.in
- https://www.eatm.in

Note: Latest editions of all the suggested readings must be used
IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TECE-101/201: ENVIRONMENTAL SCIENCE

Objectives: To provide understanding of component of environment, their function, quality, issues related to environment effect of quality degradation on human beings and their solutions.

Unit I: **(8 sessions)**
Environment: Definition of environment, environmental education, need for public awareness. Concepts of ecology: Ecosystem, energy and nutrient flow in ecosystem, food chain. Environmental segments: Atmospheric structure, classification of air pollutants, sources of air pollution and their effects on human health and property. Atmospheric chemistry: Global warming, acid rain, photochemical smog, ozone layer depletion.

Unit II: **(8 sessions)**
Air quality and standards: Meteorological phenomenon and their influence on air quality, lapse rates, dispersion of pollutants. Air pollution control: Introduction to particulate and gaseous pollutants such as SOx, NOx & COx and their effects.

Unit III: **(8 sessions)**
Water quality: Physical, chemical & biological parameters, water quality standards, BOD, COD and BOD/COD calculations. Environmental Analysis: pH, alkalinity, conductivity, ammonia, fluoride, sulfate, chloride. Analysis and measurement of gaseous pollutants.

Unit IV: **(8 sessions)**
Pollution from industry and agriculture, polymers and plastics, food additives, fertilizers, insecticides, fungicides and herbicides, heavy metals and energy, their environmental implications. Solid waste and its management, pollution and public health aspects. Environmental Protection- Role of government, initiatives by non-governmental organizations (NGO).

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the issues related to environment and their impact on the human life for skill development.
CO2: Learn the air quality parameters and control of air pollution for skill development.
CO3: Understand the air quality parameters and control of air pollution for skill development and employability.
CO4: Understand about the industrial and domestic pollution and role of government agencies for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3

Suggested Readings

1. Environmental Studies – Benny Joseph – Tata McgrawHill-2005
2. Environmental Studies – Dr. D.L. Manjunath, Pearson Education-2006.
3. Environmental studies – R. Rajagopalan – Oxford Publication - 2005.
4. Text book of Environmental Science & Technology – M. Anji Reddy – BS Publication..
5. Principles of Environmental Science and Engineering – P. Venugoplan Rao, Prentice Hall of India.
6. Environmental Science and Engineering – Meenakshi, Prentice Hall

Website Sources:

- https://web.stanford.edu
- https://sites.google.com
- https://en.wikipedia.org
- https://nptel.ac.in

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
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TECH-101/201: ENGINEERING CHEMISTRY

Objective(s):

- To emphasize the relevance of fundamentals and applications of chemistry in the field of engineering.
- To take into account appropriate combinations of old and new emerging concepts for the potential uses in engineering.
- To address the principles of general chemistry and specific topics relevant to various engineering disciplines.
- To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
- To bring potential applications of chemistry and practical utility in order to become good engineers and entrepreneurs.

UNIT I: **(8 Sessions)**

Matter - Chemical Bonding and its States: Types of bonds (Ionic, covalent and chemical bonds), valence bond theory, molecular orbital theory and its applications to homo and hetero (CO & NO) diatomic molecules. Solid state- Types of unit cells, space lattice (only cubes) calculation of density of the unit cell, two dimensional solids such as graphite and its conduction properties. Fullerenes and their applications.

UNIT II: **(8 Sessions)**

Chemical Kinetics and Electrochemistry: Molecularity and order of reactions, zero, first and second order reactions, theories of reaction rates, electrode potential, electrochemical cells (galvanic and concentration), Nernst equation, electrochemical and galvanic series, definition, significance and classification of corrosion, electrochemical corrosion.

UNIT III: **(8 Sessions)**

Reaction Mechanism and Spectroscopy: Electrophile, Nucleophile (SN^1 and SN^2reactions)
Mechanism of the following reactions: (i) Aldol condensation (ii) Beckmann rearrangement (iii) Cannizaro reaction (iv) Hoffmann rearrangement (v) Diels-Alder reaction and ((vi) Friedel craft reaction
Basic principle, instrumentation and general application of UV, Visible, IR/FTIR & ^{1H}NMR spectroscopy (excluding specific applications).

UNIT IV: **(8 Sessions)**

Polymers: Polymers, classification and applications, polymerization (addition and condensation), Thermoplastic and Thermosetting polymers, preparation, properties and uses of PVC, Dacron, nylon66 and Bakelite. Elastomers (Natural rubber, bunaN, bunaS) vulcanization, conducting polymers (Intrinsic & Extrinsic), doping, ion exchange resins, biodegradable polymers.

UNIT V: **(8 Sessions)**

Water Treatment and Fuels: Hardness of water, calculation on hardness and its determination by EDTA method, sludge and scale formation, causes and prevention of scale formation (colloidal, phosphate, and calgon

conditioning), removal of hardness (Soda lime process, zeolite process & ion-exchange process), calculations based on lime soda process.
Definition of fuels, classification of fuels, calorific value, determination by Dulong's formula, analysis of coal (Proximate and ultimate analysis), petroleum, important fractions of petroleum and their uses, gaseous fuels (CNG & LPG)

Course Outcome:
At the end of the course, students will be able to:

CO1: Gain knowledge about the basic concepts of chemistry and states of matter for skill development.
CO2: Understand kinetic and electrochemical methods for various reactions for skill development.
CO3: Demonstrate the mechanism of different reactions and their characterization using spectroscopy for skill development and employability.
CO4: Learn about the various kinds of polymers and their applications for skill development and employability.
CO5: Demonstrate knowledge of science behind common impurities in water, methods to treat them and gain the basic knowledge of various types of Fuels, their properties for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	2
CO2	3	2	1
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Suggested Readings:

1. Text Book of Polymer Science by F.W. Billmeyer, John Wiley & sons, 1994.
2. Liquid Crystals and Plastic Crystals, vol.-l, edited by G.W. Gray and P.A. Winsor, Ellis Harwood Series in Physical Chemistry, N York.

3. Corrosion Engineeringby M.G. Fontana MeGraw Hill Publications Engineering Chemistry by J C Kuriacose and J. Rajaram, Tata McGraw-Hill Co. New Delhi (2004)
4. Chemistry of Engineering Materials by C.P. Murthy. C.V. Agarwal and A. Naidu BS Publication Hyd.

Website Sources:

- http://www.commonchemistry.org
- https://w w w.engineeringvillage.com
- https://www.technicalsy mp0sium.com

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TPSD101/201: PROFESSIONAL SKILL DEVELOPMENT-I

Objective(s):

- To develop knowledge and understanding of grammar.
- To develop abilities to make use of the grammar in own writing English.
- To increase understanding and recall of what is read and listen including facts and main idea.
- To enhance competencies in writing paragraph, gist or abstract/précis of the passage in own words/ language and in writing resumes, bio-data, letters and applications of different kinds.
- To develop all the four skills of English language.

Unit I: (08 Session)

Basic Applied Grammar and Usage

The Sentences: Parts – Subject and Predicate; Kinds of Sentences and their Transformation. Parts of Speech. **Noun:** Kinds; Gender; Case; Number; Usage**. Pronouns:** Definition; Kinds; Usage. **Adjectives:** Kinds, Degrees of Comparison, Transformation of Degrees. **Determiners:** Kinds: many, many a, a great many; less and fewer; each and every; elder, eldest and older, oldest; much, many; little, a little, the little. **Articles:** Kinds, Articles and Number system, Articles and Gender system, Omission of Articles, Repetition of Articles. **Verbs:** Kinds; Auxiliaries: Principal Auxiliaries; Modal Auxiliaries; Semi-Modals; Usage

Unit II: (08 Session)

Basic Applied Grammar Continued

Non-Finite Verbs: Kinds; Infinitives; Gerund; Participle. **Adverbs:** Kinds and Usage. **Prepositions:** Kinds and Usage. **Conjunctions:** Kinds; Usage. **Interjections:** Definition; Usage.

Unit III: (08 Sessions)

Clauses and Phrases, Tenses, Active and Passive Voice, Direct and Indirect Speech

Unit IV: (08 Session)

Précis Writing: Techniques of Précis Writing; examples**. Paragraph Writing:** Structure of Paragraph, Construction of Paragraphs; Techniques of Paragraph Writing: Unity, Coherence, Emphasis. **Reading Comprehension. Listening Comprehension.**

Unit V: (08 Sessions)

Writing of Resume, Bio-Data. **Writing of Letters and Applications:** Formats; Elements; Kinds: Leave Applications, Job Applications, Order Letters, Letters of Claims and Complaints, Letters of Adjustment.

Course Outcomes:

The students completing this course will be able to:

CO1: Use grammar in their writing in English correctly for skill development.

CO2: Have in-depth knowledge of action words, preposition and conjunction and to express their strong feelings and emotion for skill development.
CO3: Use clauses and phrases, write a sentence using Present, Past and Future Tense and to interchange the Voice (Active and Passive) and Narration (Direct and Indirect) for skill development.
CO4: Write gist and paragraphs and to recall what is being read and listen including facts and main ideas for skill development.
CO5: Differentiate between Resume and Bio-data and to write letters for different reasons for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	3
CO2	3	3	3
CO3	3	2	3
CO4	3	2	2
CO5	3	3	2

Suggested Readings:

1. Remedial English Language by Malti Agarwal, Krishna Publications, Meerut.
2. Professional Communication by Malti Agarwal, Krishna Publications, Meerut.
3. High School English Grammar & Composition by Wren & Martin, S. Chand & Company LTD., New Delhi.

Website Sources:

- www.wikipedia.org
- www.english grammar.org
- www.perfect-english-grammar.com
- www.sucesscds.net
- www.grammarly.com

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TEEC101/ 201: ELECTRONICS ENGINEERING

Objective: The objective of the course is to familiarize the students with concepts of semiconductor and its working along with their applications in real life.

UNIT I: (08 Sessions)
Theory of Semiconductor material: Energy band Theory of crystals, Insulators, Semiconductors and Metals, classification of semiconductors, Mobility and Conductivity, Donor and Acceptor Impurities, Mass- Action law, Variation in semiconductor parameters with Temperature, Hall – Effect.

UNIT II: (08 Sessions)
Semiconductor Diodes and Applications: p-n junction, depletion layer, V-I characteristics, diode resistance, capacitance, p-n junction as rectifiers, filter (Shunt capacitor filter), clipping circuits, clamping circuits, breakdown mechanism, breakdown characteristics, zener resistance, zener diode application as shunt regulator. Introduction of LED, and Photo diode.

UNIT III: (08 Sessions)
Bipolar Junction Transistor (BJT): construction, transistor action, CB, CE and CC configurations, concept of voltage gain, current gain. Field Effect Transistor (FET): JFET: construction, principle of working, concept of pinch-off, drain saturation current, characteristics, characteristic equation, CG, CS and CD configurations, MOSFET: depletion and enhancement type, construction.

UNIT IV: (08 Sessions)
Number system: conversion of bases (decimal, binary, octal and hexadecimal numbers) addition and subtraction, BCD numbers, Boolean algebra, logic gates, concept of universal gates. Canonical forms, minimization using K-map (Upto four variable, don't care conditions also)

UNIT V: (08 Sessions)
Operational Amplifier (Op-Amp): concept of ideal operational amplifier, parameters. Inverting, non-inverting and unity gain configurations, Op-amp as adder, subtractor, Block diagram of Communication Systems, Introduction to Modulation, Need for modulation, Definition of AM and FM.

Course Outcome:

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

CO1: Understand the basic of semiconductor technology for skill development and employability.
CO2: Define the purpose of different diodes used in several applications for skill development and employability.

CO3: Develop understanding and impact of resistance regions for skill development, employability and entrepreneurship development.

CO4: Discuss how basic communication occurs over wireless medium for skill development and employability.

CO5: Discuss the benefits of transistors over conventional vacuum tubes for skill development, employability and entrepreneurship development..

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Suggested readings:

1. S. Salivahanan, N Suresh Kumar, “Electronic Devices and circuits” 2nd Edition, TMH
2. Robert L. Boylestad/ Louis Nashelsky “Electronic Devices and Circuit Theory”, 9th Edition, Pearson Education
3. Jacob Millman, Christos C. Halkias, “Integrated Electronics”, TMH
4. Morris Mano “Digital Computer Design”, PHI 2003
5. Kennedy, Davis, “Electronics Communication System” 4th Edition, TMH.

Website sources:

- www.sanfoundary.co.in
- Grade up online course on transistors (www.gradeup.org)
- www.nptel.ac.in
- en.wikipedia.org

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TEEE-101/201 ELECTRICAL ENGINEERING

Objective: To provide comprehensive idea about AC and DC circuits and its analysis along with the working principles and applications of basic machines in electrical engineering.

UNIT I: **(08 Sessions)**

D.C. Circuit Analysis: Network, Active And Passive Elements, Concept of Linearity And Linear Network, Unilateral And Bilateral Elements, Sources, Source Transformation, Kirchhoff's Laws, Star-Delta Transformation, **Network Theorems:** Thevenin's Theorem, Superposition Theorem, Norton's Theorem, Maximum Power Transfer Theorem.

UNIT II: **(08 Sessions)**

Single Phase AC Circuits: AC Waveforms, Average and Effective Values, Form and Peak Factors, Analysis of Series, Parallel and Series-Parallel RLC Circuits, Active, Reactive and Apparent Powers, Power Factor, Causes of Low Power Factor, Resonance in Series and Parallel Circuits.

UNIT III: **(08 Sessions)**

Three Phase AC Circuits: Three Phase System, Advantages, Phase Sequence, Star and Delta Connections, Balanced Supply and Balanced Load, Three-phase Power and its Measurement, **Measuring Instruments:** Types of Instruments, PMMC and Moving Iron Instrument, Single-Phase Dynamometer Wattmeter, Induction Type Energy Meter

UNIT IV: **(08 Sessions)**

Magnetic Circuits: Magnetic Circuit Concepts, Analogy between Electric & Magnetic Circuits, Magnetic Circuits with DC and AC Excitations, B-H Curve, Hysteresis and Eddy Current Losses, **Single Phase Transformer:** Principle, Working, Construction, E.M.F. Equation, Power Losses, Efficiency, Introduction to Auto-Transformer (Excluding Numerical)

UNIT V: **(08 Sessions)**

Principles of Electro-Mechanical Energy Conversion,

DC Generator: Construction & Working, E.M.F. Equation of Generator, Types of D.C. Generator, Applications, **D.C. Motor:** Principle of operation, Torque Equation of a Motor, Types of D.C. Motor, Applications (Excluding Numericals) **Three Phase Induction Motor:** Construction-(Squirrel cage and slip-ring motor), Principle of Operation, Applications (Excluding Numerical)

Course Outcomes:

On completion of the course students will be able to

CO1: Use basic electrical DC concepts and theorems to analyze circuits for skill development and employability.

CO2: Draw the relevant phasor diagrams and waveform diagrams of voltage and current along with the concepts of reactance and impedance and power factor. Use of resonance and implications for practical circuits for skill development and employability.

CO3: Understand the preference of poly phase system over single phase system, star and delta connections along with develops the knowledge of theoretical and mathematical principles of electrical measuring instruments for skill development, employability and entrepreneurship development.

CO4: Analyze magnetic circuit and differentiate magnetic and electric circuits and understand single phase transformer, auto transformer and three phase transformer for skill development and employability.

CO5: Understand the construction of D.C machine, different windings, their merits and demerits and the basic concept of Three-phase induction motor and its working principle instruments for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Suggested Readings:

1. V. Del Toro, “Principles of Electrical Engineering” Prentice Hall International
2. I.J. Nagarath, “Basic Electrical Engineering” Tata McGraw Hill
3. D.E. Fitzgerald & A. Grabel Higginbotham, “Basic Electrical Engineering” Mc- Graw Hill
4. T.K. Nagsarkar & M.S. Sukhija, “Basic Electrical Engineering” Oxford University Press
5. W.H. HaytP, “Engineering Circuit Analysis” Mc Graw Hill

Website Sources:

- www.lecturenotes.in
- www.examupdates.in
- www.iare.ac.in
- www.notes.specworld.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TEME – 101 / 201: ENGINEERING MECHANICS

Objective: The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering. This capacity requires more than a mere knowledge of the physical and mathematical principles of mechanics; also required is the ability to visualize physical configurations in terms of real materials, actual constraints, and the practical limitations which govern the behavior of machines and structures.

Unit I: **(10 Sessions)**
Two Dimensional Force Systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and non-concurrent force systems, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

Unit II: **(08 Sessions)**
Trusses: Introduction, Simple Truss and solution of simple truss, Method of Joints and Method of Sections.
Friction: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Application.

Unit III: **(08 Sessions)**
Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorem, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

Unit IV: **(06 Sessions)**
Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

Unit V: **(08 Sessions)**
Kinematics of Rigid Body: Introduction, Plane Motion of Rigid Body, Velocity and Acceleration under Translation and Rotational Motion. Relative Velocity.
Kinetics of Rigid Body: Introduction, Force, Mass and Acceleration, Work and Energy, Impulse and Momentum, D'Alembert's Principles and Dynamic Equilibrium.

Course outcome:

Students completing this course will be able to:
CO1: Recognize different force systems, moments and couple for skill development.
CO2: To draw Free Body Diagram and label the reactions on it for skill development and employability.

CO3: Find centroid and Moment of Inertia of different bodies for skill development and employability.
CO4: To draw shear force diagram and bending moment diagram for skill development and employability.
CO5: Understand Newton's law in motion, and recognize different kinds of particle motions for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	2	1	3	1	3	1	3	1	1	3
2	2	3	2	3	3	3	2	3	3	2	3	3
3	3	3	3	3	3	3	3	3	3	2	3	3
4	3	3	3	2	3	3	1	3	1	2	3	1
5	3	1	1	3	3	2	2	2	3	3	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	2
CO5	3	3	2

Suggested Readings:

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall
2. Mechanics of Solids by Abdul Mubeen, Pearson Education Asia.
3. Engineering Mechanics by R.K.Bansal, Laxmi Publications, New Delhi.
4. Engineering Mechanics by SS Bhavi Katti, New age International Publisher, New Delhi.

Website Sources:

- https://nptel.ac.in/courses/122/104/122104014/
- https://www.coursera.org/learn/engineering-mechanics-statics
- https://www.edx.org/course/engineering-mechanics-2
- https://www.youtube.com/watch?v=ADR04oYgpAM

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TECS101/ TECS201: COMPUTER FUNDAMENTALS & PROGRAMMING

OBJECTIVE:
The objective of this course is to introduces the concepts of computer basics & programming with particular attention to Engineering examples and to learn the fundamentals of the C programming language.

UNIT I: (8 sessions)
Introduction: Introduction to Computer Systems, Generation of Computers, BIOS, Various types of memories, CPU organization, ALU, registers. Introduction to various operating Systems. Number systems: Binary, hexadecimal, octal and their inter conversions. Computer Languages and Software & hardware: High Level Languages and Low-Level Language, Various types of software. Firmware, Compiler, Interpreter and Assembler. File Allocation Table, Hardware.

UNIT II: (8 sessions)
Input, Output and storage units: Introduction to various Input and output Devices. Printers: Various type of Impact and Non- Impact Printers.
Introduction to algorithm and Flow chart: Representation of an algorithm, flowchart symbols and levels of flow chart, advantage and limitations of flowchart and pseudo code. Basics of programming: Introduction to the design and implementation of correct, efficient and maintainable programs. Use of high-level programming languages for the development of programs.

UNIT III: (8 sessions)
Standard I/O in "C", Fundamental Data Types and Storage Classes: Character types, Integer, short, long, unsigned, single and double-precision floating point, storage classes, automatic, register, static and external, Operators and Expressions: Using numeric and relational operators, mixed operands and type conversion, Logical operators, Bit operations, Operator precedence and associativity.

UNIT IV: (8 sessions)
Conditional Program Execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch, Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue.

UNIT V: (8 sessions)
Modular Programming: Passing arguments by value, scope rules and global variables, separate compilation, and linkage, building your own modules. Arrays: Array notation and representation, manipulating array elements, using multidimensional arrays, arrays of unknown or varying size, Structure, union, enumerated data types. Functions: Introduction, types of functions, functions with array, recursive functions, Introduction to pointers, Introduction to file handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

COURSE OUTCOMES:

At the end of the course students will be able to
CO1: Basic knowledge of components of Computer for skill development.
CO2: Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming for skill development.
CO3: Write, compile and debug programs in C language and use different data types for writing the programs for skill development.
CO4: Design programs using the concepts decision statements, loops, functions, arrays pointers etc. for skill development, employability and entrepreneurship development.
CO5: Programming by using function, recursion and pointers for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	3
CO2	3	1	3
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3

Suggested Readings:

1. "Let us C", Yashvant Kanitkar
2. "Programming with C", Byron Gottfried
3. "Computer Fundamentals", Anita Goel, Pearson Education
4. "Computer Concepts and Programming in C", E Balaguruswami, McGraw Hill
5. "C programming", Kernighan and Ritchie, PHI
6. "Computer Fundamentals and Programming in C", Reema Thareja, Oxford Publication

Website Resources:

- www.swayam.gov.in
- onlinecourses.nptel.ac.in

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)

TEMA – 202: Elementary Mathematics- II

Objective: -The main aims of this course are to recall and remember basics of algebra, probability theory, vectors and three-dimensional geometry. The focus of the subject to understand the concepts of basic mathematical methods to solve engineering problems, analyze engineering problems and evaluate the solutions.

UNIT I: (12 Sessions)

ALGEBRA: Fundamental theorem of algebra, Solution of quadratic equations in the complex number system, Linear inequalities, Algebraic solutions of linear inequalities in one variable and their representation on the number line, Graphical solution of linear inequalities in two variables, Solution of system of linear inequalities in two variables graphically.

UNIT II: (08 Sessions)

SEQUENCES, SERIES, PERMUTATION & COMBINATION: Sequence and series, Arithmetic progression (A.P.), Arithmetic mean (A.M.), Geometric progression(G.P.), General term of a G.P., Sum of n terms of a G.P., Geometric mean (G.M), Relation between A.M. and G.M., Fundamental principle of counting, Factorial n (n!), Permutation and combinations formulae and their connections, Simple applications, Sum of n terms of the special series n, n^2 and n^3.

UNIT III: (10 Sessions)

PROBABILITY THEORY: Random experiments, Outcomes, Sample spaces(set representation), Events , Occurrence of events, 'and' and 'or' events, Exhaustive events, Mutually exclusive events , Connections with the theories of earlier classes, Probability of an event , Multiplication theorem on probability , Bays theorem , Binomial distribution , Poisson distribution and Normal distribution.

UNIT IV: (10 Sessions)

VECTOR AND SCALARS: Vectors and Scalars, Magnitude and direction of a vector, Direction cosines / ratios of vectors, Type of vectors (equal , unit, zero, Parallel and collinear vectors), Position vector of a point , Negative of a vector , Components of a vector, Addition of a vectors, Multiplication of a vector by a scalar, Position vector of a point dividing a line segment in a given ratio, Scalar product of vectors, Projection of a vector on a line, Cross product of vectors.

UNIT V: (12 Sessions)

THREE-DIMENSIONAL GEOMETRY: Introduction to three- dimensional geometry coordinate axes and coordinate planes in three dimensions, Coordinates of a point, Distance between two points and section formula, Direction cosines / ratios of a line joining two points, Cartesian and vector equation of a line, Coplanar and skew lines, Shortest distance between two lines, Cartesian and vector equation of a plane, Angle between (i) two lines, (ii) two planes (iii) a line and a plane, Distance of a point from a plane.

Course Outcomes:

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

CO1: Remember equations, inequalities, and systems of equations to represent situations and find solutions via symbolic, numeric and graphic methods for skill development.

CO2: Understand and calculate Series, Sequences and Permutation and combinations issues for skill development.

CO3: Understand and calculate probabilities by applying probability laws and theoretical results for skill development.

CO4: Compare and analyze the methods by using coordinates to represent and work with ***vectors*** for skill development.

CO5: Understand the concepts & advance topics related to *three-dimensional geometry* and study the applications of conics for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	2
CO2	3	3	3
CO3	3	3	3
CO4	3	1	3
CO5	3	3	1

Suggested Readings:

1. R.D. Sharma: Mathematics (I& II-XI), Dhanpatrai publication (Pvt.) Ltd. New Delhi, India.
2. R.D. Sharma: Mathematics (I& II-XII):Mathematics (I& II-XI), Dhanpatrai publication (Pvt.) Ltd. New Delhi, India.
3. Gorakh Prasad: Differential Calculus, Pothishala Private Limited, Allahabad.
4. Gorakh Prasad: Integral Calculus, Pothishala Private Limited, Allahabad.
5. B.S. Grewal: Engg. Mathematics, khanna publishers, New Delhi.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in

- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (II Semester)

EBT209T ELEMENTARY BIOLOGY-II

Objective(s): The objectives of this course:

- Provide necessary knowledge of the microbial world, structure and functions of microbes and their relationship to environment and human health.
- Emphasizes on imparting basic construction of a living organism, its metabolism and relation to diseases.

UNIT I: **(8 Sessions)**
Microbiology: Brief history of microbiology**,** Types of microorganisms, Basic idea of domain bacteria, lichens, algae, protozoa, helminthes and virus, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

UNIT II: **(8 Sessions)**
Cells: Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells.

UNIT III: **(8 Sessions)**
Metabolism: Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & amp; pathways of energy use. Integration of metabolism.

UNIT IV: **(8 Sessions)**
Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Krebs cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

UNIT V: **(8 Sessions)**
Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines.

Course Outcomes:

At the end of the course students will able to:
CO1: Define the science of microbiology, its development and importance in human welfare for skill development.
CO2: Acquire knowledge about the organizational and functional aspects of cell and cell organelles for employability.
CO3: Emphasizes on imparting basic construction of a living organism, its metabolism and relation to diseases for skill development.
CO4: Learns the concept of energy utilization and factors affecting respiration for skill development, employability and entrepreneurship development.
CO5: Understands the basic concepts of immunology and reproductive health and human welfare

for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	3
CO2	3	3	3
CO3	3	3	1
CO4	2	3	3
CO5	3	3	2

Suggested Readings:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzer, Tata Mcgraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house
5. Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan
6. Singer (MacGraw Hill Publication)
7. General Microbiology: Stainer, Adelberg and Ingraham

Website Sources:

- https://routledgetextbooks.com/textbooks/9780815345138/lecture-notes.php
- https://www.slideshare.net
- https://lecturenotes.in/
- https://www.shomusbiology.com/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (II Semester)

EBT102T/ EBT202T INTRODUCTION TO BIOTECHNOLOGY

Objective(s): The objectives of this course:

- Introduce students to the global significance of biotechnology, the categories of biotechnology processes and products, and in the context of "traditional" Vs "modern" biotechnology processes and its applications.
- Introduce the developments in the field of biotechnology, genomics and proteomics.
- Introduce to the bioinformatics which is one of the emerging fields in biotechnology.

UNIT I: **(8 Sessions)**

Introduction to Biotechnology: Fundamentals of Biochemical Engineering, Biotechnology and Society-Principles and Processes; Application in Health, food, medicine and Agriculture; genetically modified organisms (GMO); biosafety issues.

UNIT II: **(8 Sessions)**

Biomolecules: Building Blocks of Biomolecules-Structure and dynamics. Structure and function of Macromolecules (Carbohydrates, Proteins, Lipids). Classification of Enzymes- Purification and characterization of enzymes from natural sources. Comparison of chemical and enzyme catalysis.

UNIT III: **(8 Sessions)**

Introduction to Cell & Microbiology: Basic concept of Cell and cell theory, Types of Cells, Structure and function of cell organelles, Microbes and their classification. Application of microbes in Biotechnology.

UNIT IV: **(8 Sessions)**

History of Bioinformatics: Introduction and application. Biological databases (nucleotide and protein data bases, Structure databases) Data retrieval system (ENTREZ, SRS and DBGET); Sequence file formats and molecular file formats.

UNIT V: **(8 Sessions)**

Genomics: Genome Sequencing, Gene Prediction and counting, Genome similarity, SNP's and comparative genomics, Human Genome Project.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the field of biotechnology viz., Agricultural Biotechnology, Microbial biotechnology, medical biotechnology, etc for skill development.
CO2: Learn about the structure and function of macromolecules for employability.
CO3: Understand the types, structure, function, evolution and diversity of cells for skill development.
CO4: Search and retrieve information from genomic and proteomic databases (e.g., GenBank,

Swiss-Prot), and to analyze their search results using software available (e.g., BLAST, ClustalW) for skill development, employability and entrepreneurship development.
CO5: Understand the theory of genome sequencing and other predictions for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	2	3	2
CO3	3	2	2
CO4	1	2	3
CO5	3	2	2

Suggested Readings:

1. Introduction to Biotechnology by William J. Thieman, Michael A. Palladino, Publisher: Benjamin Cummings.
2. Basic Biotechnology by Colin Ratledge Publisher: Cambridge University Press.
3. Text book of Biotechnology by H.K.Dass (Wiley India publication).
4. Biotechnology by B.D.Singh (Kalyani Publishers).
5. Text book of Biotechnology by R.C.Dubey (S.Chand and company).

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology I Year (I/II Semester)

EBT102P/202P Introduction to Biotechnology Lab

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	Introduction to Laboratory Instruments	Experiment 1
6	To learn the Preparation of media	Experiment 2
7	Isolation of microbes from the given sample by spread plate technique	Experiment 3
8	To characterize bacterial colony using gram staining	Experiment 4
9	Preparation of buffers and measurement of pH	Experiment 5
10	Identification of carbohydrates by Molisch's test	Experiment 6
11	Estimation of reducing sugars by **Benedict test**	Experiment 7
12	To distinguish between polysaccharides and other carbohydrates **(Iodine test)**	Experiment 8

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology I Year (I/II Semester)

EBT301T BIOCHEMISTRY

Objective(s): The objectives of this course:

- Provide basic knowledge and fundamentals of biochemistry.
- Understand the fundamental chemical principles that govern complex biological systems.
- Enable students to acquire a specialized knowledge and understanding for importance and role of biomolecules in life.
- Teach knowledge and understanding of the principles and basic mechanisms of metabolic control and molecular signaling in cells and, to develop basic laboratory skills for biochemical research.

UNIT I: (8 Sessions)

Introduction: Background and scope of Biochemistry; properties of water, acids, bases and buffers; Covalent and non-covalent interactions in biological systems; Biomolecules and separating techniques- Centrifugation, Chromatography (Paper and Gel filtration).

UNIT II: (8 Sessions)

Carbohydrate: Classification of carbohydrates; Structure and function of carbohydrates; Metabolism- Glycolysis, TCA cycle, Gluconeogenesis, HMP pathway, Glycogenesis, Glycogenolysis.

UNIT III: (8 Sessions)

Proteins and Enzymes: Amino acids- Classification, structure and properties of amino acids; Structure of proteins- Primary, secondary, tertiary and quaternary structure; Heme and porphyrin metabolism; Enzymes-Introduction, nomenclature and applications of enzymes.

UNIT IV: (8 Sessions)

Fats and lipids: Structure and function; Biosynthesis of fatty acids, Degradation of fatty acids- Fatty acid oxidation (β oxidation of fatty acid); Regulation of fatty acid metabolism; Ketone bodies.

UNIT V: (8 Sessions)

Nucleic Acids: Structure and properties of DNA (A-, B- and Z-form) and RNA (mRNA, rRNA and tRNA); metabolism of Purines and Pyrimidines (*De-novo* and Salvage pathway).

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the concept of chemical bonds and interaction of water with biomolecules, working and uses of separation techniques for skill development.
CO2: Classify carbohydrates on a different basis and their metabolism inside the cell for skill development, employability and entrepreneurship development.
CO3: Develop the knowledge of amino acids, structure, classification and organization of proteins, and their application as enzymes for employability.
CO4: Know the classification, structure, and metabolism of fatty acids for skill development,

employability, and entrepreneurship development.
CO5: Understand the structure and function of nitrogenous bases containing biomolecules and their metabolism for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	2
CO2	3	3	3
CO3	3	3	2
CO4	2	2	3
CO5	3	3	3

Suggested Readings:

1. David L. Nelson and Michael M. Cox, Lehninger Principles of Biochemistry, 7th Edn, 2017, W. H. Freeman and Co., NY.
2. D. Voet, C. W. Pratt, J.G. Voet, Principles of Biochemistry: International StudentVersion, IV Ed., Wiley, New York.
3. Lupert Styrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J. Biochemistry. 9th Edn (2019). W.H.Freeman & Co. New York.
4. D. Papachristodoulou, A. Snape, W. H. Elliott, Daphne C. Elliott. Biochemistry and Molecular Biology, V Ed.,Oxford University Press, (2014).
5. Robert K. Murray, Daryl K. Granner, Victor W.Harper's Illustrated Biochemistry, 31th Edn (2018.) Rodwell. McGraw-Hills.USA.

Website Sources:

- https://themedicalbiochemistrypage.org/
- https://www.nature.com/nchembio/
- https://biochemistry.org/

- https://www.ebooks.com/en-ae/2110659/biochemistry-of-lipids-lipoproteins-andmembranes/neale- ridgway-roger-mcleod/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology II Year (III Semester)
(Effective from 2022-23)

EBT302T MICROBIOLOGY

Objective(s): The objectives of this course:

- Provide necessary knowledge of the microbial world.
- Impart knowledge of structure and functions of microbes.
- Study physiology and relationship to the environment and human health.

UNIT I: **(8 Sessions)**

Introduction and History of Microbiology: Broad classification and taxonomy of microorganisms, culture media, isolation and identification of microbes, culture techniques, preservation of cultures. Growth and physiology; Methods of microbial enumeration; Microbial control by physical and chemical techniques, Strain improvement by Mutations and Genetic Engineering.

UNIT II: **(8 Sessions)**

Bacteria: Origin of bacteria, general characteristics, structure and classification. Bacterial photosynthesis- Photosynthetic structures, types of bacterial pigments, photosynthetic electrontransport system, Photophosphorylation.

UNIT III: **(8 Sessions)**

Virus: Origin of Virus, Morphology, Shape, Size, Structure, type of envelope and their composition, Classification of viruses, lytic and lysogenic cycles, Viroids and Prions.

UNIT IV: **(8 Sessions)**

Microbial metabolism: Enzymes and their regulation, energy production, respiratory chain, anaerobic respiration, glycolysis, pentose phosphate pathway, Entner-Doudoroff pathway.

UNIT V: **(8 Sessions)**

Applications of microbiology: Microbiology of waste water; bioremediation; Biological nitrogen fixation- Bio fertilizers; Biofuels; Medical Microbiology- tuberculosis, typhoid, diarrhea, amoebiosis, rabies.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand inventions and discoveries in microbiology, microbial culture techniques, preservation, and control methods for skill development.
CO2: Learn about the diversity in the microbial world, their structure and classification, and photosynthesis in bacteria for skill development, employability and entrepreneurship development.
CO3: Know about the classification of viruses on a morphological and physiological basis for skill development, employability and entrepreneurship development.
CO4: Understand microbial metabolisms and their regulations for skill development and employability.

CO5: Learn about the various applications of microbes for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	1
CO2	3	3	3
CO3	3	2	3
CO4	2	3	1
CO5	3	3	3

Suggested Readings:

1. Powar & Dagniwala. Microbiology, Volume 1, Himalaya Publishing House Pvt. Ltd, 2012.
2. M J Pelczar Jr, E C S Chan and N R Krieg. Microbiology, McGraw Hill, Fifth Edition.
3. R Y Stanier, J L Ingraham, M L Wheelis. General Microbiology, MacMillan Fifth Edition, 2007.
4. G J Tortora, B R Funke and C L Case. Microbiology- An Introduction, Pearson Education, Ninth Edition, 2008.

Website Sources:

- https://routledgetextbooks.com/textbooks/9780815345138/lecture-notes.php
- https://www.slideshare.net
- https://lecturenotes.in/
- https://www.shomusbiology.com/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology II Year (III Semester)
(Effective from 2022-23)

EBT303T CELL BIOLOGY

Objective(s): The objectives of this course:

- Familiarize the students with the core principles and concepts of the cellular mechanisms which are significant in the development, growth and survival of the organism.
- Includes the fundamental concepts of cellular biology like cell organelles, various transport mechanisms signal mechanisms.

UNIT I: (8 Sessions)

Structure and Function of the Cell: Eukaryotic and prokaryotic cells; Membrane organization - Micelles, membrane proteins, cytoskeleton proteins, contractile proteins (Actin and myosin); Extra cellular matrix; Cell division- Mitosis and meiosis, Cell cycle, Molecules controlling cell cycle.

UNIT II: (8 Sessions)

Transport Across Cell Membranes: Passive and active transport; Sodium potassium pump, Ca^{2+} ATPase pump; Lysosomal and vacuolar membrane ATP dependent proton pumps; Co transport; Symport; Antiport; Ion-selective gated channel against neuronal cell membrane; Transport into prokaryotic cells; Endocytosis and exocytosis; Entry of virus and toxins into cells.

UNIT III: (8 Sessions)

Receptors and Models of Extra Cellular Signaling: Cytosolic, nuclear and membrane bound receptors; Examples of receptors; Autocrine, paracrine and endocrine modes of action; Quantization and characterization of receptors.

UNIT IV: (8 Sessions)

Signal Transduction: Signal amplification; Different models of signal amplifications; Role of cyclic AMP, cyclic GMP and G proteins in signal transduction; Biosynthesis of inositol tri phosphates and their role as messengers; Calcium ion flux and its role in cell signaling, phosphorylation and regulation of protein kinases in signaling, serine – threonine kinases in signaling.

UNIT V: (8 Sessions)

Cell Culture: Techniques for the propagation of eukaryotic and prokaryotic cells; Cell lines- Generation of cell lines, maintenance of stock cells, characterization of cells, techniques in cell culture, explants cultures, primary cultures, contamination, three dimensional cultures; Role of matrix in cell growth.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the ultrastructure of prokaryotic and eukaryotic cells, properties of cells, membrane organization, cell divisions, and significance of cell cycle for skill development.

CO2: Differentiate types of transport mechanisms, ATP-dependent proton pumps, Co-transport, transport into prokaryotic cells, endocytosis, and exocytosis for skill development and employability.
CO3: Develop the understanding of different types of receptors and their action mechanism in extracellular signaling for skill development, employability and entrepreneurship development.
CO4: Know the models in signal amplification, the role of secondary messengers and kinases in signaling for skill development.
CO5: Use techniques of cell culture, characterization of cells, explants cultures, primary cultures, contamination, three-dimensional cultures, and role of matrix in cell growth for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	1
CO2	2	3	2
CO3	1	2	3
CO4	3	1	2
CO5	1	3	2

Suggested Readings:

1. G.M. Cooper, R. E. Hausman. The Cell: A Molecular Approach, VI Edition, ASM Press and Sinauer Associates, Inc.,USA, 2013.
2. R.I. Freshney. Culture of Animal Cells, VI Ed., Wiley-Blackwell, 2010.
3. De Robertis and De Robertis (2005). (8th edition) (Indian) Cell and Molecular Biology, Lippincott Williams, Philadelphia. [B.I Publications Pvt. Ltd. New Delhi].
4. Watson J.D et al., Molecular Biology of the Gene, VI Ed, Cold Spring harbor laboratory Press, 2008.

Website Sources:

- https://microbenotes.com/category/cell-biology/
- http://www.isca.co.in/BIO_SCI/book/ISBN%20978-93-86675-40-8.pdf
- http://www.biologyjunction.com/cell++notes+bi.htm
  https://www.biologydiscussion.com/cell/

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B.Tech. Biotechnology II Year (III Semester)
(Effective from 2022-23)

EBT304T BIOENERGETICS

Objective(s): The objectives of this course:

- Study energy flow through living systems and its role in biological processes like growth, development and metabolism.
- Provides deep knowledge about cellular process like cell respiration, metabolic and enzymatic processes.
- Explain thermodynamic principles and concept of free energy.

UNIT I: **(8 Sessions)**

Introduction to thermodynamics: General idea of system and surrounding; Laws of thermodynamics: Zeroth, First, Second and third laws. Concept of energy, work and heat; Conversion of units; Heat capacity.

UNIT II: **(8 Sessions)**

Concept of free Energy: Molecular basis of entropy, standard free energy and measurement of free energy, significance in metabolism; Energy rich bonds, ATP and inter conversion of nucleotide phosphates; Phosphorylation potential, redox reaction and reduction potential; ATP generation in bacterial system.

UNIT III: **(8 Sessions)**

Bioenergetics of animals: Site of Oxidative Phosphorylation; AT synthetase; Electron-Transferring Reactions; Mechanism of Oxidative Phosphorylation; Oxidation of Extra mitochondrial NADH and ATP; Aspartate-malate Shuttle; Glycerol-3-P Shuttle;

UNIT IV: **(8 Sessions)**

Bioenergetics of plants: Architecture- light harvesting complexes, Hill reaction, photosystem I and II, location and mechanism of energy transfer, photophosphorylation and reduction of carbon dioxide; Calvin cycle, quantitative efficiency, photorespiration, C4 metabolism, Chemiosmotic theory and evidence of its occurrence.

UNIT V: **(8 Sessions)**

Energetic pathways and their regulation: Glycolytic pathway and its regulation, glycogen breakdown, Citric acid cycle and its cycle, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway.

Course Outcomes:

At the end of the course students will be able to:
CO1: Perceive the laws of thermodynamics along with the concept of systems, work, and heat for skill development.
CO2: Know about concepts of entropy, free energy, redox reactions in the metabolism of energy-rich compounds for skill development, employability and entrepreneurship development.

CO3: Understand oxidative phosphorylation, electron transport, and mitochondrial shuttles for skill development and employability.
CO4: Understand the general idea about ATP production, utilization from different energy-producing pathways for skill development, employability and entrepreneurship development.
CO5: Understand the amphibolic pathways in which carbohydrates are involved for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	1
CO2	3	1	3
CO3	2	3	3
CO4	1	3	3
CO5	3	3	2

Suggested Readings:

1. E.E. Conn, P.K. Stumpf, G. Bruening, R.H. Doi. Outlines of Biochemistry, V Ed.,John Wiley & Sons, (2009).
2. D.L. Nelson, M. M. Cox. Lehninger Principles of Biochemistry, V Ed., CBS Publication (2016).
3. J.M. Berg, J.L., Tymoczko, L. Stryer. Biochemistry: VII Ed., W.H. Freeman Int. Edition (2010).
4. R C Srivastava, S.K. Saha, A.K. Jain. Thermodynamics: A core course, III Ed, PHI Learning Private Limited, New Delhi (2010).

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.pnas.org/

IFTM University, Moradabad
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B.Tech. Biotechnology II Year (III Semester)
(Effective from 2022-23)

EBT305T FLUID FLOW AND SOLID HANDLING

Objective(s): The objectives of this course:

- Familiarize the students with the properties of fluids and the applications of fluid mechanics.
- Formulate and analyze the problems related to fluid flow.
- Understand the concept of flow measurement, types of flows and dimensional analysis.

UNIT I: **(08 Sessions)**

Properties of fluids: Types of Fluid, Capillarity, Cavitations, surface tension. Fluid statics: Euler's equation, Hydrostatic Law and Pressure Measurement, Transport of fluids, pipe fittings, minor losses in pipe flow.

UNIT II: **(08 Sessions)**

Flow measurements: Bernoulli's Equation and its application, Orifice meter, venturimeters, rotameter and Pitot tube.

UNIT III: **(08 Sessions)**

Pumps: Reciprocating pumps, rotary pumps, centrifugal Pumps, Characteristic curve, Efficiency, Minimum Operating speed, Net positive suction Head Introduction of fluidization and types of Fluidization.

UNIT IV: **(08 Sessions)**

Properties of solids: Screening, industrial screening equipment, screen analysis, size reduction of solids, stages of reduction. Intermediate and fine size reduction, power requirement and mechanism. Power driven machines: Crushers, grinders and conveyers.

UNIT V: **(08 Sessions)**

Filtration theory: Continuous and branch equipment's. Flow of solids through fluids, classification and sedimentation.

Course Outcomes:

At the end of the course students will able to:
CO1: Understanding the concepts of fluid behavior for skill development.
CO2: Applying the concept of fluid mechanics on static as well as dynamic conditions for skill development and employability.
CO3: Analyzing the mechanics related to fluid motion for skill development.
CO4: Evaluating different problems related to the fundamental principles of fluid statics, fluid kinematics and fluid dynamics for skill development and employability.
CO5: Creating designs of different machining equipment's using fluid as a working medium for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	3	1	3	3	2	2	3	2	3	2	3
2	3	3	2	1	3	2	3	3	3	3	3	2
3	2	2	3	3	3	2	1	3	3	3	3	1
4	3	3	3	3	1	3	1	3	1	3	3	1
5	3	3	2	3	1	3	1	1	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	1
CO2	3	3	2
CO3	3	3	1
CO4	3	3	3
CO5	3	2	3

Suggested Readings:

1. Fox and McDonald's Introduction to Fluid Mechanics.7 edition. Wiley; (2008) McCabe Smith.
2. Richardson, J.F.; Harker, J.H.; Backhurst, J.R..Coulson and Richardson's Chemical Engineering Volume 2 - Particle Technology and Separation Processes (5th Edition) Elsevier.
3. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering",2nd Edition, SK. Katania and Sons, 2010.
4. Dr. R.K. Bansal "A Text book of Fluid Mechanics and Hydraulic Machines", 9th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2010.
5. A. K. Jain, "Fluid Mechanics Including Hydraulic Machines", 8th Edition, Khanna Publishers, New Delhi, 2003.

Website Sources:

- nptel.ac.in/course.html
- www.nsf.gov
- en.wikipedia.org
- www.sciencedirect.com
- www.slideshare.net
- www.researchgate.net

Note: Latest editions of all the suggested readings must be used.

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TEMA302 BIOSTATISTICS

Objective: The main aims of this course are to advance statistical science and its application to problems of human health and disease, with the ultimate goal of advancing statistics. The role of biostatisticians is an important one, especially when it comes to designing studies and analyzing data from research problems.

UNIT I: **(8 Sessions)**
Introduction: Frequency Distribution, Types of graphs Histogram, Frequency polygon Frequency Curves, Cumulative frequency curve of ogive, Diagrammatic Representation of date measures of Central Tendency (Mean, Median, Mode). Measures of Dispersion, Range, Quartile, Deviation, Average Deviation or Mean deviation, Standard Deviation, Variance.

UNIT II: **(8 Sessions)**
Moment: Moment generating functions, Skewness, Kurtosis curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves ($Y = ab^x$ and $Y = ax^b$ and $Y = ae^{bx}$ etc.).

UNIT III: **(8 Sessions)**
Correlation: Correlation table, Positive and Negative correlation, Karl Pearson's coefficient of correlation; correlation of Rank, Tied Ranks. Linear, Nonlinear and multiple Regression analysis, Line of Regression coefficient, Angle Between two Regression Lines, Binomial, Poisson and normal distribution.

UNIT IV: **(8 Sessions)**
Sampling Theory (small and large): Comparison of Two Large sample, Hypothesis, Null hypothesis & Alternative hypothesis, Test of significance: Chi-square test, t-test, F-test Analysis of variance (One way). Application to Engineering Medicine, agriculture etc.

UNIT V: **(8 Sessions)**
The Design of Experiments: Introduction, Planning of Experiments, Definition of Design of Experiment, and Some Important terms, Field Experiment, Basics principles of Field Experiment, Completely Randomized Design (CRD), Randomized block, Design Latin Square Design.

Course Outcomes:

At the end of the course students will be able to
CO1: Understand the relationship between numbers in a data set through the calculation of median, mode, mean and range and graphs for skill development.
CO2: Understand and interpret the concepts of descriptive statistics from these data for skill development.
CO3: Remember restate the principal concepts about biostatistics and collect data relating to variable which will be examined for skill development and employability.

CO4: Demonstrate knowledge of applicable large sample theory of estimators and tests and derive their properties. Be capable of self-directed learning of unfamiliar statistical methods and written and oral presentation of results/findings for skill development and entrepreneurship development.
CO5: Understand how the analysis of variance can be extended to the randomized complete block design for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	1
CO2	3	2	1
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3

Suggested Readings:

1. Georgr W and Willian G., Statistical Methods, IBH Publication.
2. Zar, J, Biostatistics, Prenticw Hall, London.
3. R. Rangaswami, A Text Book of Agricultural Statistics, New Age International Publication.
4. Methods in Biostatistics by B. K. Mahajan: S.Chand& Company (Pvt.) Ltd., New Delhi.
5. Fundamentals of Applied Statistics S.C. GUPTA & V.K. KAPOOR: Sultan Chand & Sons, New Delhi.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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(Effective from 2022-23)

TEHU-301 / 401: DISASTER MANAGEMENT

Objective: The objective of this course is to provide students an understanding to the concepts and aspects of disaster and its relationship with development. To ensure awareness of Disaster Risk Reduction (DRR) approaches among students. To assist students, develop ability to respond to their environment with potential response to disaster.

UNIT I: (12 Sessions)

Introduction to Disasters

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks; Types of disasters – Earthquake, Landslide, Flood, Drought, Fire, campus shooting, bomb threat, terrorist incidence and financial emergency etc.; Causes and Impacts including social, economic, political, environmental, health, psychosocial, etc.; Differential impacts- in terms of caste, class, gender, age, location, disability; Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II: (10 Sessions)

Approaches To Disaster Risk Reduction

Disaster life cycle – its analysis, phases, culture of safety, prevention, mitigation and preparedness; Community based DRR (Disaster Risk Reduction), Structural-nonstructural measures; Roles and responsibilities of community: Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders

UNIT III: (08 Sessions)

Inter-Relationship between Disasters and Development

Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc.; Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources; Role of international cooperation's in Disaster Management

UNIT IV: (08 Sessions)

Disaster Risk Management In India

Hazard and Vulnerability profile of India. Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management; Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation; Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V: (07 Sessions)

Disaster Management: Applications, Case Studies and Field Works

The project /fieldwork are meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the

geographic location and hazard profile of the region where the college is located. A few ideas or suggestions are discussed below:

Several governmental initiatives require Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) to be proactive in preparing DM plans and community based disaster preparedness plans. Information on these would be available with the district collector or Municipal corporations.

Teachers could ask students to explore and map disaster prone areas, vulnerable sites, vulnerability of people (specific groups) and resources. The students along with teacher could work on ways of addressing these vulnerabilities, preparing plans and consultation with local administration or NGOs.

Students could conduct mock drills in schools, colleges or hospitals. They could also work on school safety, safety of college buildings, training in first aid. Other examples could be- identifying how a large dam, road/ highway or an embankment or the location of an industry affects local environment and resources or how displacement of large sections of people creates severe vulnerabilities may be mapped by student project work.

The suggested topics for Project work for student could be as follows:

- Monitoring and evaluation plan for disaster response
- Low cost Home based water purification methods
- Planning Nutrition intervention programmes
- Safety tips before during and after earthquake, cyclone, floods and fire accidents.
- Mock Drills
- Major disasters in India
- Disaster Management in India
- Flood affected areas and damages in India
- Heat waves in India
- Earth quakes in India
- Historical Tsunamis in India
- Nuclear emergence
- Traffic accidents in India
- Train Accidents
- Major disease outbreak
- Disaster management structure in India
- Precaution, mitigation of disaster in India
- Warning system in India to prevent disaster
- Bhopal gas tragedy
- Kutch earth quake
- Tsunami (2004)
- Kosi Calamity 2008
- Mayapuri radiation exposure Delhi (2010)
- Mock exercises

Course Outcome:

At the end of the course students will able to:

CO1: Ability to understand major types of disaster in Indian context for skill development

CO2: Understanding of approaches to reduce disaster risks for employability.

CO3: Capable of understanding relationship between development and disaster. Sustainable development for skill development

CO4: Understanding of when an event becomes disaster and the phases to handle the situation for employability

CO5: Ability to analyze how to handle a situation of disaster by taking case studies of events in past for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	3	2	3	3	3	3	2	2	2	1	3
2	2	3	3	2	3	3	3	2	3	3	1	3
3	3	3	2	2	3	3	3	3	1	2	3	2
4	3	3	3	3	1	3	1	3	1	3	3	3
5	1	3	3	1	3	1	2	3	3	3	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	3
CO2	2	3	3
CO3	3	2	3
CO4	2	3	2
CO5	3	1	1

Suggested Readings:

1. Satish Modh, Introduction to Disaster Management, Macmillan Publisher India Ltd
2. Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press
3. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann,
4. Singhal J.P. "Disaster Management", Laxmi Publications. ISBN-10: 9380386427 ISBN-13: 978-9380386423
5. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., . ISBN-10: 1259007367, ISBN-13: 978-1259007361]
6. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi

7. KapurAnu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi.
8. Cuny, F. Development and Disasters, Oxford University Press. Document on World Summit on Sustainable Development.
9. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.

Website sources:

- https://www.physio-pedia.com/Disaster_Management
- http://www.ifrc.org/en/what-we-do/disaster-management
- http://www.wcpt.org/disaster-management/what-is-disaster-management
- en.wikipedia.org

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology II Year (III Semester)
(Effective from 2022-23)

EBT301P Biochemistry Lab

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	Introduction to Laboratory Instruments	Experiment 1
6	Introduction to Biochemistry Lab: Units, Volume / Weight measurements, concentration units	Experiment 2
7	Preparation of Acid and Alkali Solutions	Experiment 3
8	Measurement of pH of any given sample	Experiment 4
9	Identification of carbohydrates by **Molisch's test**	Experiment 5
10	To distinguish between polysaccharides from other carbohydrates **(Iodine test)**	Experiment 6
11	Estimation of reducing sugars by **Benedict test**	Experiment 7
12	Estimation of total carbohydrates by Anthrone's method	Experiment 8
13	Test to distinguish between monosaccharides from disaccharides **(Barfoed's test)**	Experiment 9
14	Test to distinguish ketoses from aldoses sugars **(Seliwanoff's test)**	Experiment 10
15	To detect whether given sample is protein or non-protein	Experiment 11
16	To estimate protein concentration in sample by Biuret assay	Experiment 12
17	Estimation of protein concentration by Lowry method	Experiment 13

IFTM University, Moradabad
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EBT302P Microbiology Lab

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	Preparation of Nutrient Agar Media and Nutrient Broth.	Experiment 1
6	To determine the microbial flora in water sample. Ex. laboratory, tap and drinking water (Hostel).	Experiment 2
7	To determine the microbial flora in air sample.	Experiment 3
8	To determine the microbial flora in soil sample by serial dilution technique	Experiment 4
9	Isolation of soil Microorganisms by pour plate method.	Experiment 5
10	Isolation of soil Microorganisms by spread plate method.	Experiment 6
11	To identify given bacterial culture by Gram's staining method.	Experiment 7
12	To study Growth curve of bacteria	Experiment 8

IFTM University, Moradabad
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EBT303P Cell Biology Lab

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	Observation of distinguishing features of different eukaryotic cells.	Experiment 1
6	To measure the length and breadth of the given cell sample by using micrometer.	Experiment 2
7	To study the mitosis cell cycle in onion root tip.	Experiment 3
8	To study the meiosis cell cycle in onion root tip.	Experiment 4
9	To identify the blood cell types in human blood smear.	Experiment 5
10	Preparation of microscope slide for Dicot leaf section.	Experiment 6
11	To prepare permanent slides using the given sections like Stem, Root and Leaf.	Experiment 7
12	Isolation of plant cellular DNA	Experiment 8

IFTM University, Moradabad
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EBT401T ENZYMOLOGY

Objective(s): The objectives of this course:

- Provide the fundamentals of enzyme structure, functions, and kinetics of enzymes.
- Explain how enzymes are able to increase speed of a biochemical reaction in sense of thermodynamics, kinetics and molecular interactions.
- Current applications and future potential of enzymes.

UNIT I: **(8 Sessions)**

Introduction of Enzyme: Classification, EC-Number, Properties of Enzymes, Factors affecting the Enzyme activity, Isolation and Purification of Enzymes from plant, animal and Microbial Sources

UNIT II: **(8 Sessions)**

Mechanisms of Enzyme Action: Concept of active site and energetic of enzyme substrate complex formation; Kinetics of single substrate reactions; turnover number; estimation of Michaelis-Menton parameters. Importance of K_m, Multi-substrate reaction mechanisms and kinetics.

UNIT III: **(8 Sessions)**

Types of Inhibition: Competitive, un-competitive and non-competitive inhibition; kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes; Deactivation kinetics.

UNIT IV: **(8 Sessions)**

Enzyme Immobilization: Physical and Chemical techniques for enzyme Immobilization adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples; Advantages and disadvantages of different Immobilization techniques; Major applications of immobilized enzyme system.

UNIT V: **(8 Sessions)**

Enzyme Reactors- Stirred tank reactor, membrane reactor, continuous flow reactor (CSTR, PBR, FBR), advantages and

disadvantages; Application of enzyme reactors in industries (Pharmaceutical, textile and food).

Course Outcomes:

At the end of the course students will able to:
CO1: Gain knowledge about the structure, properties of enzymes, enzyme classification, and purification from various sources for skill development.
CO2: Understand proper mode of action of the enzyme and its kinetics model for skill development, employability and entrepreneurship development.
CO3: Analyze and apply mathematical derivations in enzyme inhibition reaction kinetics and inhibitions for skill development.
CO4: Learn the basic principles of various techniques for the immobilization of enzymes and their applications for skill development, employability and entrepreneurship development.
CO5: Understand the design of different enzyme reactors and their applications in various industries for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Suggested Readings:

1. Dixon and Webb. Enzymes: IRL Press.
2. Chaplin and Bucke. Enzyme technology Cambridge University Press.
3. Protein Biotechnology and Biochemistry, 2nd ed.- Walsh, Wiley Publications.
4. Alan Fersht: Structure and Mechanism in Protein Science, 2nd ed. W.H. Freeman & Co.
5. Nicolas Price & Lewis Stevens: Fundamentals of Enzymology, 2nd edition, Oxford Univ. Press, New York, NY.
6. Trevor Palmer: Understanding Enzymes, Second Edition, J. Wiley & Sons, New York.

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- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.masterclass.com

IFTM University, Moradabad
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EBT402T IMMUNOLOGY

Objective(s): The objectives of this course:

- Introduce the basic concepts of immunology.
- Describes about immune response, antigen types and blood groups.
- Understand techniques required for diagnosis of diseases like ELISA, RIA and Western blotting are described.
- Provides understanding about development and function of the immune system.

UNIT I: **(8 Sessions)**

Introduction to immunity: Characteristics of innate and adaptive immunity, Humoral and Cell mediated immune response, Hematopoiesis, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, T &B cell maturation, activation and differentiation, Inflammation.

UNIT II: **(8 Sessions)**

Antigens and Antibodies: Factors affecting the immunogenicity, Haptens and adjuvants, ABO blood group Types of antigens, Epitopes, Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins.

UNIT III: **(8 Sessions)**

Immune interaction: Structure and Function of MHC molecules, Antigen processing and presentation, Complement system, Structure, function and application of cytokines, regulation of immune response, immune tolerance.

UNIT IV: **(8 Sessions)**

Immunological techniques: Antigen and antibody interactions-Cross reactivity, precipitation reactions, Agglutination reactions; Serological techniques–ELISA, RIA and western blotting; Production and application of monoclonal antibodies, Vaccines.

UNIT V: **(8 Sessions)**

Immunity against diseases: Immunity against infectious diseases- Influenza, Tuberculosis, Malaria; Hyper-sensitivity; Autoimmunity; Cancer; AIDS; Transplantation immunology.

Course Outcomes:

At the end of the course students will able to:
CO1: Understand immunogenic response and differentiate between innate and adaptive immunity for skill development.
CO2: Know the concept of antigens and antibodies and their types for skill development and employability.
CO3: Understand the structure and function of MHC molecules, complement system, and cytokines for skill development.
CO4: Develop practical application of various Immunological techniques viz ELISA, RIA, and western blotting for disease diagnosis for skill development, employability and entrepreneurship development.
CO5: Understand the concept of autoimmunity, hypersensitivities and allergies for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	3	3
CO2	3	2	3
CO3	3	3	3
CO4	2	3	3
CO5	3	3	3

Suggested Readings:

1. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai: Basic Immunology (Function and Disorder of Immune System), 4th Edition; Elsevier Publisher.
2. W.L. Anderson: Immunology, Fence Creek Publishing (Blackwell).
3. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Kuby: Immunology, 6th Edition; Publisher: W H Freeman & Co.
4. P.J. Delves, S. J. Martine, D.R. Burton, I.M. Roitt: Immunology, 12th Edition. Wiley-Blackwell.

Website Sources:

- https://www.creative-diagnostics.com/blog/index.php/immunogen-antigen-hapten-epitope-and-adjuvant/
- https://www.redcrossblood.org/donate-blood/blood-types.html
- http://mcb.berkeley.edu/courses/mcb150/lecture5/Lecture5(6).pdf
- https://nptel.ac.in/courses/102/103/102103038/

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EBT403T MOLECULAR GENETICS

Objective(s): The objectives of this course:

- Understand the fundamental principles of genetics, storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems.
- Make students understand intricate molecular mechanisms of carcinogenesis and apoptosis and their applications.

UNIT I: **(8 Sessions)**

Fundamental principles of genetic: Mendelian genetics, Gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomal basis of heredity; Central Dogma.

UNIT II: **(8 Sessions)**

DNA as the genetic material: Structure and functions of DNA, thermodynamic stability of DNA; supercoiling; linking number; concept of gene, transposable elements.

UNIT III: **(8 Sessions)**

DNA replication: DNA replication in prokaryotes & Eukaryotes; Enzymes involved in DNA replication, DNA proof reading; DNA repair mechanism.

UNIT IV: **(8 Sessions)**

Transcription: Transcription in prokaryotic and eukaryotic; Post transcriptional modification processes (5' capping, poly-A tailing and splicing), open reading frames.

UNIT V: **(8 Sessions)**

Translation: Genetic Code; Wobble hypothesis, Translation in Prokaryotes and Eukaryotes; Regulation of gene expression in prokaryotes and Eukaryotes.

Course Outcomes:

At the end of the course students will able to:
CO1: Understand the fundamental principles of genetics and central dogma for skill development and employability.
CO2: Learn about the structure and function of DNA and its thermodynamic stability, the concept of the gene, and transposable elements for skill development, employability and entrepreneurship development.
CO3: Understand the DNA replication in prokaryotes and eukaryotes, enzymes involved, DNA proofreading and repair for skill development and employability.
CO4: Understand the transcription in prokaryotes and eukaryotes, post-transcriptional modifications, and ORF for skill development and employability.
CO5: Understand translation in eukaryotes and prokaryotes, genetic code, and regulation of gene expression for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	2
CO2	2	2	3
CO3	3	3	3
CO4	3	2	3
CO5	3	3	3

Suggested Readings:

1. Advance Genetics by G.S. Miglani, Narosa Publishing House.
2. S.B. Primrose, R.Twyman. Principles of Gene Manipulation and Genomics, VII Ed., Wiley-Blackwell, 2006.
3. D.L. Nelson, M.M. Cox. LehningerPrinciples of Biochemistry, V Ed., 2016.
4. M.R. Green, J. Sambrook. Molecular Cloning: A Laboratory Manual (Vol I/II/III), IV Ed., 2014.
5. J.D. Watson. A Passion for DNA: Genes, Genome &Society, Cold Spring Harbor Laboratory Press, 2000.
6. Strickberger M.W., Genetics, Third Edition. Macmillan Publishing, N.Y. London, 1985.
7. Lewin B., Genes VII, 7th edition, Oxford University Press; 2000.

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- https://nptel.ac.in/courses/102/105/102105064/
- https://www.khanacademy.org

IFTM University, Moradabad
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EBT404T DATA STRUCTURE USING C

Objective(s): The objectives of this course:

- Teach efficient storage mechanisms of data for an easy access.
- Improve the logical ability. To design and implementation of various basic and advanced data structures.
- Introduce various techniques for representation of the data in the real world.
- Develop applications using data structures.
- Teach the concept of protection and management of data.
- Teach various file management techniques.

UNIT I: **(8 Sessions)**

Introduction to Data Structure: Definition to Data Structure, Linear and Non-Linear Data Structure, Operations, Algorithm, Asymptotic notations, Space and Time Complexity of an algorithm, Time Space Trade off, Information and its storage representation, Representation and its manipulation of Strings. Array – Definition of Array, Single and Multidimensional Array, Representation of Array in memory, sparse matrices. Sorting and Searching- Bubble, Selection and Insertion sort, Linear and binary search.

UNIT II: **(8 Sessions)**

Linked List: Single Linked list, Array and Linked representation of Linked List, Two Way List, Operations on linked lists, Polynomial representation and addition using linked list.

UNIT III: **(8 Sessions)**

Stack and Queues: Stacks: Stack operations, Array and linked representation of stack, Application of Stack, Prefix and postfix expressions, Recursion, Tower of Hanoi problem. Queue operations, Circular queue, Priority queues, Array and linked representation of Queue, Dequeue.

UNIT IV: **(8 Sessions)**

Tree: Definition of Trees, Binary tree, Inorder, Preorder and Post order traversals of a Binary tree, extended binary tree, complete tree, Huffman Algorithm, Multi linked structure, Binary Search Tree, AVL Tree, B Trees. Hashing: Hashing functions, Collision resolution

techniques, Application of Hashing techniques.

UNIT V: **(8 Sessions)**

Graph: Graphs and their representation, spanning trees, dynamic storage management, Sorting: Selection sort, Bubble sort, Radix sort, Merge Sort, Quick Sort, Insertion Sort, Bucket Sort, Heap Sort, topological sorting, external sorting, internal sorting etc.

Course Outcomes:

At the end of the course students will able to:

CO1: Ability to select the data structures that efficiently model the information in a problem for skill development.
CO2: Able to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures for skill development.
CO3: Able to use linear data structures like stacks, queues for skill development.
CO4: Able to use non-linear data structures like tree and also know about Hashing technique for skill development and employability.
CO5: Able to know the application of graph and algorithms for sorting and pattern matching for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	2	2	3
CO3	3	3	3
CO4	3	2	3
CO5	3	3	3

Suggested Readings:

1. Seymour Lipschutz, “Data structures”, McGraw Hill International Edition.
2. Sartaj Sahni, Data structures, Algorithms and Applications in Java, McGraw Hill,
1. J.P.Tremblay and Paul G. Sorenson, “An introduction to data structures with applications”, TMH.
2. Robert Kruse C.L. Tondo and Bruce Leung, “Data Structures and Program Design in C”, Pearson Edu.
3. Tenenbaum A.M and Augenstein M.J, “Data Structures using C ", Prentice Hall.

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- onlinecourses.nptel.ac.in
- http://courses.cs.vt.edu/csonline/DataStructures/Lessons/
- https://www.geeksforgeeks.org/

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TPSD401: PROFESSIONAL SKILL DEVELOPMENT-II

Objective(s): The objectives of this course are:

- To develop knowledge and abilities to make correct use of the grammar in own writing English.
- To build vocabulary and to enhance the ability to correct the sentences.
- To enhance competencies in written and oral communication.
- To increase understanding and recall of what is read and listen including facts and importance of the main idea.
- To groom the overall personality of the students.

Unit I: **(05 Sessions) Communicative Skills**

Communication: Concept, Classification, Purpose, Process, Importance, Flow & Level of Communication, Barriers & Gateways in Communication, 7 C's of Communication, Types of Communication & communication without words

Unit II: **(07 Sessions)**

Intrapersonal Relationship Skills

Personality: Characteristics of Healthy & Sick Personality
Self-awareness
Self Esteem
Self Confidence
Assertiveness V/S Aggressiveness
Values: Types & Importance

Unit III: **(08 Sessions)**

Interpersonal Relationship Skills

Group: Concepts, Types, Stages
Team: Concepts, Elements, Types, Stages
Presentation Skills& strategies
Interview: Concepts, Types, Process, Interview Preparation Checklist, Interview Handling Skills, Common Interview mistakes

Unit IV: **(10 Sessions)**

Argumentative Skills

Debate
Role Play
Speeches
Elocution
Group Discussion

Unit V: **(08 Sessions)**

Campus to Company Skills

The corporate Fit: Dressing and Grooming
Basic Etiquette: Office (Do's and Don'ts for men and women), Telephone, Email
Dealing with People in Corporate

Course Outcomes:

The students completing this course will be able to:
CO1: Communicate effectively verbally and non-verbally for skill development and employability.
CO2: Develop and exhibit accurate sense of self and to demonstrate knowledge of personal belief and values for skill development and employability.
CO3: Work well with other people in teams or group formally and informally and to face interview with confidence for skill development and employability.
CO4: Learn to argue and argue to learn and to improve their reasoning/argumentative and presentation skills for skill development and employability.
CO5: Gain not just a positive impression but also respect in the workplace and to know how to cope up according to the organization culture for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	2
CO5	3	3	2

Suggested Readings:

1. M.K. Sehgal & V. Khetrapal's Business Communication published by Excel Books.
2. Rajendra Pal's Business Communication published by Sultan Chand & Sons Publication.
3. P. D. Chaturvedi's Business Communication published by Pearson Education, Delhi.
4. Elizabeth B. Hurlock's Personality Development by Tata McGraw Hills, Delhi.

Website Sources:

- www.fluenu.com
- www.skilluneed.com
- www.campus2-corporate.in
- www.thebalancecareers.com

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B.Tech. Biotechnology II Year (IV Semester)
(Effective from 2022-23)

EBT405T MODERN ANALYTICAL TECHNIQUES

Objective(s): The objectives of this course:

- Acquire basic concepts, principles, and techniques of modern analytical techniques that would empower students with an analytical mind set.
- Solve diverse analytical problems in an efficient and quantitative way that conveys the importance of accuracy and precision of the analytical results.

UNIT I: **(8 Sessions)**

Concept of Good Laboratory Practices: Good Laboratory Practices, Quality assurance and Quality Control, Steps of Analysis, Basic Aspects of Qualitative and quantitative Analysis; Accuracy and precision.

UNIT II: **(8 Sessions)**

Centrifugation: Theory and Principle of centrifugation, Sedimentation, Sedimentation rate, sedimentation coefficient. Use and design of different types of rotors, Types of centrifuges, Preparative and analytical centrifugation: Density gradient centrifugation (zonal and isopycnic), Differential centrifugation.

UNIT III: **(8 Sessions)**

Chromatography: Basic Theory- Plate and Rate Theory, Principle of Chromatography, Chromatographic performance parameters, High performance liquid chromatography, Adsorption chromatography, Partition chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Affinity chromatography, Reverse phase chromatography.

UNIT IV: **(8 Sessions)**

Electrophoresis: General Principle, SDS PAGE, Agarose electrophoresis of nucleic acid & 2D gel Electrophoresis, Pulsed gel electrophoresis, Capillary Electrophoresis, Microchip Electrophoresis.

UNIT V: **(8 Sessions)**

Microscopy & Spectroscopy: Simple and Compound microscope; Overview of Electromagnetic spectrum; Beer-Lambert's Law; Instrumentation, Principle, Working and application of- UV-Vis spectrophotometer, Colorimeter, IR Spectroscopy; Raman effect.

Course Outcomes:

At the end of the course students will able to:

CO1: Understand concept of good laboratory practices and learned the all constituents of GLP for skill development, employability and entrepreneurship development.

CO2: Understand the basic principle, instrumentation and rotors of different types of centrifuges for skill development, employability and entrepreneurship development.

CO3: Understand the principle, instrumentation and chromatographic performance parameters of different types of Chromatography for skill development and employability.

CO4: Describe various applications of different types of electrophoresis for skill development, employability and entrepreneurship development.

CO5: Describe the theory and practical use of simple and compound microscope and understand the principle of spectroscopy and Raman Effect for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	3
CO2	3	3	3
CO3	3	3	3
CO4	3	1	3
CO5	2	2	3

Suggested Readings:

1. Keith Wilson & John Walker Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press.
2. S. K. Sawhney, Randhir Singh., Introductory Practical Biochemistry, 2nd Edition.
3. Gurdeep R Chatwal Sham K Anand., Instrumental Methods of Chemical Analysis, Oscar publication.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology II Year (IV Semester)
(Effective from 2022-23)

EBT401P Enzymology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Introduction to Enzymology Laboratory.	Experiment 1
6.	Extraction of enzyme from plant source.	Experiment 2
7.	To determine the effect of temperature on the rate of enzyme action.	Experiment 3
8.	To determine the effect of pH on the rate of enzyme action.	Experiment 4
9.	To determine the effect of substrate concentration on the rate of enzyme action.	Experiment 5
10.	To determine the effect of enzyme concentration on the rate of enzyme action.	Experiment 6
11.	Extraction of pure amylase enzyme and its mode of action on substrate (starch).	Experiment 7
12.	Immobilization of amylase enzyme.	Experiment 8

IFTM University, Moradabad
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B.Tech. Biotechnology II Year (IV Semester)
(Effective from 2022-23)

EBT402P Immunology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To enumerate total number of RBC in human blood.	Experiment 1
6.	To enumerate total no. of WBC's in Human blood.	Experiment 2
7.	To identify blood group by simple slide agglutination.	Experiment 3
8.	To determine presence of specific antibodies present in serum by rapid slide test (WIDAL test)	Experiment 4
9.	To perform Sandwich ELISA (dot ELISA) for test antigen.	Experiment 5
10.	To perform precipitation reaction - Radial Immunodiffusion	Experiment 6
11.	To Perform precipitation reaction - Ouchterlony double diffusion.	Experiment 7
12.	To perform Counter current Immuno electrophoresis.	Experiment 8

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology II Year (IV Semester)
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EBT403P Molecular Genetics Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To study the properties of a buffer solution.	Experiment 1
6.	Isolation and purification of plasmid DNA.	Experiment 2
7.	To perform DNA electrophoresis.	Experiment 3
8.	To estimate the DNA Conc. by the Diphenylamine reaction (DPA)	Experiment 4
9.	To determine the Conc. of RNA from Orcinol method.	Experiment 5
10.	To amplify a specific DNA fragment by Polymerase Chain Reaction using random primers.	Experiment 6
11.	To learn the technique of Northern Blotting for the detection of a specific RNA fragment in a sample.	Experiment 7
12.	To learn the technique of Southern Blotting for the detection of a specific DNA fragment	Experiment 8

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS
EBT-501 Bioinformatics

Unit I: Introduction of Bioinformatics, Aim of Bioinformatics, Various branches of bioinformatics and applications to provide employability and skills.

Unit II: Biological databases in Bioinformatics for better skilling of entrepreneurship, Database retrieval systems, Sequence and molecular file formats, Sequence conversion tools.

Unit III: Sequence Alignment: Dot matrix analysis, skill based development of Dynamic programming algorithm (Needle-Wunsch algorithm and Smith Waterman algorithm), Heuristic methods (BLAST, FASTA).

Unit IV: Protein structure prediction: Protein characterization, Primary structure analysis and prediction, Secondary structure analysis and prediction, Protein modeling- methods, Homology modeling, Fold recognition, *Ab-initio* modeling for skill enhancement

Unit V: Protein classification and protein structure visualization: Protein structure database, Protein structure visualization databases and tools, Protein classification approaches.

Recommended Text Books/ Reference books

1. Baxevanis, Andreas D., and BF Francis Ouellette. Bioinformatics: a practical guide to the analysis of genes and proteins. Vol. 43. John Wiley & Sons, 2004.
2. Krane, Dan E. Fundamental concepts of bioinformatics. Pearson Education India, 2003.
3. Attwood, Teresa K., and David J. Parry-Smith. Introduction to bioinformatics. Prentice Hall, 2003.
4. Westhead, David R., J. Howard Parish, and Richard M. Twyman. "Instant Notes: Bioinformatics, The INSTANT NOTES Series." (2002).
5. Mallick, Bibekanand. Bioinformatics: principles and applications. Oxford University Press, 2008

Course Outcomes:

IFTM UNIVERSITY, MORADABAD
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At the end of the course students will be able to:
CO1: Understand the application of bioinformatics with the help of global databases and data retrieval systems for skill development.
CO2: Learn about skill-based development of computational methods to understand its features, function, structure, or evolution.
CO3: Understand methods of sequence alignment-based knowledge providing better entrepreneurship
CO4: Learn about parameters in protein structure prediction and protein modeling methods to provide employability and skills.
CO5: Learn about visualization and characterization of protein structures based knowledge providing better entrepreneurship.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	2	2	2
CO5	3	3	3

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS
EBT-502 Bioprocess Engineering-I

Unit I: Media in Fermentation- Chemically defined and complex media, media formulation-carbon source, nitrogen source, minerals, media optimization for biomass and product, inoculum preparation, development of inoculum for bacterial yeast, mycelia and fungi. Renewable energy sources-industrial and agricultural waste

Unit II: Sterilization: concept & methods. Skill based techniques used for Sterilization of medium. Kinetics of thermal death of microorganism. Batch sterilization, continuous sterilization. Sterilization of fermenter, Filter Sterilization of air and fermentation media theory of depth filters.

Unit III: Microbial growth kinetics: batch, fedbatch and continuous culture, kinetics of pellet formation, effect of temperature, pH, aeration and agitation on growth. Biomass and product yield, estimation of biomass, production kinetics in cell culture.

Unit IV: **Material and Energy Balance:** Steady state and equilibrium, law of conservation of mass, differential and integral balance, steady and unsteady state mass balance equation, material balance with recycle, bypass and purge system, stoichiometry of growth and product formation, basic concept of internal energy enthalpy and heat capacity, steady and unsteady state energy balance equation, thermodynamics of microbial growth.

Unit V: Bioreactors- Configuration and construction, material, stirred tank, bubble column, air-lift reactor, operating characteristics and application of packed-bed, fluidized bed and trickle-bed bioreactor, monitoring and control of bioreactor- feedback control, programmed control.

Recommended Text Books/ Reference books

1. Doran, Pauline M., and J. Francisco. Bioprocess engineering principles. No. TP248. 3. D6718 1998. 1998.
2. Shuler, Michael L., and Fikret Kargi. "Bioprocess Engineering: Basic Concepts, 2001.
3. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013.

Course Outcomes:

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

CO1: Do calculations in bioprocess engineering by a systematic approach with well-defined methods and rules to develop skill.
CO2: Analyze and apply different modes of mass transfer operations enhancing employability

CO3: Understand the Criteria for selection of bioreactors, design and functioning of various global types of reactors viz Batch, Fed-batch CSTR, Airlift, Fluidized bed and PFR for skilling of entrepreneurship
CO4: Understand the scale-up concepts for bioprocess and work on the scale-up process of the bioprocess plant/industry for development of skill and employability
CO5: Control of physical, chemical and biological environment of the bioreactor for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	1
CO2	2	3	1
CO3	2	3	3
CO4	3	3	3
CO5	3	3	3

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-503 Engineering Principle and Calculations

UNIT I: Applications of engineering principles in biotech industry to provide employability and skills, introduction to unit operations and unit processes, skill-based development of concept and application of transport phenomenon (momentum, mass and heat transfer), elementary and non-elementary reactions, reversible and irreversible reactions, Arrhenius law and activation energy, reaction rate.

UNIT II: Interpretation of batch reactor data: constant volume batch reactor (Differential and integral approach), varying volume batch reactor, temperature and reaction rate. batch mixed and plug flow reactor. Introduction to reactor design. Ideal reactors for single reaction, steady state mixed flow reactor, steady state plug flow reactor knowledge for better employability in industries

UNIT III: Design for single reactions: size comparison of single reactors, multiple- reactor system, equal size mixed flow reactor in series, recycle reactor. Autocatalytic reactions, optimum recycle operations. Temperature and pressure effect for single reaction, heats of reaction and temperature. Adiabatic operations and non adiabatic operations.

UNIT IV: Reactions catalyzed by solids: Introduction to heterogeneous reactions, solid catalyzed reactions: rate equation for surface kinetics, heat effects during reaction, pore diffusion resistance combined with surface kinetics, porous catalyst particles, heat effects during reaction and performance equation for reactors containing porous catalyst particle.

UNIT V: Biochemical reaction system: enzyme fermentation, Michaelis Menten kinetics, inhibition by a foreign substance(competitive and non competitive inhibition),Microbial fermentation, mixed flow fermenter and batch fermenter to provide employability product distribution and kinetic expressions.

Recommended Textbooks/References:

1. Levenspiel, Octave. "Chemical reaction engineering." Industrial & engineering chemistry research 38.11 (1999): 4140-4143.
2. Fogler, H. Scott. Essentials of chemical reaction engineering. Pearson Education, 2010.
3. Smith, Joseph Mauk. Chemical engineering kinetics. No. TP149 S58. 1981.

C**ourse Outcomes:**

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

CO1: Understand the basic concepts of Elementary/Non-elementary and reversible reactions in biological systems to provide employability and skills
CO2: Design the different modes of Bioreactors-Batch, Fed-batch, and Continuous operations.
CO3: Develop the concept for single and multiple reactor systems, adiabatic operation to provide national employability and skills
CO4: Understand the solid catalyzed reactions for skill development and employability.
CO5: Understand the biochemical reaction system, competitive and non-competitive enzyme inhibition for providing employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	1	1	2
CO2	3	1	2
CO3	3	3	1
CO4	3	2	3
CO5	1	2	1

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS
EBT-504 Genetic Engineering

Unit I: Gene cloning -concept and basic steps; application of bacteria and viruses in genetic engineering; providing skill development and employability Molecular biology of *E. Coli* and bacteriophages in the context of their use in genetic engineering, Cloning vectors: Plasmid cloning vector PBR322, Vectors for cloning large piece of DNA; –Bacteriophage-l and other phage vectors; Cosmids, Phagemids; YAC and BAC vectors, Model vectors for eukaryotes - Viruses,

Unit II: Restriction modification, enzymes used in recombinant DNA technology endonucleases, ligases and other enzymes useful in gene cloning, Use of Agrobacterium for genetic engineering in plants for better employability; Cloning of foreign genes: DNA delivery methods -physical methods and biological methods, Genetic transformation of prokaryotes: Transferring DNA into *E. coli* –Chemical induction and Electroporation,

Unit III: Gene library: Construction cDNA library and genomic library, Screening of gene libraries–screening by DNA hybridization, Marker genes: Selectable markers and Screenable markers, nonantibiotic markers, ; DNA sequencing techniques (Maxam Gilbert's chemical degradation methods and Sanger's dideoxy chain termination method), Molecular-Markers-types and Applications knowledge for the better employability in industry.

Unit IV: Gene expression in prokaryotes and eukaryote system: Recombinant protein production in yeast: *Saccharomyces cerevisiae* expression systems; Mammalian cell expression vectors: Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters; increasing protein production; Fusion proteins; Translation expression vectors;

Unit V: Origins of organism cloning in developmental biology research on frogs; nuclear transfer procedures and the cloning of sheep (Dolly) & other mammals; therapeutic vs. reproductive cloning; ethical issues and the prospects for skill development in human cloning; Two vector expression system; two-gene expression vector, Site-directed mutagenesis; transposon mutagenesis, Gene targeting, Site specific recombination

Recommended Text Books/ Reference books

1. Glover, David M., and B. David Hames. DNA cloning 3: a practical approach. IRL Press Ltd, 1995.
2. Maniatis, Tom, Edward F. Fritsch, and Joseph Sambrook. Molecular cloning: a laboratory manual. Vol. 545. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory, 1982.
3. Watson, James D. Recombinant Dna. Macmillan, 1992.
4. Friedberg, Errol C., et al., eds. DNA repair and mutagenesis. American Society for Microbiology Press, 2005.
5. Susan Elrod, William Stansfield "Schaum's Outline of Genetics, Fifth Edition"
6. Tamarin, Robert H. Principles of genetics. McGraw-Hill, 2015.

Course Outcomes:

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

CO1: Understand the concept of Gene cloning and vectors involved for local skill development.
CO2: Understand the enzymes involved in genetic engineering, PCR, and DNA delivery methods to provide employability.
CO3: Know the construction of local Gene Library, Screening, and Sequencing Techniques for skill based knowledge in industry.
CO4: Develop an understanding of Gene expression in prokaryotes and eukaryote systems.
CO5: Understand the prospects of cloning and related national ethical issues providing entrepreneurship.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	3
CO2	3	3	3
CO3	3	3	3
CO4	3	1	3
CO5	2	2	3

IFTM UNIVERSITY, MORADABAD
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SYLLABUS

EBT-504 I DATA BASE MANAGEMENT SYSTEM

UNIT I: Introduction to Databases and Transactions: What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management. knowledge for better employability in industry.

UNIT II: Data Models The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction. knowledge for better employability in industry and skill development

UNIT III: Database Design, ER-Diagram and Unified Modeling Language Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML. **Relational database model**: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF) knowledge for better employability in industry .and skill development

UNIT IV: Constraints, Views and SQL What is constraints, types of constrains, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.

UNIT V: Transaction management and Concurrency control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management knowledge for better employability in industry.

Recommended Text Books/References:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill , Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning
2. Raghurama Krishnan, Johannes Gehrke , Database Management Systems, 3rd edition, Tata McGraw Hill, New Delhi,India.
3. ElmasriNavate, Fundamentals of Database Systems, Pearson Education, India.

4. Abraham Silberschatz, Henry F. Korth, S. Sudarshan (2005), Database System Concepts, 5th edition, McGraw-Hill, New Delhi,India.
5. Peter Rob, Carlos Coronel (2009), Database Systems Design, Implementation and Management, 7thedition.

Course Outcomes:

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

CO1: Describe the databases and transactions, global purpose of database system, view of data, database architecture, transaction management. knowledge for better employability in industry

CO2: Explain the data models importance of data models, Basic building blocks, Business rules, evolution of data models, data abstraction for better employability and skill development

CO 3: Understand the methods of design Unified Modeling Language Database design, ER Model, its constraints, diagrams, issues, weak entity sets, Codd's rules, Relational Schemas knowledge for better employability and skill development

CO4: Understand the SQL, types of constrains, integrity constraints, data independence, security, updates on views, comparison between tables and views SQL for skill development

CO5: Learn about transaction management, properties, serializability, concurrency control, lock-based concurrency control, time stamping methods for better employability in industry and skill development

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	1

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SYLLABUS

EBT-504 II PROJECT MANAGEMENT

UNIT I: INTRODUCTION TO PROJECT MANAGEMENT AND PROJECT SELECTION: Objectives of Project Management- Importance of Project Management- Types of Projects Project Management Life Cycle- Project Selection – Feasibility study: Types of feasibility Steps in feasibility study. knowledge for better employability in industry

UNIT II: PROJECT PLANNING AND IMPLEMENTATION: Project Scope- Estimation of Project cost – Cost of Capital – Project Representation and Preliminary Manipulations - Basic Scheduling Concepts - Resource Levelling – Resource Allocation skill development and entrepreneurship development

UNIT III: PROJECT MONITORING AND CONTROL: Setting a base line- Project management Information System – Indices to monitor progress. Importance of Contracts in projects- Teamwork in Project Management - Attributes of a good project team – Formation of effective teams – stages of team formation. skill development and entrepreneurship development

UNIT IV: PROJECT CLOSURE: Project evaluation- Project Auditing – Phases of project Audit- Project closure reports Guidelines for closeout reports skill development

UNIT V: SPECIAL TOPICS IN PROJECT MANAGEMENT: Computers, e-markets and their role in Project management- Risk management Environmental Impact Assessment. Case studies in Project management. knowledge for better employability in industry

Recommended Text Books/Refrences :

1. Berkun, Scott (2005), The Art of Project Management, O'Reilly Media: Cambridge, MA
2. Campbell, Clark A. (2006), The One-Page Project Manager: Communicate and Manage Any Project With a Single Sheet of Paper, Wiley: New York
3. Cook, Curtis R. (2004), Just Enough Project Management, McGraw-Hill: Boston, MA

4. Crowe, Andy (2006), Alpha Project Managers: What the Top 2% Know that Everyone Else Does Not, Velociteach: Kennesaw, GA
5. Cunningham, Michael C. (2006), Finish what you Start: 10 Surefire Ways to Deliver your Projects On Time and On Budget, Kaplan Business: New York

Course Outcomes:

At the end of the course students will be able to:
CO1: Explain the importance of local and global Project Management- Types of Projects, Life Cycle, Project Selection, Types of feasibility Steps in feasibility study knowledge for better employability in industry
CO2: Understand Project Scope, estimation of Project cost, Project Representation and preliminary manipulation, scheduling Concepts for skill development and entrepreneurship development
CO3: Setting a base line, project management Information System, importance of Contracts in projects, teamwork, attributes of a good project team skill development and entrepreneurship development
CO4: Understand the Project evaluation, Project Auditing, project closure reports Guidelines for closeout reports skill development
CO5: Explain the Computers, e-markets and their role in Project management- Risk management Environmental Impact Assessment for better employability in industry.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

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(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	3
CO3	2	2	2
CO4	3	2	3
CO5	3	1	1

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SYLLABUS
EBT-504 III PATENT SEARCH AND ANALYSIS

UNIT I: Inventions and Patent Eligibility, Patentability criteria for inventions, Prior Art categories, Disclosure Norms, Patent Specification – Description and Claims knowledge for better employability in industry

UNIT II: How to read a patent document - Patent Anatomy, Introduction to Patent search, Fundamentals of Patent Search, Fields for Search -Keyword Search -Classification Search – IPC, CPC, USPC, F term –Combination knowledge for better employability in industry. And skill development

UNIT III: Public search databases IPO EPO USPTO Patent Scope, Subscribed databases search, Differences between public search and subscribed database search, knowledge for better employability in industry

UNIT IV: Types of Patent search: Patentability Search ,Validity Search, Patent Landscape Search, Clearance Search Advantages and Limitations of each type of search knowledge for better employability in industry

UNIT V: Analysis of Patent Search with illustration (examples from different technology areas), Patent landscape analysis, Value of Patent Search and analysis. knowledge for better employability in industry

Recommended Text Books/References:

1. Patent Search: Tools and Techniques- David Hunt
2. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
3. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

Course Outcomes:

At the end of the course students will be able to:
CO 1: Understand the local and national inventions and patent Eligibility, prior art categories, disclosure norms, patent specification for better employability in industry.
CO 2: Understand the patent anatomy, Patent search, Classification Search – IPC, CPC, USPC, F term –Combination knowledge for better employability in industry for skill development
CO 3: Explain the public search databases, Patent Scope, subscribed databases search, for better employability in industry.
CO 4: Describe the global types of Patent search, validity Search, patent landscape Search, clearance search advantages and limitations of each type of search knowledge for better employability in industry.
CO 5: Understand the Patent Search with illustration, patent landscape analysis, Value of Patent Search and analysis for better employability in industry.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

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(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	2
CO3	2	2	3
CO4	3	2	2
CO5	3	1	3

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SYLLABUS
EBT-504 IV STRESS MANAGEMENT

UNIT I: Introduction to Stress: (i) Meaning, Definition, Eustress, Distress, (ii) Types of stress: Acute stress, Episodic Acute stress and chronic stress, signs and Symptoms knowledge for better employability in industry. And skill development

UNIT II: Sources of stress: (i) Psychological, Social, Environmental (ii) Academic, Family and Work stress knowledge for better employability in industry

UNIT III: Impact of stress: (i) Physiological Impact of stress -Autonomic Nervous System Changes, Changes in Brain, General adaptive syndrome (GAD), Quality of sleep, Diet and Health effects . (ii) Psychological Impact of stress - Impaired Mental functions, Poor memory. (iii) Social Impact of stress - Stressful Life Events, Social support and health knowledge for better employability in industry

UNIT IV: Stress Response: 'Fight or Flight' Response, Stress warning signals knowledge for better employability in industry. And skill development

UNIT V: Stress and Coping: Coping Mechanisms: Appraisal focused, Emotional focused and Problem focused, Stress Reduction Techniques: 1. Autogenic Training 2. Biofeedback 3. Relaxation 4. Yoga and Meditation. Skill development

Recommended Text Books/Refrences:

1. Stress Management, Hina T Bhagtani, Himalyan Publishing House
2. Stress Management: by Prof. Raj Lakshmi Guha, IIT Kharagpur

Course Outcomes:

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

CO 1: Understand the stress, its meaning, Eustress, Distress, types of stress, acute stress and chronic stress, signs and symptoms for better employability in industry. And skill development.

CO 2: Explain the psychological, social, environmental stress, academic, family and work stress knowledge for better employability in industry

CO 3: Describe the physiological Impact of local stress, changes in Brain, Quality of sleep, Diet and Health effects, Psychological, Impact of stress, stressful Life Events, Social support and health knowledge for better employability.
CO 4: Explain the stress Response, 'Fight or Flight' Response, Stress warning signals knowledge for better employability in industry. And skill development
CO 5: Understand the Stress and Coping, appraisal focused, Emotional focused and Problem focused, Stress Reduction Techniques for Skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	3	1
CO2	2	3	2
CO3	2	1	3
CO4	2	2	2
CO5	3	2	3

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SYLLABUS
EBT-504 V Biotechnology for Human Welfare

Unit I: Environmental Biotechnology- Waste management – Solid, liquid, sewage, municipal waste Bioremediation. Bioleaching. Biodegradationfor effective development of employability skills.

Unit II: Biotechnology for disease diagnosis- Clinical diagnosis. Lab diagnosis – Microscopy, Macroscopy, Biochemical, serological & Molecular diagnosis of diseases – PCR, RT–PCR, RAPD, RFLP, Karyotping for development of employability skills

Unit III: Biotechnology for treatment & prevention of diseases.
Treatment – Symptomatic therapy, specific therapy, antimocrobials Prevention – Active immunization, passive immunization, combined immunization, herd immunity for skill development.

Unit IV: Food & Dairy Biotechnology- Microbes as food, feed. Prebiotics. Probiotics. Algae - SCP, Beta carotene, Fungi as food – Mushroom. Fermented food products to inculcate skills.

Unit V: Agricultural Biotechnology- Organic farming. Integrated farming, Vermicompost, Crop Improvement to acquire skills for the development of entrepreneurship and employability.

Recommended Text/ Reference Book:

1. D. Balasubramanian, C. F. A. Bryce, K. Dharmalingham, J. Green and K.Jayaraman.1996. Concepts in Biotechnology. Universities Press.
2. Ashok K. Chauhan. 2009. A Textbook of Molecular Biotechnology. I.K. International Publishing house Pvt. Ltd.
3. Chandrakant Kokate, SS Jalalpure, Pramod H.J. 2011. Textbook of Pharmaceutical Biotechnology. A division of Reed Elsevier India Pvt. Ltd.
4. B.C. Bhattacharyya and Rintu Banerjee. 2007. Environmental Biotechnology. Oxford Higher Education Publication.
5. Krishna B Ghimire. 2000. Social change and conservation. London Earthscan Publ.
6. P.J.Delves, I S.J.Artin, I D.R.Burton and I I.M.Roitt. 2006. Essential Immunotechnology. 12th Edition. Wiley & Blackwell.

Course Outcomes:
At the end of the course students will be able to:

CO1: Understand the local waste management, bioremediation. Bioleaching. Biodegradation for effective development of employability skills.
CO2: Explain the clinical diagnosis. Lab diagnosis, biochemical, serological & Molecular diagnosis of diseases, for development of employability skills.
CO3: Understand Symptomatic therapy, specific therapy, antimicrobials Prevention, immunization, herd immunity for skill development.
CO4: Understand the global microbes as food, feed. prebiotics. probiotics, Fungi as food, Fermented food products to inculcate skills
CO5: Understand the Organic farming. Integrated farming, Vermicompost, Crop Improvement to acquire skills for the development of entrepreneurship and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	1
CO2	2	1	2
CO3	2	1	2
CO4	1	2	3
CO5	1	3	1

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SYLLABUS
EBT504 VI Molecular & Structural Biophysics

UNITI: Introduction To Macromolecules- Introduction to quantum mechanics, the electronic structure of atom, Molecular orbits and covalent bonds, molecular interaction, Stereo chemistry and chirality, Molecular mechanics, Bond stretching, angle bending improper torsions, Van der waals interactions, hydrogen bond interactions, water models, force fields, all atoms force field and united atom force fieldfor skill development..

UNIT II: Principles Of Protein Structure And Confirmations- Basics problems of protein structure, Polypeptide chain geometrics, estimates of potential energy, results of potential energy calculations, hydrogen bonding, hydrophobic interactions and water as universal solvent in biological systems, Disruption of hydrophobic interactions by urea, ionic interactions, hydrophobic versus ionic interactions, Disulfide bond, Ways of pairing N-half cystine, formation of specific disulfide link, prediction of protein structure for skill development.

UNIT III: Protein Structure & Stability- Two state model of protein stability, chemical denaturation and stabilization, surface denaturation. Principles of ionization equilibrium ionization of side chain, equilibria in proteins. Predicting properties from amino acid composition, Primary structure sequencing of polypeptide, hemoglobin, homologies in proteins, Secondary structure alpha and beta confirmation, collagen structure, stability of alpha helix, Ramachandran plot for development of employability skills

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UNIT IV: Structure Of Nucleic acids- Introduction of nucleic acids, definition of terms for nucleic acids, old nomenclature, IUPAC-IUB nomenclature. Basis of Watson Cricks original model Different, base- pairing schemes Unsatisfactory nature of Hoogsteen and other base pairing schemes, biological implication of Watson Crick base pairing, single crystal X-ray diffraction, and NMR studies on mono- and oligonucleotides for effective development of employability skills..

UNIT V: Structural Analysis- X-ray crystallography, determination of molecular structures, X-ray fiber diffraction, electron microscopy, neutron scattering - light scattering, NMR spectroscopy to acquire skills for the development of entrepreneurship and employability.

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Recommended Text/ Reference Book:

1. Vasanthapattabhiraman and P. Gautham (2002) *Fundamentals of Biophysics* Narosa Publishing house
2. Charles Cantor &Paul R Schimmel. *Biophysical Chemistry (Parts I – III),*(1st Ed) W.H. Freeman & Co Ltd
3. LubertStryer (2002) *Biochemistry* (5th Ed) W. H. Freeman and Company

Course Outcomes:

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

CO1: Understand the quantum mechanics, molecular orbits and covalent bonds and all atoms force field for skill development.

CO2: Understand the global architecture of protein and hydrophobic interactions by urea, ionic interactions, hydrophobic versus ionic interactions and universal solvent in biological systems.

CO3: Understand the local protein Structure & Stability and properties from amino acid composition for skill development.

CO4: Understand the Structure of Nucleic acids and IUPAC-IUB nomenclature for effective development of employability skills.

CO5: Understand the Structural Analysis by using the different techniques to acquire skills for the development of entrepreneurship and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	2	2	2	2	2	2	2	2	2	2	2
CO2	2	3	3	3	3	2	2	3	2	2	3	2
CO3	3	2	3	3	2	2	2	2	3	3	2	3
CO4	2	3	3	3	3	3	3	2	2	3	3	2
CO5	3	3	2	2	2	3	2	2	3	2	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**2**	2
CO2	3	**3**	**2**
CO3	2	3	3
CO4	2	**2**	2
CO5	3	**2**	2

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SYLLABUS
EBT-505 Heat and Mass Transfer in Biological Systems

Unit I: Conduction & Convection-- Skill based development of Basic concepts, Mechanism of heat transfer: Conduction, Convection and Radiation, Fourier law of conduction, General differential equation of heat conduction: Cartesian and Cylindrical Coordinates, One dimensional steady state heat conduction, Critical and Optimum insulation thickness, Basic principles of convection, Empirical correlations for free and forced convection.

Unit II: **Radiation--** Introduction, Physical mechanism, Features and characteristics of radiation, Laws of Radiation: Stefan Boltzmann Law, Kirchhoff's Law, Radiation shape factors, Gas radiation, Black Body and Grey body concept, Solar radiations, Combined heat transfer coefficients.

Unit III: Mass Transfer-- Molecular diffusion in fluids, Diffusion coefficient, Fick's Law of diffusion,Molecular diffusion in Gases at steady state, Molecular diffusion in Liquids at steady state, Mass Transfer theories, Diffusion in solids: Molecular, Knudsen & surface diffusion, Inter- phase mass transfer: Diffusion between phases, Simultaneous heat and mass transfer.

Unit IV: Applications Of Heat Transfer-- Heat Exchangers-- Heat transfer equipments: Heat exchangers, Condensers, Boilers, Types of heat exchangers, Overall heat transfer coefficient, Fouling factors. Evaporation, Properties of evaporating liquid, Types of evaporators, Performance of evaporators: Capacity and Economy for providing better employability in industries.

Unit V: Applications Of Mass Transfer- Drying And Absorption- Drying: Solid-gas equilibria, Different modes of drying operation, Types of batch and continuous driers, providing employability Definitions of moisture contents, Rate of batch drying, Mechanism of batch drying. Absorption: Gas-Liquid equilibria. Henry's Law, Selection of solvents, Absorption in tray column, Absorption in packed column, HTU, NTU and HTEP concepts.

Recommended Text /Reference Books:

1. Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).
2. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
3. McCabe Smith: "Unit Operations in Chemical Engineering", McGraw Hill
4. Ashim K. Datta: "Biological and Bioenvironmental Heat and Mass Transfer", Marcel Dekker, Inc: New York, (2002).

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Course Outcomes:

At the end of the course students will able to:
CO1: Understand the basic laws of heat transfer for skill development.
CO2: Analyze problems involving steady state heat conduction in simple geometries for skill development and employability.
CO3: Understand the fundamentals of convective heat transfer process for skill development and employability.
CO4: Evaluate heat transfer coefficients for natural convection and forced convection inside ducts for skill development and employability.
CO5: Calculate radiation heat transfer between black body surfaces & heat exchange between gray body surfaces for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	1	3	3	3	1	2	3	1	1	3
2	2	3	1	3	3	3	3	2	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	2
5	3	3	3	1	3	3	3	3	2	3	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	1	3	3

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SYLLABUS
EBT 506 Plant Biotechnology

Unit I: Plant Tissue Culture: Cleaning, sterilization, sterile handling of tissue culture of Plant; Nutritional requirement for in vitro culture; Concept of cellular totipotency, single cell culture, micro propagation, somoclonal variation and its application for plant improvement; providing skill development Somatic embryogenesis; Anther and ovule culture; Haploid and double-haploid production.

Unit II: Protoplast Culture: Isolation, fusion and culture; Somatic hybridization; Selection system for hybrids; Cybrid production and their application in crop improvement; Gene banks based knowledge for better employability.

Unit III: Plant Cloning Vectors: Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors); Mechanism of DNA transfer; particle bombardment, Electroporation, microinjection, transformation of monocots and dicots; Role of virulence Genes; Genetic markers- Use of reporter genes, transgene stability and gene silencing; Herbicide, insect and salt resistance, Plant DNA fingerprinting -Hybridization and PCR based markers (RFLP, RAPD, AFLP etc.).

Unit IV: Transgenic plants: Commercial status and public acceptance; Biosafety guidelines for research involving GMO's, benefits and risks; Socio economic impact and ecological consideration of GMO's for skill development

Unit V: Biological nitrogen fixation and biofertilizers: Molecular mechanism of nitrogen fixation; Biopesticides; biological control of pests and disease; Plant cell culture for the production of useful secondary metabolism-pigments, perfumes , flavor, pharmacologically significant compounds, biodegradable plastics Commercial application of Plant Tissue Culture for entrepreneurship development

Recommended Text / Reference books

1. Hammond, John, Peter McGarvey, and Vidadi Yusibov, eds. Plant biotechnology: new products and applications. Vol. 240. Springer Science & Business Media, 2012.
2. Stewart Jr, C. Neal, ed. Plant biotechnology and genetics: principles, techniques and applications. John Wiley & Sons, 2012.
3. Bhojwani, Sant Saran, and Maharaj K. Razdan. Plant tissue culture: theory and practice. Vol. 5. Elsevier, 1986.
4. HS Chawla. Introduction to plant biotechnology. Science Publishers, 2002.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the concept of explants in plant tissue culture and its applications in local crop improvement for better skilling of entrepreneurship
CO2: Explore the methods and use of Protoplast culture for developing cybrids
CO3: Realize the mechanism of DNA transfer, screening of the recombinant by PCR based and genetic markers.
CO4: Understand the ethics and national government regulations that are there for the safe introduction of GMOs for providing better employability.
CO5: Understand the skill-based plant cell culture for the production of useful secondary metabolites pigments, perfumes, flavor, pharmacologically significant compounds.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	1	3	2
CO2	2	2	3
CO3	3	2	3
CO4	1	3	2
CO5	2	2	3

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SYLLABUS

EBT-506 I Macromolecular Structure & Analysis

Unit I: Carbohydrates: Structural aspects – Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, Constitution of Glucose & Fructose, Osazone formation, Pyranose & Furanose forms, Determination of ring size, Inter-conversion of monosaccharides for development of employability skills

Unit II: Proteins: Structural aspects – General introduction, Classification & General characteristics for skill development., Structure of Primary, Secondary, Tertiary & Quaternary proteins (elementary idea), alpha- & beta chains of proteins (elementary idea), Classification of Amino acids.

Unit III: **Nucleic acid**: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson - Crick Model), various forms of DNA to acquire skills for the development of entrepreneurship and employability.

Unit IV: Lipids: Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membrane, Membrane protein – structural aspects, Lipoproteins (elementary idea) for effective development of employability skills.

Unit V: Genes are DNA – DNA is the genetic material, DNA is a double helix, DNA replication is semi-conservative, mutations change the sequence of DNA, a gene codes for a single polypeptide, recombination occurs by physical exchange of DNA, genetic code is triplet.

Recommended Text/ Reference Book:

1. Physical Chemistry of Macromolecules. Basic Principles and Issues. S. F. Sun. 2004.
2. Macromolecules, Vol. Industrial Polymers and Syntheses. Hans-Georg Elias. 2006.
3. Macromolecules, Vol. Synthesis, Materials, and Technology. H.G. Elias.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the Classification of Reducing & Non-reducing Sugars, Glucose forms, determination of ring size, Inter-conversion of monosaccharides for development of employability skills
CO2: Explain the protein structure, characteristics for skill development., Structure of Primary, alpha- & beta chains of proteins, Classification of Amino acids for skill development
CO3: Understand Components of DNA and RNA, Nucleosides & Nucleotides, structure of DNA, various forms of DNA to acquire skills for the development of entrepreneurship and employability
CO4: Understand the lipids, its properties, biological membrane, Membrane protein – structural aspects, Lipoproteins for effective development of employability skills.
CO5: Understand the DNA replication, mutations, recombination, genetic code to acquire skills for the development of entrepreneurship and employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

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(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	**3**	**3**	3
CO2	**3**	**2**	**3**
CO3	**2**	2	2
CO4	**2**	**3**	2
CO5	**3**	**3**	2

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SYLLABUS
EBT-506 II CYTO-GENETIC TECHNIQUES

UNIT I: Architecture of chromosome in prokaryotes and eukaryotes; Terminology. Euchromatin and heterochromatin; karyotype and techniques for karyotyping; Banding patterns for identification of chromosomes; C value paradox-DNA content (genome size) and adaptability, Split gene; Special types of chromosomes -lamp brush chromosomes, polytene chromosomes, B-chromosomes and sex chromosomes. knowledge for better employability in industry

UNIT II: Recombination models and cytological basis of crossing over; Structural chromosomal aberrations, Deletions types of deletions, origin and occurrence. Meiosis and breeding behaviour of deletion heterozygote, genetics of deletions; Duplications-origin, types of duplications, chromosome pairing and crossing over at meiosis in duplicate heterozygotes, phenotypic effects of duplications; Bridge-breakage-fusion cycle in corn. .knowledge for better employability in industry and skill development

UNIT III: Role of duplications in plant breeding and evolution; lnversions: origin, types of inversions–meiotic pairing in inversions-detection and uses of pericentric and paracentric inversions; Breeding behaviour of inversion heterozygotes, Role of inversions in evolution and karyotype; Breeding behaviours of translocation heterozygote, Permanent hybrids in Oenothera, Robertsonian translocations, detection and uses; Numerical chromosomal aberrations: classification; Euploidy; Haploidy, Terminology and classification of haploids; Origin, occurrence and production of haploids Detection of haploids Phenotypic effects of haploids, Meiosis and Breeding behaviour of haploids. Use of haploids in plant breeding knowledge for better employability in industry and skill development

UNIT IV: Transfer of individual whole chromosome -alien addition lines-alien substitution lines; Apomixis-Evolutionary and genetic problems in crops with apomixis; Chromosome painting, chromosome walking and chromosome jumping; Artificial chromosome construction and its uses; Reversion of autopolyploids to diploids; Genome mapping in polyploids knowledge for better employability in industry and skill development

UNIT V: Fertilization barriers in crop plants at pre-and post -fertilization levels; In vitro techniques to overcome the fertilization barriers in crops; chromosome manipulations in wide hybridization; case studies-Production and use of haploids, dihaploids and doubled haploids in genetics and breeding knowledge for better employability in industry and skill development

Recommended Text Books/References:

1. Molecular Cytogenetics: Protocols and Applications by Yao-Shan Fan.
2. Medical Cytogenetics by Mark Hon Fong L.
3. Fundamentals of Cytogenetics and Genetics by Mahabal Ram

Course Outcomes:

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

CO1: Understand the basic concepts of karyotype, chromosome properties, C value paradox-DNA content, special types of chromosomes for knowledge for better employability in industry.

CO2: Describe the crossing over mechanism, different types of chromosomal aberrations, breeding behaviour of deletion heterozygote, for better employability in industry and skill development

CO3: Explain the abnormal chromosomal behaviour ,numerical chromosomal aberrations, haploids-its occurrence, properties, classification of haploids knowledge for better employability in industry and skill development

CO4: Understand the transfer of individual whole chromosome, apomixis, Chromosome painting, walking and chromosome jumping for skill development

CO5:Describe the fertilization barriers in plants, in vitro techniques to overcome fertilization barriers in crops; chromosome manipulations in wide hybridization for better employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

IFTM UNIVERSITY, MORADABAD
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	Skill Development	Employability	Entrepreneurship Development
CO1	2	2	1
CO2	2	1	2
CO3	2	1	2
CO4	1	2	1
CO5	1	3	3

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS

EBT-506 III Computational Biology

Unit I: Introduction to Genomics - information flow in biology, DNA sequence data, Experimental approach to genome sequence data, genome information resources for effective development of employability skills.

Unit II: Functional Proteomics - protein sequence and structural data, protein information resources and secondary data bases for development of employability skills

Unit III: Computational Genomics - Internet basics, biological data analysis and application, sequence data bases, NCBI model, file format to acquire skills for the development of entrepreneurship and employability.

Unit IV: Sequence alignment & data base search - Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm for effective development of employability skills., BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA. (10 Periods)

Unit V: Structural data bases - Small molecules data bases, protein information resources, protein data bank for skill development..

Recommended Text/ Reference Book:

1. Bioinformatics Algorithms: An Active Learning Approach (Vol. 1)By: Phillip CompeauEdition: 2nd Edition, August 2015
2. Computational Biology: Unix/Linux, Data Processing and ProgrammingBy: RobbeWunschiers
3. Computational Cell Biology By: Christopher Fall (Ed), Eric Marland (Ed), John Wagner (Ed), John Tyson (Ed) Edition: 1st edition, July 2002

Course Outcomes:
At the end of the course students will be able to:
CO1: Understand the information flow in biology, DNA sequence data, experimental approach to genome sequence data for effective development of employability skills.
CO2: Explain the protein sequence and structural data, protein information resources and secondary data bases for development of employability skills
CO3: Internet basics, biological data analysis and application, sequence data bases, NCBI model, file format to acquire skills for the development of entrepreneurship

CO4: sequence alignment, FASTA algorithm for effective development of employability skills., BLAST, multiple sequence alignment, DATA base searching
CO5: Small molecules data bases, protein information resources, protein data bank for skill development

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	1
CO2	2	1	1
CO3	2	1	2
CO4	1	2	3
CO5	1	3	3

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS
EBT-506 IV INTRODUCTION TO DBMS, COMPUTER NETWORK & NUMERICAL ANALYSIS

UNIT I: Introduction: Characteristics of database approach, data models, DBMS architecture and data independence knowledge for better employability in industry

UNIT II: E-R Modeling: Entity types, Entity set, attribute and key, relationships, relation types, roles and structural constraints, weak entities, enhanced E-R and object modeling, Sub classes; Super classes, inheritance, specialization and generalization. knowledge for better employability in industry and skill development

UNIT III: File Organization: Indexed sequential access files; implementation using B & B++ trees, hashing, hashing functions, collision resolution, extendible hashing, dynamic hashing approach implementation and performance. knowledge for better employability in industry and skill development

UNIT IV: Relational Data Model: Relational model concepts, relational constraints, relational alzebra SQL: SQL queries, programming using SQL. EER and ER to relational mapping: Data base design using EER to relational language. knowledge for better employability in industry and skill development

UNIT V: Data Normalization: Functional Dependencies, Normal form up to 3rd normal form. Concurrency Control: Transaction processing, locking techniques and associated, database recovery, security and authorization. Recovery Techniques, Database Security knowledge for better employability in industry and skill development

Recommended Text Books/References :

1. Bipin Desai, 'An Introduction to Database Management System', Galgotia publications 1991.
2. Jim Melton, Alan Simon, "Understanding the new SQL: A Complete guide", Morgan.
3. A.K.Majumdar, P.Bhattacharya, "Database Management System", TMH, 1996

Course Outcomes:

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

CO 1: Understand the Characteristics of database approach, and data models, architecture knowledge for better employability in industry.

CO2: Explain the local Entity types, Entity set, attribute and key, relationships, relation types, roles and structural constraints, weak entities, object modeling, Sub classes; Super classes, inheritance for skill development
CO3: Describe the File Organization methods, Indexed sequential access files, extendible hashing, dynamic hashing approach implementation and performance for knowledge for better employability in industry and skill development.
CO4: Understand SQL queries, programming using SQL, EER and ER to relational mapping knowledge for better employability in industry and skill development.
CO5: Understand the Data Normalization, Concurrency Control, locking techniques, recovery techniques, Database Security knowledge for better employability in industry and skill development

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	1	3
CO2	2	1	3
CO3	2	2	1
CO4	3	2	2
CO5	3	2	2

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B. Tech. Biotechnology

SYLLABUS

EBT-506 V Model Organisms in Genome Project

Unit I: Genome – about genomes of model organisms (*E. coli*, Yeast, *Arabidopsis thaliana, C. elegans, Drosophila melanogaster*, laboratory mouse, Zebra fish, Human), types of genomes, genomes & genetic variation, comparison of different genomes, genome evolution for effective development of employability skills.

Unit II: Genomics – about the genomics, history, comparative genomics, comparative genomic hybridization, functional genomics for development of employability skills

Unit III: Genome projects – an overview of genome projects of human and other model organisms of Human Genome Project to acquire skills for the development of entrepreneurship and employability.

Unit IV: Genome Mapping- physical mapping, genetic mapping, gene ontology, gene annotation. RFLP, microsatellite markers, STS, EST, DNA sequencing, DNA microarray for effective development of employability skills.

Unit V: Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, expected scientific & medical benefits of this project, about the organizations behind this project.

Recommended Text/ Reference Book:

2. Hartl and Jones (1998). Genetics – Principles and Analysis. Jones & Bartlett
3. Snustad et al (1998). Principles of Genetics. Wiley and sons
4. Strickberger (1985). Genetics. Mcmillan
5. Brooker (2012). Genetics – Analysis and Principles, 4th edition. Benjamin/Cumings

Course Outcomes:

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

CO1: Understand the local and global genomes of model organisms (E. coli, Yeast, Arabidopsis thaliana,C. elegans, Drosophila melanogaster, genetic variation, comparison of different genomes, genome evolution for effective development of employability skills

CO2: Understand the national history, comparative genomics, comparative genomic hybridization, functional genomics for development of employability skills.
CO3: Understand overview of genome projects of human and other model organisms of Human Genome Project for skill development.
CO4: Understand Genome Mapping, genetic mapping, gene ontology, gene annotation, microsatellite markers, sequencing, DNA microarray for skill development.
CO5: Understand the concept of an overview of the project, goals of the project, major scientific strategies & approaches used in HGP for employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	3
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-506 VI Advanced Mathematics for Biotechnology

UNIT I: Algebra- Partial fraction-Binomial, Exponential and Logarithmic Series (without proof of theorems)-problems on Summation and Approximation (simple problems) for skill development..

UNIT II: Matrices II- Determinant-Symmetric & Skew symmetric matrices-Unitary matrix-Characteristic equation-Eigen values and Eigen vectors of a real matrix- Cayley-Hamilton theorem (without proof) for skill development..

UNIT III: Sequence And Series- Basic definitions of Sequence and Series-Convergence & Divergence-Ratio test-Comparison test-Cauchy's root test -Raabe's test (simple problems) for development of employability skills

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UNIT IV: Ordinary Differential Equations- First order differential equations-Second and higher order linear differential equations with constant coefficients and with RHS of the form: e ax, xn, Sin ax, cos ax, eax f(x), xf(x) where f(x) is Sin bx or Cos bx-Differential equations with variable coefficients (Euler's form) (simple problems) for development of employability skills

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UNIT V: Functions Of Several Variables- Partial derivatives- Total differential- Differentiation of implicit functions-Taylor's expansion –Maxima and Minima by Lagrange's Method of undetermined multipliers-Jacobians plantibodies to acquire skills for the development of entrepreneurship and employability.

Recommended Text/ Reference Book:

1. Kreyszig E., (2011). *Advanced Engineering mathematics* (9th Ed.), John Wiley & Sons,
2. Grewal B.S. (2012)., *Higher Engineering Mathematics*, Khanna Publishers,
3. John Bird, (2010). *Basic Engineering Mathematics* (5th Ed.), Elsevier Ltd
4. Vittal P.R., (2010).*Vector analysis, Analytical solid geometry, sequences and series* (3rd Ed.), Margham publications,
5. Arumugam et.al., Engineering Mathematics vol.1(VTU),Scitech Publications.
6. P.Kandasamy, K. Thilagavathy and K. Gunavathy (2000).*Engineering Mathematics* Vol. I (4th Revised Ed.), S. Chand & Co., Publishers, New Delhi
7. John Bird (2006)., *Higher Engineering Mathematics* (5th Ed.), Elsevier Ltd.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the Binomial, Exponential and Logarithmic Series and Summation and Approximation (simple problems) for skill development.
CO2: Understand the Determinant-Symmetric & Skew symmetric matrices for skill development.
CO3: Understand the Basic definitions of Sequence and Series for development of employability skills.
CO4: Understand the Ordinary Differential Equations with variable coefficients (Euler's form) (simple problems) for development of employability skills.
CO5: Understand the Functions of Several local Variables and Maxima and Minima by Lagrange's Method to acquire skills for the development of entrepreneurship and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-601 Advanced Bioinformatics

Unit I: Overview of scoring matrices and gap penalties in sequence alignments, assessing the significance of sequence alignments, sequence alignments and evolutionary distance estimation by Bayesian statistical methods, skill based application of Bayesian statistics to sequence analysis.

Unit II: Machine learning approach: Basic learning model, skill based application of machine learning approach in bioinformatics. Iterative methods of multiple sequence alignment: Genetic algorithm, Hidden Markov Model, Statistical methods for aiding alignment, Support Vector Machine, Position- Specific Scoring Matrices.

Unit III: Phylogenetic Prediction: Relationship of Phylogenetic analysis to sequence alignment. Methods: Maximum parsimony method, Distance methods (Fitch- Margoliash method, Neighbor-joining method, Unweighted pair group method), Maximum likelihood approach, Reliability of Phylogenetic predictions.

Unit IV: DNA versus protein searches, Methods: FASTA, BLAST, psi- BLAST, phi- BLAST. Microarray Data Analysis, Significance Analysis of Microarrays, for better skilling of entrepreneurship, Self- Organization Maps.

Unit V: Introduction to drug discovery, Technology and Target discovery strategies, Target validation, Computer aided Drug Designing: Introduction, drug-design approaches, ADME- Tox property prediction for providing better employability.

Recommended Text Books/ Reference books

1. David W. Mount, Bioinformatics: sequence and genome analysis. Second ed., New York: Cold spring harbor laboratory press, 2001.
2. Jonathan Pevsner, Bioinformatics and Functional Genomics, Second ed., Wiley Blackwell, 2009.
3. Gibas and Jambeck, Developing Bioinformatics Computer skills, First ed., O'Reilly media, 2001.
4. Zhumur Ghosh and Mallick ,Bioinformatics: Principles and Applications, Oxford university press, 2008.
5. S.C. Rastogi, Bioinformatics: Genomics, Proteomics and drug discovery, Fourth ed., PHI publications, 2013.

Course Outcomes:

At the end of the course students will able to:

CO1: Understand the concept of scoring matrices and gap penalties in the local and global sequence alignment and will be able to assess the significance of sequence alignment for providing better employability
CO2: Conceptualize about machine-learning approach, iterative methods of multiple-sequence alignment and will learn about the statistical methods for aiding alignment to provide knowledge for better employability.
CO3: Learn about various global tools and methodologies used in the phylogenetic analysis in biological sequences for better skilling of entrepreneurship
CO4: Understand the various types of BLAST and FASTA and Microarray Technology knowledge for better employability
CO5: Gain knowledge about various steps of drug discovery, advanced techniques and tools like docking, QSAR providing skill development and employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-602 Animal Biotechnology

Unit I: History and scope of Animal cells and tissue culture, skill based advantages and limitations of tissue culture, physical requirements for tissue culture, substrates on which cell grow and treatment of substrate surfaces, culture media for animal cell culture, culture procedure-preparation and sterilization of apparatus, media, reagents and animal material.

Unit II: Primary culture and tissue disaggregation by enzymatic and mechanical methods, subculture- criteria for subculture, subculture of monolayer, subcultures of cells growing in suspension, Evolution of cell-lines, properties of finite and continuous cell-lines. Culture of Stem cells.

Unit III: Organotypic culture, Histotypic culture, organ culture- culture of chick embryo, embryonic and adult organ culture of mammalian embryos or ova, whole embryo culture, *In vitro* Fertilization and oocyte culture, Tissue engineering and regenerative medicine eg; artificial skin, cartridge embryo transfer methods in Humans for better understanding of entrepreneurial skill

Unit IV: Bioreactors: small scale culture system, types of bioreactors knowledge for better employability, homogenous bioreactors-stirred tank, Air-lift bioreactors, heterogeneous bioreactors-micro-carriers, hollow fiber bioreactors, membrane bioreactor and perfusion bioreactor

Unit V: Transgenic animals: Gene transfer to animals-chemical and physical transfection techniques, gene transfer using bacteria as vector, gene transfer using viruses as vector. Transgenic mice: methodology (DNA micro-injection, retroviruses and transfection of ES ells), transgenic cattle and sheep, . Applications of transgenic animals providing skill development and employability.

Recommended Text Books/ Reference books

1. R. Ian Whitney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth ed., Wiley Blackwell, 2010.
2. Michael Butler, Animal Cell Culture & Technology, Second ed., Taylor & Francis, 2003.
3. John M. Davis, Animal cell culture: Essential methods, First ed., Wiley publications, 2011.
4. R. Sasidhara, Animal Biotechnology, MJP Publishers, 2009.
5. U. Satyanarayana, Biotechnology, Books and Allied (P) Ltd, 2008

Course Outcomes:

At the end of the course students will able to:
CO1: Understand the national limitations and challenges faced by the animal industries and learn about the requirements of cell culture for better understanding of entrepreneurial skill
CO2: Understand the techniques and procedures involved in the development of cell culture, tissue culture, and organ culture providing skill development and employability
CO3: Understand the concept of sub culturing. Skill based study to Gain knowledge about the process of in-vitro fertilization and tissue engineering.
CO4: Learn about the use of various bioreactors in animal biotechnology for entrepreneurship.
CO5: Learn about different gene transfer methods used for the development of transgenic animals and the benefits of transgenic animals knowledge for better employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	3	2
CO2	2	3	2
CO3	3	3	2
CO4	2	3	2
CO5	2	3	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-603 Nanobiotechnology

Unit I: Definition, History of Nanotechnology, Context of Nanotechnology, Basic biology Principles and practice of micro fabrication techniques, Carbon Nanotubes, (SWCNTs, MWCNTs, DWCNTs), biological production of metal nanoparticles like silver, gold copper, macro molecular assemblies.

Unit II: Nanomedicine, Nanodrug delivery, Developing drug delivery tools through nano biotechnology, nano particle based immobilization assay, quantum dots technology and its application.

Unit III: Application in Biomedical and biological research providing employability, nano particles, viruses as nano-particles , nano chemicals and application. ,tumor targeting and other diagnostic applications.

Unit IV: Synthesis and characterization of different classes of biomedical polymers- SEM, TEM and STM , their uses in pharmaceutical, cardiovascular**,** ophthalmic and orthopedic areas developing employability

Unit V: Biosensors and nano biotechnology principles used in skill based construction of micro electronic devices, Sensors and macro mechanical structures. and their functioning, immuno-nanotechnology

Recommended Textbooks/References

1. Christof Niemeyer, Chad Mirkin, Nanobiotechnology- concepts, applications and perspectives, First ed., Wiley- VCH publishers, 2004.
2. Donald Martin, Nanobiotechnology of biomimetic membranes, Springer, 2007.

Course Outcomes:

At the end of the course students will able to:

CO1: Understand the principles of nanobiotechnology and basic fabrication techniques for the synthesis of nanoparticles for better skilling of entrepreneurship
CO2: Acquire the knowledge to incorporate nanotechnology for developing global drug delivery systems like aerosol, inhalants, injectables, etc. providing employability
CO3: Get familiarize with potentialities and concerns associated with nanomaterials usage fortargeting tumors and other diagnostics developing employability
CO4: Acquire the knowledge of synthesis and characterization of local skill based different classes of biopolymers and their applications in the field of health sciences.
CO5: Acquire the knowledge for designing diagnostic tools, biosensors, and microelectronic devices for various applications in health science developing employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	3
CO2	3	3	3
CO3	2	2	3
CO4	2	2	3

CO5	2	2	3

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-604 Fermentation Biotechnology

Unit I: History and development of fermentation industry providing employability, Range of fermentation processes component parts of a fermentation processes, Introduction to submerged and solid state fermentation. Primary and secondary metabolites.

Unit II: Raw material availability, quality processing and pretreatment of raw materials; Media for microbial fermentation: Carbon sources, Nitrogen sources, Inducers, Minerals, Antifoam.

Unit III: Isolation and preservation of industrially important microbes: Isolation using selection of desired characteristics and not utilizing selection of desired characteristics, skill based storage of industrially important microbes at reduced temperature and in dehydrates form

Unit IV: Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes: Induction, catabolite repression, Crabtree effect, feedback inhibition and feedback repression. Concept for over production of metabolites and Strain improvement: Isolation of different types of mutants for production of primary and secondary metabolites- Auxotrophic mutants, resistant mutants, revertant mutants, recombinant microorganisms.

Unit V: Large-scale production of industrially important products knowledge for better employability in industry Ethanol, Citric acid, Penicillin, Amino Acids, Biopolymers.

Recommended Text/Reference Books:

1. Cruger and A Cruger; A textbook of Industrial microbiology, Second ed., Sinaeur Associates, 1990.
2. Peter F. Stanbury, Allan Whitaker and Stephen J. Hal , Principles of Fermentation Technology, Second ed., Pergamon, 1995.
3. Y.H Hui et al., Handbook of Food and Beverages Fermentation Technology, First ed., CRC Press, 2004.
4. A.R. Allman, Mansi El- Mansi, C.F.A. Bryce, Arnold L. Demain, Fermentation Microbiology and Biotechnology, Third ed., CRC press, 2012.
5. Brain McNeil (Editor), Linda Harvey, Practical Fermentation Technology, Wiley-Blackwell, 2008.
6. Greed, Prescott and Dunn's, Industrial Microbiology, Fourth ed., CBS Publishers, 2004.

Course Outcomes:

At the end of the course students will able to:
CO1: Understand the history, role, and range of fermentation products providing employability
CO2: Know the raw materials for national industrial fermentation and the pretreatment process providing employability
CO3: Isolate and skill based method to preserve of the industrially important microbes.
CO4: Understand the metabolic pathways and their role in product formation for employment.
CO5: Develop the understanding of the global production of industrially important products knowledge for better employability in industry

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	2
CO5	3	1	2

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SYLLABUS

EBT-604 I Cell Culture Technologies

Unit I: Types of cell culture media for plants, animals and microbial cells; Ingredients of media; Physiochemical properties; Buffers; Oxygen; Osmolarity; Temperature; Balance salt solutions; Antibiotics, growth supplements; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media and other reagents knowledge to inculcate skills for employability and entrepreneurship.

Unit II: History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture; Behaviour of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number knowledge to inculcate skills for employability and entrepreneurship.

UNIT III: Development, Characterization and maintenance of cell lines, Cryopreservation; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell cultureknowledge to inculcate skills for employability.

Unit IV: Microbial Cell Isolation, Culture maintenance. Isolation of pure-colonies. Bacterial titre estimation. Growth curve. Culture characterization. Auxotroph culture isolation. Biochemical characterization. Antibiotic sensitivity. Bacterial recombination, replica plating techniqueknowledge to inculcate skills for employability.

Unit V: Preservation of microbial products. Production of antibiotics. Enumeration and screening of novel microbial secondary metabolites, strain improvement, Use of microbes in industrial waste treatment. Microbial leachingknowledge to inculcate skills for employability.

Recommended Text / Reference Books

1. Plant Tissue Culture by SATHYANARAYANA BN, IK Intl. Publishers
2. Plant Molecular biology by D. Grierson & S.N. Covey Blackie, London.
3. Animal Cell biotechnology by R.E. Spier and J.B. Griffiths, Academic press.
4. Living resources for Biotechnology, Animal cells by A. Doyle, R. Hay and B.E. Kirsop, Cambridge University Press.

5. Fermentation & Enzyme Technology by D.I.C. Wang et.al., Wiley Eastern.
6. Principle of Microbe & Cell Cultivation by SJ Prit, Blackwell Scientific co.
7. Animal cell culture Techniques by Ian Freshney, Wiley-Liss.
8. Animal Cell Culture – Practical Approach BY Ed. John R.W. Masters, 3rd Edition, Oxford University Press.
9. Animal Cell Culture Techniques BY Ed. Martin Clynes,. Springer
10. Plant Cell Culture: A Practical Approach by R.A. Dixon & Gonzales, IRL Press.
11. Experiments in Plant Tissue Culture by John H. Dodds&Lorin W. Robert

Course Outcomes:

At the end of the course student will be able to:

CO1: Understand the local types of culture media and learn about the requirements of cell culture for better understanding of entrepreneurial skill

CO2: Understand the techniques and procedures involved in the development of cell culture, tissue culture, and organ culture providing skill development and employability

CO3: Understand the concept of sub culturing. Skill based study to Gain knowledge about the process of Application of animal cell culture for in vitro testing of drugs.

CO4: Learn about Microbial Cell Isolation and Culture maintenance for entrepreneurship.

CO5: Learn about Preservation of microbial products. Production of antibiotics knowledge for better employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	3	2
CO3	3	3	2
CO4	2	3	2
CO5	2	3	2

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS

EBT-604 II Technologies for Clean and Renewable Energy Production

Unit I: Introduction and characterization of coal; conventional routes for energy production from coal**,** Cleaner routes for energy production from coal ***for skill development***.

Unit II: Cleaner routes for energy production form petroleum crude. Cleaner energy production from gaseous fuels ***for enhancing the technical skills.***

Unit III: Characterization of crude oil, conventional routes for crude oil utilization ***to increase the knowledge that will be helpful in better employability.***

Unit IV: Solar energy production, wind energy production, production of hydro and geothermal energy***for better employability.***

Unit V: Energy production from biomass and wastes and energy conservation***to improve skills for a successful entrepreneurship.***

Recommended Text/ Reference Book:

1. Miller Bruce G., Coal Energy Systems, Elsevier Academic Press, Paris 2005
2. Twidel, J. and Tony W., Renewable Energy Resources, Second Edition, Taylor & Francis 2006
3. Kreith F., Goswami D.Y., Energy Management and Conservation, CRC Press 2008
4. Sukhatme S., J Nayak J., Solar Energy: Principles of thermal Collection and Storage, 3 rd Ed., Tata McGrow-Hill Pulishing Company Ltd. 2008
5. Mondal P and Dalai A., Sustainable utilization of natural resources, CRC Press 2017

Course Outcomes:

At the end of the course students will be able to

CO 1: Understand the characterization of coal; conventional routes for energy production from coal, Cleaner routes for national energy production from coal for skill development. .

CO 2: Describe the cleaner routes for energy production form petroleum crude. Cleaner energy production from gaseous fuels for enhancing the technical skills.
CO 3: Understand the characterization of crude oil, conventional routes for crude oil utilization to increase the knowledge that will be helpful in better employability.
CO 4: Learn Solar energy production, wind energy production, production of hydro and geothermal energy for better employability.
CO 5: Understand the Energy production from biomass and wastes and energy conservation to improve skills for a successful entrepreneurship

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	1	1
CO2	2	1	1
CO3	2	2	1
CO4	3	2	2
CO5	3	2	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-604 III Polymers: concepts, properties, uses and sustainability

Unit I: polymers and their unique features. Polymers: Molecular structure, process, structure, property. Biopolymers. Molecular weight and distribution. Macromolecular nature. Renewable sources for polymers. Polymerization / depolymerization. Reuse and repurpose. Molecular conformations. Size, mobility and flexibility. Polyelectrolytes ***for skill development***.

Unit II: Polymeric systems of different kind. Liquid crystalline polymers. Copolymers. Blends, copolymers and composites. Microstructure in polymers. Composite. Additives for polymeric systems. Blends / composites in recycling. Physical / chemical crosslinking. Mechanical properties ***to inculcate the conceptual skills***.

Unit III: Viscoelasticity in polymers. Viscoelasticity: introduction, thermal response, characterization, simple models, dynamic mechanical analysis, damping Applications. Testing for applications. Properties of blends. Viscoelastic response: examples. Polymer packaging. Porous polymers / membranes. Polymer at interfaces. Diffusion in polymers ***to enhance the concepts helpful in better employability***.

Unit IV: Interaction of polymers with other materials / Polymers processing and recycling techniques. Compatibilizers. Biopolymer applications. Adhesives and Paints. Dissolution and recovery. Polymerization kinetics. Polymerization reactors. Polymer processing. Polymers processing and recycling techniques. Flow simulations. Processing for recycling. Recycle, up-down cycling. Flow behaviour – rheology. Crosslinking. Conversion of polymers ***for development of the skills***.

Unit V: Polymeric materials in nature: Microplastics, aerosols, sediments, biodegradation of polymers, biodegradable polymers ***for improvement of skills for entrepreneurship.***

Recommended Text/ Reference Book:

1. Polymer Science and Technology, JR Fried,Prentice Hall, 2014
2. Materials Science of Polymers for Engineers,TAOsswald and G Menges, Hanser, 2012
3. Introduction to Polymers, RJ Young and PALovell,

Course Outcomes:

At the end of the course students will be able to

CO1: describe the Biopolymers, macromolecular nature, renewable sources for polymers, polymer properties, molecular conformation, polyelectrolytes for skill development.

CO2: explain the microstructure in polymers, additives for polymeric systems, composites in recycling, chemical crosslinking, mechanical properties to inculcate the conceptual skills.

CO3: describe the visco elasticity, thermal response, simple models, dynamic mechanical analysis, damping applications, properties of blends for skill development

CO4: describe the compatibilizers. Biopolymer applications, adhesives, paints. polymerization kinetics, polymerization reactors, polymers processing techniques to enhance the concepts helpful in better employability.

CO5: define the microplastics, aerosols, sediments, biodegradation of polymers for improvement of skills for entrepreneurship.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	1	1
CO2	2	1	3
CO3	2	2	3
CO4	3	2	2
CO5	3	2	2

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SYLLABUS
EBT-604 IV Basic Environmental Engineering and Pollution Abatement

Unit I: Introduction; Ecology, environment and biodiversity; Ecosystem services and its risk; Pollution types and sources ; Impact/consequences of pollutants; Transmission of pollutants in environment ***for development of the skills***.

Unit II: Ambient air quality and standards; Water quality and standards; Industrial pollution and standards. Sampling and Characterization of gas/air/emission; Sampling and Characterization of water/waste water; Characterization of solid wastes and soil; Environmental law and regulatory framework ***to improve analytical skills***.

Unit III: Pollution prevention strategies and processes; Pollution prevention by using optimum water**.** Air pollution control ***for skill development***.

Unit IV: Treatment of surface and ground water for drinking water generation; Treatment of domestic and industrial waste water: Schemes; Primary treatment equipment; Secondary treatment equipment; Advances in secondary treatment process ***for better employability***.

Unit V: Industrial pollution control in GPI Solid waste management schemes; Solid waste transformation: incineration, gasification, Pyrolysis, Anaerobic digestion; Hazardous waste management; Management of special category wastes ***for developing the skills helpful in employability***.

Recommended Text/ Reference Book:

1. "Pollution Control Acts, Rules, Notification issued there under" CPCB, Ministry of Env. And Forest, G.O.I., 3rd Ed.(2006)
2. Vallero D., "Fundamentals of Air Pollution", 4th Ed. Academic Press.(2007)
3. Eckenfelder W. W., "Industrial water pollution Control", 2nd Ed., McGraw Hill.(1999)
4. Kreith F. and Tchobanoglous G., "handbook of Solid waste Management", 2nd Ed., McGraw Hill.(2002)
5. Pichtel J., "Waste Management Practices: Municipal, Hazardous and Industrial", CRC.(2005)
6. Tchobanoglous G., Burton F. L. and Stensel H.D., "Waste Water Engineering: Treatment and Reuse", 4th Ed., Tata McGraw Hill.(2003).

Course Outcomes:

At the end of the course students will be able to

CO1: Understand the ecology, environment and biodiversity, ecosystem services and its risk, pollution types, transmission of pollutants for development of the skills

CO2: Describe water quality, standards, industrial pollution, sampling and characterization of gas/air/emission, water/waste, environmental law and regulatory framework to improve analytical skills

CO3: Explain the pollution prevention strategies and processes, pollution prevention air pollution control for skill development.

CO4: Understand the treatment of domestic and industrial waste water, schemes, primary treatment equipment; Secondary treatment for better employability.

CO5: Describe the Solid waste management schemes, incineration, gasification, Pyrolysis, Anaerobic digestion, hazardous waste management for developing the skills helpful in employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	1	1
CO2	2	1	2
CO3	2	2	1
CO4	3	2	2
CO5	3	2	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EBT-604 V Mathematical modeling and simulation of chemical engineering process

Unit I: Introduction. Classification of different process types and modeling approaches. Constitutive relations in Fluid flow, Heat and mass transfer. Introduction to special functions: Bessel and Legendre polynomial. Mathematical background in solving PDEs. Separation of variables, Laplace and Fourier transform ***for skill development***.

Unit II: Numerical techniques in solving PDE – Method of lines, implicit and explicit methods. Numerical stability schemes.Perturbation methods, asymptotic analysis. Stability of dynamical systems ***for improving the analytical skills***.

Unit III: : modeling of Mass transfer based transport problems. Mass transfer with reaction problems. modeling enzymatic and cellular reaction process. Demonstration of COMSOL Multiphysics***for skill development***.

Unit IV: modeling and simulation of multistage multicomponent continuous distillation process. Multi-stage distillation process design – continued. Pinch analysis. Heat exchanger network design. Heat exchanger network continued. Aspen Plus demonstration ***for enhancing the conceptual skills***

Unit V: Dispersed phase modeling using population balance methods.Dispersed phase modeling – continued. Solution of population balance equations. Basics of Kinetic Monte Carlo simulation. Response surface methodology. Artificial Neural Network Design ***for better skilling required for employability.***

Recommended Text/ Reference Book:

1. Applied mathematical methods for chemical engineers – Norman W. Loney
2. Mathematical Modelling and Simulation in Chemical Engineering – M. Chidambaram
3. Mathematical Modeling: A Chemical Engineer's Perspective – Rutherford Aris
4. Mathematical Methods in Chemical Engineering – MorbidelliVarma, ArvindVarma, A. Varma, Massimo Morbidelli

Course Outcomes:

At the end of the course students will be able to
CO1: Understand the global classification of different process types, modeling approaches, fluid flow, heat and mass transfer, mathematical models, Laplace and Fourier transform for skill development.
CO2: Describe the different types of method of numerical techniques, implicit and explicit methods. Numerical stability schemes for improving the analytical skills
CO3: Explain the mass transfer based local transport problems, demonstration of COMSOL multiphysics for skill development.
CO4: Explain the Pinch analysis, heat exchanger network design, aspen plus demonstration for enhancing the conceptual skills
CO5: Understand the dispersed phase modeling using population balance methods. Basics of Kinetics, artificial neural network design for better skilling required for employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	1	1
CO2	2	2	2
CO3	2	2	3
CO4	2	2	3
CO5	3	3	2

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SYLLABUS
EBT-604 VI Bio Fuels

UNIT I: Biogas Technology-I- Biogas Technology -I Worldwide perspective of anaerobic digestion, Review of anaerobic digesters, Realistic potential of biogas plant installation, Problems encountered in the installed plants, Analysis of biogas systems, Optimizing the prospects of different designs of biogas plants, Engineering design of fixed dome type - continuous type plants - semi continuous plants, Microbiology of biogas production, Methods to enhance the biogas production, Performance of different types of gas holders for development of employability skills

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UNIT II: Biogas Technology-II - Biogas Technology-II Alternate constructions material for biogas plant construction, Various techniques for increasing gas production in cold region. Effect of heating , insulation and stirring on gas production, Design optimization for biogas production, Multi criteria optimization, Immobilization biogas plant system – principle, Application of immobilization, Modular biogas systems for tropical areas – principle, Prospects of modular biogas systems for development of employability skills

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UNIT III: Bio-Ethanol And Bio-Diesel Technology- Bio-Ethanol and Bio-Diesel Technology**:** Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for Leaded Petrol. - Trans- esterification of Oils to Produce Bio-Diesel for skill development.

UNIT IV: Green Technology – Microbial Fuel Cell- Green Technology – Microbial Fuel Cell**:** Types of Biological fuel cells – Working Principle - Applications of biological Fuel cells. A brief study of the principle, construction of different types of fuel cells. Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants to acquire skills for the development of entrepreneurship and employability.

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UNITV: Energy From Biomass – Introduction – Biomass conversion Technologies – Photosynthesis – Biogas generation – Factors affecting Biodigestion – Classification – Types – Construction Details – Methods of obtaining energy from Biomass – Pyrolysis – Alcohol fuels - Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems:Combustion of Woody Biomass: Theory, Calculations and Design of Equipments. Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration for skill development.

Recommended Text/ Reference Book:

1. G.D.Rai (2011), *Non-Conventional Energy Sources* , Khanna Publishers.
2. B.H.Khan,(2006*) Non-conventional Energy Sources* , The McGraw Hill Companies.

3. Halwagi,(1984) *Biogas Technology - Transfer and Diffusion.* MNES Publication.

Course Outcomes:

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

CO1: Understand the about biogas technology and problems encountered in the installation of plants and methods to enhance the national biogas production.

CO2: Understand the alternate constructions material for local biogas plant construction and factors affects the biogas production.

CO3: Understand the technologies to produce Bio-Ethanol and Bio-Diesel Technology for skill development.

CO4: Understand the principle, construction of different types of fuel to acquire skills for the development of entrepreneurship and employability.

CO5: Understand the Methods of obtaining energy from Biomass and Factors affecting Bio digestion.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	2	2	2	2	1	3	2	2	2	2	3	2
CO2	3	3	3	3	2	2	2	3	2	2	2	3
CO3	2	2	3	3	3	2	2	2	3	3	3	3
CO4	3	3	3	3	3	3	3	2	2	3	2	2
CO5	2	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	**2**	**2**	3
CO2	**2**	**3**	**2**
CO3	2	2	2
CO4	2	**3**	3
CO5	3	**3**	2

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SYLLABUS
EBT-605 Food Biotechnology

Unit I: History of microorganisms in food, role and significance of microorganisms in foods, food spoilage. Intrinsic and Extrinsic parameters of Foods that affect microbial growth. Basic principles, unit operations, and equipment involved in the commercially important food processing methods for skill development

Unit II: Microorganisms in fresh meats and poultry, processed meats, seafood's, fermented and fermented dairy products and miscellaneous food products. Starter cultures, cheeses, beer, wine and SCP production methods and significance of these food products. for development of knowledge for better employability, primary & secondary fermentation: B-glucan problem, getting rid of diacetyl and desugaring in Beer, wine and distilled spirits. GM foods.

Unit III: Nutritional boosts and flavor enhancers**:** Emerging processing and preservation technologies for milk and dairy products. Investigation of Food-borne disease outbreaks, Bioassay and related methods. Mycotoxins

Unit IV: Food Preservation, Food Preservation Using Irradiation, Characteristics of Radiations of interest in Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Application of Radiation, to provide employability and skill Radappertization, Radicidation, and Radurization of Foods. Legal Status of Food Irradiation, Effect of Irradiation on food constituents.

Unit V: Storage Stability Food Preservation with Low Temperatures, Food Preservation with High Temperatures, Preservation of Foods by Drying, for entrepreneurship and employability Indicator and Food-borne Pathogen Rheology of Food Production.

Recommended Text/Reference Books

1. H. Charley, Food Science, Second ed., John wiley and sons, 1982.
2. Anthony Pometto et al., Food Biotechnology, Second ed., CRC Press, 2005.
3. Sukumar De, Outlines of Dairy Technology, First ed., Oxford University Press, 2007.
4. M. Swaminathan, Food Science, Chemistry and Experimental Foods, Second ed, 1990.
5. Shakuntala Manay, Food Facts and Principles, New Age International, 2009.

Course Outcomes:

At the end of the course students will able to:

CO1: Learn about the role of microorganisms in food processing and global factors which effect microbial growth for skill development.
CO2: Learn about the production and spoilage of fermented animal products and beverages for skill development.
CO3: Understand the methods that are employed for the preservation of food for employability.
CO4: Know: the role of global microbes in relation to food borne diseases and case studies of food borne diseases outbreak in India to provide employability and skill
CO5: Acquire knowledge on the fundamentals of food science and nutrition, food chemistry and biochemical changes during processing and preservation, nutraceuticals for development of knowledge for better employability in industry.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	2
CO5	3	1	2

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SYLLABUS
EBT-605 I Chemical Reaction Engineering

Unit I: Overview of chemical reaction engineering, Classification of reactions, Variables affecting rate, Definition of reaction rate, single and multiple reactions, Elementary and non-elementary reactions, molecularity and order of reaction, extent of reactions, conversion, Selectivity, Reaction rate fundamentals - elementary reaction sequences, steady state approximation and rate limiting step theory***for skill development***.

Unit II: Kinetics: Constant volume and variable volume batch, CSTR and PFR reactor data, data collection & plotting, linearization of rate equations. Analysis of total pressure data obtained from a constant-volume batch reactor, Integral and differential methods of analysis of data, Autocatalytic reactions, Reversible reactions, and Bio-chemical reactions ***to develop the skills that are required for better employability***.

Unit III: Homogeneous Single Reactions: Performance equations for ideal batch, Plug flow, Backmix flow and semi batch reactors for isothermal condition, Size comparison of single reactors, Multiple-reactor systems, Recycle reactor, Optimum recycle operations ***for better employability in industry.***

Unit IV: Multiple Reactions: Parallel reactions of different orders, Yield and selectivity, Product distribution and design for single and multiple-reactors, Series reactions: first-order reactions and zero-order reactions, Mixed series parallel complex reactions ***for better skilling***.

Unit V: Temperature Effects for Single and Multiple Reactions: Thermal stability of reactors and optimal temperature progression for first order reversible reactions, Adiabatic and heat regulated reactions, Design of non-isothermal reactors, Effect of temperature on product distribution for series and parallel reactions ***for building the concepts required for better skill development.***

Recommended Text/ Reference Book:

1. Octave Levenspiel, Chemical Reaction Engineering, 3rd Edition, Wiley-India Pvt. Ltd.
2. H. Scott Fogler, Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall of India Pvt. Ltd

3. Froment, G.B., and K.B. Bischoff, 1990, Chemical Reactor Analysis and Design, 2nd Ed., Wiley, New York
4. Smith, J.M., 1981, Chemical Engineering Kinetics, 3rd Ed., McGraw-Hill, New York.
5. L. D. Schmidt, the Engineering of Chemical Reactions, Oxford Press. 6. Carberry, J.J., 1976, Chemical and Catalytic Reaction Engineering, McGraw-Hill, New York.

Course Outcomes:

At the end of the course students will be able to
CO 1: Understand the classification of reactions, Variables affecting rate, elementary and non-elementary reactions, molecularity for skill development
CO 2: Explain the analysis of total pressure data obtained from a constant-volume batch reactor, analysis of data, Autocatalytic reactions, for better employability.
CO 3: Describe the performance equations for ideal batch, Plug flow, Back mix flow and semi batch reactors for isothermal condition, Size comparison of single reactors, Multiple-reactor systems, Recycle reactor for better employability in industry..
CO 4: Understand the parallel reactions of different orders, yield and selectivity, product distribution and design, first-order reactions and zero-order reactions for better skilling.
CO 5: Understand adiabatic and heat regulated reactions, design of non-isothermal reactors for building the concepts required for better skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	3
CO3	2	2	2
CO4	2	2	3
CO5	3	3	2

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SYLLABUS
EBT-605 II Biological Inorganic Chemistry

Unit I: Introduction: Biological inorganic Chemistry**.** Basic biological Coordination Chemistry. Kinetic and spectroscopic characteristics of bioinorganic systems. examples of inorganic elements in biology ***for skill development***.

Unit II: Ion transport: membranes, energy, channels, pumps. Biomineralization. Nanoparticles, Inorganic structural elements in proteins, RNA & DNA. Lewis acid catalysis ***for conceptual skill development***.

Unit III: Oxygen transport – metal-oxygen coordination in proteins**,** Oxygen activation and processing by cytochromes, Small molecule activation and conversion by metalloenzymes – photosynthetic water splitting ***for improving the concepts required for better employability***.

Unit IV: Radicals and Bioorganometallic Chemistry – from RNA to DNA and from Vitamin B12 to methanogens and methanotrophs. Biological conversion and formation of hydrogen and nitrogen– hydrogenases and nitrogenases ***for better skilling of employability***.

Unit V: Metal pharmacology: uptake storage toxicity**,** Metals in medicine: anti cancer agents, diabetes, arthritis, radionuclides and related applications ***to inculcate skills*****.**

Recommended Text/ Reference Book:

1. Bioinorganic Chemistry by Wolfgang Kaim; Brigitte Schwederski
2. Biological Inorganic Chemistry by Joan Selverstone Valentine
3. Inorganic Biochemistry 2nd Ed by J. A. Cowan
4. Bioinorganic Chemistry by IvanoBertini; Harry Gray; Stephen J. Lippard; Joan Valentine
5. Principles of Bioinorganic Chemistry by Stephen J. Lippard; Jeremy Berg; Georg Klatt (Illustrator)

Course Outcomes:

At the end of the course students will be able to

CO1: Explain the biological inorganic chemistry, spectroscopic characteristics of bioinorganic systems, examples of inorganic elements in biology for skill development.

CO2: Understand the transport: mechanisms, energy, channels, pumps. biomineralization. nanoparticles, for conceptual skill development.

CO3: Describe the oxygen activation and processing by cytochromes, Small molecule activation and conversion by metalloenzymes for better employability.

CO4: Understand the Bioorganometallic Chemistry ,from RNA to DNA and from Vitamin B12 to methanogens and methanotrophs for employability

CO5: Explain the metal pharmacology, uptake storage toxicity, metals in medicine to inculcate skills.

Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	1
CO2	2	2	2
CO3	2	2	1
CO4	2	2	2
CO5	2	3	2

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology

SYLLABUS
EBT-605 III NMR spectroscopy for Structural Biology

Unit I: Basics Principles of NMR; Nuclear Spin in static magnetic field, chemical Shift; Factors Influencing Isotropic Chemical shifts ***for conceptual skill development.***

Unit II: NMR instrumentation and Peptide sample preparation; Overview of NMR instrument Magnet, transmitters etc. Two-dimensional NMR And Practical Aspects for experiment; Two- dimensional correlation experiments COSY. Peptide and Protein structure Structural features and parameters; Structural features and parameters ***for improving the analytical skills***.

Unit III: Sample preparation for Protein NMR; Expression systems, Optimization of protein expression. Multi-dimensional Heteronuclear NMR experiments; 2D Heteronuclear NMR experiments. Experiments for Backbone assignment ***for better employability.***

Unit IV: Protein Structure determination from NMR data; Structure calculation methods and NMR parameters. Protein dynamics from NMR data; Theory of spin relaxation in proteins ***to enhance the skills***.

Unit V: Nucleic acids NMR experiments; Structural features and parameters for Nucleic acids. DNA and structure determination from NMR data ***to increase the chances of better employability.***

Recommended Text/ Reference Book:

1. Structural Biology practical NMR applications by Quincy Teng
2. NMR of proteins and Nucleic acids by Kurt Wuthrich
3. NMR spectroscopy by John Cavanagh, Arthur G. Palmer, III, Nicholas J. Skelton, Wayne J. Fairbrother

Course Outcomes:

At the end of the course students will be able to

CO1: Explain the Nuclear Spin in static magnetic field, chemical Shift; Factors Influencing Isotropic Chemical shifts globally for conceptual skill development.

CO2: Understand the NMR instrument, magnet transmitters, two-dimensional NMR, practical aspects for experiment, protein structure for improving the analytical skills.
CO3: Describe the sample preparation for Protein NMR, Expression systems, optimization, multi-dimensional NMR experiments for skill development
CO4: Understand the Protein Structure determination from NMR data, calculation methods, NMR parameter, theory of spin relaxation in proteins to enhance the skills
CO5: Explain the Structural features and parameters for Nucleic acids. DNA and structure determination from NMR data to increase the chances of better employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	1
CO2	2	1	3
CO3	2	1	2
CO4	1	2	3
CO5	1	3	1

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SYLLABUS
EBT-605 IV Analytical Chemistry

Unit I: Inorganic Chemistry: Modern periodic law and present form of the periodic table.s, p, d and f block elements. Periodic trends in properties of elements atomic and ionic radii, ionization enthalpy. The position of hydrogen in periodic table, isotopes, preparation, properties, and uses of hydrogen. Physical and chemical properties of water and heavy water. Structure, preparation, reactions, and uses of hydrogen peroxide. Classification of hydrides: ionic, covalent and interstitial ***for skill development***.

Unit II: Organic Chemistry: Purification and Characterization of Organic Compounds, Basic Principles of Organic Chemistry, introduction and importance of biomolecules: Carbohydrates, vitamins, proteins ***for better understanding of the concepts to improve conceptual skills.***.

Unit III: **Physical Chemistry**: Matter and its nature, Dalton's atomic theory, the concept of the atom, molecule, element, and compound. Physical quantities and their measurements in Chemistry, precision, and accuracy, significant figures, S.I. Units, dimensional analysis. Laws of chemical combination. Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae. Chemical equations and stoichiometry ***for better analytical skills***.

Unit IV: Molecular Spectroscopy: The basis of absorption and emission of radiation by molecular species, Rotational spectroscopy, Photoelectron spectroscopy, Vibrational spectroscopy, Raman Spectroscopy, Electronic Spectroscopy, Emission Spectroscopy, Spectra in magnetic field ***for better employability***.

Unit V: Environmental Analytical Chemistry: Environmental pollution**:** Atmospheric, water, and soil. Gaseous pollutants**:** Oxides of carbon, nitrogen, and sulfur, hydrocarbons; their sources, harmful effects, and prevention. Greenhouse effect and Global warming, acid rain. Particulate pollutants**:** Smoke, dust, smog, fumes, mist; their sources, harmful effects, and prevention ***to inculcate the skills required for entrepreneurship and employability.***

Recommended Text/ Reference Book:

1. Donald M. West, F. James Holler, and Stanley R. Crouch. Fundamentals of Analytical Chemistry
2. David Harvey**.** Modern Analytical Chemistry

Course Outcomes:

At the end of the course students will be able to

CO1: Understand modern periodic law and present form of the periodic table, periodic trends in properties, classification elements for skill development.
CO2: Understand principles of Organic Chemistry, biomolecules, carbohydrates, vitamins, proteins for better understanding of the concepts to improve conceptual skills.
CO3: Understand matter, dalton's atomic theory, the concept of the atom, compound, atomic properties, empirical and molecular formulae, stoichiometry for analytical skills.
CO4: Understand the Photoelectron spectroscopy, Vibrational spectroscopy, Raman Spectroscopy, Electronic and emission Spectroscopy, Spectra in magnetic field for better employability
CO5: Understand the concept of Greenhouse effect and Global warming, acid rain. Particulate pollutant to inculcate the skills required for entrepreneurship and employability.

M Mapping Course Outcomes leading for the achievement of Programme Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	1
CO2	2	1	2
CO3	2	1	2
CO4	1	2	2
CO5	1	3	1

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SYLLABUS
EBT-605 V Organic Chemistry In Biology And Drug Development

Unit I: Introduction to Molecules of Life, Biological Macro molecules and Small molecules: Importance and functions. Introduction to Amino Acids separation and detection, Electrophoresis and Ninhydrin reaction, primary structure of polypeptide/protein ***for skill development***.

Unit II: Proteins as biological catalyst, Concept of inhibition. Nucleic acids: structure, functions, and their types ***for better understanding of the concepts to improve conceptual skills.***

Unit III: Metabolism, Synthetic biology. Nucleic acid. DNA sequencing method ***to enhance the technical skills***.

Unit IV: Principle of drug design, Modern day drug discovery, Chemistry of diseases and Drug development ***to improve skills that will be helpful in better employability.***

Unit V: Proton pump inhibitors. Gene replacement and delivery ***for better employability***.

Recommended Text/ Reference Book:

1. Biochemistry by Voet and Voet
2. Drug Design by R. Silverman
3. Medicinal Chemistry by G. L. Patrick

Course Outcomes:

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

CO1: Understand macromolecules, amino acids separation and detection, Electrophoresis and Ninhydrin reaction, primary structure of protein for skill development.

CO2: Describe proteins as biological catalyst, Nucleic acids: structure, functions, and their types for better understanding of the concepts to improve conceptual skills.

CO3: Understand synthetic biology, nucleic acid. DNA sequencing method to enhance the technical skills.

CO4: Understand concept of national drug design, Modern day drug discovery, Chemistry of diseases and Drug development to improve skills that will be helpful in better employability
CO5: Understand the Proton pump inhibitors. Gene replacement and delivery for better employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	1
CO2	2	1	2
CO3	2	1	2
CO4	1	2	3
CO5	1	3	1

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SYLLABUS
EBT-605 VI Hazardous Waste Management

UNIT I: Types And Sources -solid and hazardous wastes - Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes for skill development.

UNIT II: Waste Generation- Waste generation rates – Composition - Hazardous Characteristics – TCLP tests – waste sampling- Source reduction of wastes – Recycling and reuse for development of employability skills

UNIT III: Handling And Segregation- wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations - labeling and handling of hazardous wastes for skill development.

UNIT IV: Waste Processing - processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

UNITV: Disposal In Landfills- Disposal in landfills - site selection - design and operation of sanitary landfills- secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – landfill remediation. Elements of integrated waste management for development of employability skills

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Recommended Text/ Reference Book:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, (1993) *Integrated Solid Waste Management*, McGraw- Hill, New York.
2. CPHEEO, (2000) *Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization*, Government of India, New Delhi.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the local Types and Sources of hazardous wastes and biomedical wastes for skill development.

CO2: Understand the global Waste generation rates; waste sampling tests and reuse for development of employability skills.
CO3: Understand the labeling and handling of hazardous wastes for skill development.
CO4: Understand the national stabilization of hazardous wastes and treatment of biomedical wastes.
CO5: Understand the landfill remediation and elements of integrated waste management for development of employability skills.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	**3**	2	2
CO4	2	**3**	2
CO5	**3**	**3**	2

IFTM UNIVERSITY, MORADABAD
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SYLLABUS
EHU-601
Human Values and Professional Ethics

UNIT - I : Human Values :Morals, Values and Ethics - Integrity - Work Ethic - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality for skill enhancement.

UNIT - II: Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories for developing skills...

UNIT - III: Engineering as Social Experimentation : Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study for developing skills...

UNIT - IV: Safety, Responsibilities and Rights : Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) – discrimination for developing skills..

UNIT -V: Global Issues :Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership for skill enhancement..

Recommended Text and Reference Books

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York, 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)
4. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
6. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

Course Outcome:

At the end of the course students will able to:

CO1: It ensures students sustained happiness through identifying the essentials of global human values for skill development and employability.
CO2: It facilitates a correct understanding between profession and happiness resulting in the development of entrepreneurship skills.
CO3: It helps students in skill development and employability by understanding practically the importance of trust, mutually satisfying human behavior and enriching interaction with nature.
CO4: Provide ability to develop appropriate technologies for employability and management patterns to create national harmony in professional and personal life for skill development.
CO5: Understanding about the global issues for skill development and entrepreneurship.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	Skill Development	Employability	Entrepreneurship Development
1	3	2	2
2	3	3	3
3	3	2	2
4	3	2	2
5	3	2	2

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SYLLABUS
EBT-701 Downstream Processing

Unit I: An overview of Bioseparation. Role of Downstream Processing in Biotechnology, Range and Characteristics of biological products, Skill based solution of the Problems and requirement of biological product purification. Cost cutting strategies.

Unit II: Primary treatment and solid-liquid separation: Cell, Disruption methods (Physical, chemical and Enzymatic) used for intracellular products. Removal of insoluble: Sedimentation, Centrifugation principle, Common types of centrifuges used in bio separation (Tubular bowl, Multichamber bowl, Disc stack, Decanter or scroll type centrifuge), selection of centrifuge types, Filtration Theory,Batch and Continuous filtration, Flocculation.

Unit III: Concentration and Product Isolation – skill based development of Extraction: Liquid-Liquid Extraction principle and methods, Aqueous two phase extraction process, Adsorption and adsorption techniques, Enrichment operation: Membrane based separation techniques and classification Micro and Ultra filtration, Hyperfiltration Dialysis and Electrodialysis (Theory, Design and Configuration of the Equipment), precipitation methods using solvent and solute properties modification.

Unit IV: Product Purification: Electrophoresis- principle for product purification, Different Electrophoresis technique –Isoelectric, focusing, Chromatography principles and classification, chromatographic technique with special reference to Gel filtration, ion-exchange, Affinity, HPLC for entrepreneurship and employability

Unit V: Product Polishing: Crystallization theory and equipment, Drying principle and theory formulation, steps and methods used for the recovery of; Extracellular and intracellular enzymes, Citric acid, Glutamic acid, Penicillin G, Antibodies.

Recommended Textbooks/ References

1. Comprehensive biotechnology- Murray Moo-Young, Vol. II-latest ed., Pergan Publishers.
2. H. J. Rehm and G. Reed, Biotechnology- Vol. 3, 4, 5, Verlag Publishers
3. Stanbury & Whitteker, Principles Of Fermentation Technology, Pergamon Press
4. Wilson and Golding A Biologist's Guide to Principles & Techniques of Practical Biochemistry-, Cambridge University Press
5. Humphrey, Aiba & Miller, Biochemical Engg., Academic Press.
6. Biochemical Engg. -Bailly & Ollis, Academic Press.
7. , Heinemann ,Product Recovery in Bioprocess Technology, Butterworth Publication.
8. Westermeier Electrophoresis in Practice, - Wiley Publications.

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Course Outcomes:

At the end of the course students will be able to:
CO1: Implement the local cost-cutting strategies in downstream processing industries providing employability.
CO2: Understand various separation techniques involved in global downstream processing providing skill.
CO3: Apply the principles of major unit operations used in downstream processing for skill-based development of product isolation and concentration.
CO4: Understand various skill based development of techniques used in the purification of biological products.
CO5: Know about the recovery of various products through case studies providing employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	2	2	2
CO5	2	2	2

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SYLLABUS
EBT-702 Bioethics, Biosafety & IPR

Unit I: Biosafety and Bioethical issues in Biotechnology- Biosafety in laboratory institution; Biosafety guideline and regulation gaining knowledge for industrial approach, laboratory associated infections and other hazards, biosafety regulation: skill based handling of rDNA products and process in industry.

Unit II: Concept of property with respect to intellectual creativity. IPR understanding for entrepreneurship, IPP, Patent, Copy right, Trade secrets, TRIPs, Trade mark, Industrial design, geographical indication, Plant variety protection,

Unit III: WIPO, General agreement on tariffs and trades (GATT) for entrepreneurship and employability, TRIPS, UPOV, Biodiversity, Budapest treaty, WTO with references to biotechnological affairs, Plant breeder's rights, EPO.

Unit IV: Jurisprudential definition and concept of property, rights, duties and their correlation. Concept of property with respect to intellectual creativity. Tangible and Intangible property, History and evolution of IPR-like design and copyright.

Unit V: Distinction among various forms of IPR, Requirement of a patentable novelty, invention step and prior art and state of art, procedure for understanding entrepreneurial skill.

Recommended Text books/ References

1. Knight, Patent Strategy for Researches & Research ManegersWiley Publications.
2. V. Santaniello & R E Evenson , Agriculture & Intellectual & Property Rights, , UniversityPress.
3. Thomas, Biotechnology & Safety Assessment, Ane/Rout Publishers.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the national ethical issues in biotechnological products and NGO for bioethics for skill development and employability.
CO2: Recognize the importance of global GLP, levels of biosafety, and biosafety guidelines in India to develop skill.

CO3: Identify local types of Intellectual Properties (IPs), the right of ownership as well as the scope of protection. Outline the process of patenting and development enhancing employability

CO4: Identify the role of different organizations related to IP for skill development and employability.

CO5: Identify activities and constitute IP infringements and the remedies available for the IP owner to prevent infringement of proprietary rights to develop skill.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	3
CO2	2	2	3
CO3	3	3	3
CO4	2	2	3
CO5	2	2	3

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SYLLABUS
EBT-031 Vaccine Technology & Immunoinformatics

Unit –I: Vaccines: Introduction to immunity, Fundamental concepts in vaccination and traditional methods of vaccine production (production of DPT and Rabies vaccine), skill based production of Modern Vaccines (production of Hepatitis vaccine).

Unit –II: Immunological Tools: skill based Production of Monoclonal antibodies, Immunocytochemistry, Immunoprecipitation and Immunoblotting; Applications of immunological methods in disease diagnosism developing knowledge of entrepreneurship.

Unit – III: Reverse vaccinology and Immunoinformatics. Skill based development of Databases in Immunology; SVMHC, ProPred, MHCPred, KEGG

Unit – IV: B-cell epitope prediction methods**,** T-cell epitope prediction methods**,** Resources to study antibodies, antigen-antibody interactions.

Unit –V: Structure Activity Relationship – QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronics; Topological; Quantum Chemical based Descriptors. Skill based Use of Genetic Algorithms, Neural Networks and Principle Components Analysis in the QSAR equations providing entrepreneurship and employability.

Recommended Text books/ References

1. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai, Basic Immunology (Function and Disorder of Immune System), 4th Edition; Elsevier Publisher.
2. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
3. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Kuby Immunology, 6th Edition; Publisher: W H Freeman & Co (
4. Roitt's Immunology, P.J. Delves, S. J. Martine, D.R. Burton, I.M. Roitt, 12th Edition. Wiley-Blackwell-
5. Darren R Flower Immunoinformatics: Predicting Immunogenicity in Silico Publisher: Humana Press
6. Shoba Ranganathan, Vladimir Brusic,Christian Schonbach. Immunoinformatics (Immunomics Reviews:). Publisher: Springer.

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Course Outcomes:

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

CO1: Understand the importance of global vaccines and vaccination in body defense mechanism for skill development and employability

CO2: Demonstrate the immunological techniques used for disease diagnosis and apply the knowledge of immune-associated mechanisms in medical biotechnology research for skill development and employability

CO3: Summarize the various databases used in Immunology like BIMAS, SVMHC, ProPred, MHCPred, KEGG in order to facilitate employability and entrepreneurship skills

CO4: Predict epitopes and will be able to use prediction tools like EpiDOCK, MotifScan, MAPPP, and EPISOPT.

CO5: Understand the development of predictive and robust QSAR, with a specified chemical domain, for the prediction of the activity of untested molecules for the development of skill and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	2
CO5	3	3	2

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SYLLABUS
EBT-032 Biofuels & Alcohol Technology

Unit –I: Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different microbial strains used in alcohol industries providing employability.

Unit II: Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol providing knowledge for better skilling of entrepreneurship.

Unit-III: Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, skill based development of Modem techniques of alcoholic fermentation, Bio still fermentation. Use of cellulosic feed stocks for alcohol production, Scaling in distilleries.

Unit IV: Alcohol distillation: attaining skill based knowledge of the Fundamental parameters affecting alcoholic fermentations, By products of alcoholic fermentation, Distillery quality control, Alcoholometry.

Unit V: Description of Biofuels: Biofuel production and uses. Biofuel feed stocks; Biomass conversion to heat and power-thermal gasification of biomass, anaerobic digestion, Biomass conversion to biofuel-thermochemical conversion, syngas fermentation, Detailed processing for production of bioethanol, biodiesel, biomethane and microbial fuel cell (MFC) providing employability and entrepreneurship development.

Recommended Textbooks/ References

1. Olaf Andreas Hougen, Kenneth M. Watson, Roland A. Ragatz.Chemical Process Principles: Material and energy balances
2. Wiley, 1954 KA Jacques, T P Lyons and DR Kelsall.The alcohol textbook, 4th edition, A reference for the beverage, fuel and industrial alcohol industries, Nottingham University Press
3. Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990
4. Out lines of Chemical Technology by Chmles E.
5. Shieve Chemical Process Industries, 4th Ed., Mc.Graw publication.

Course Outcomes:

At the end of the course student will be able to

CO1: Understand the requirement for an alcohol industry and study about different global microbial strains used in alcohol industries for developing skills.
CO2: Explain the different recycling process and biochemistry of alcohol production to enhance skills.
CO3: Understand different alcoholic fermentation techniques and modern development in this field.
CO4: Have skill based knowledge of the fundamental parameters affecting alcoholic fermentations.
CO5: Understand processing for production of bioethanol, biodiesel, biomethane and microbial fuel cell (MFC) providing employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	3
CO2	2	2	3
CO3	3	3	3
CO4	2	2	3
CO5	2	2	3

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SYLLABUS
EBT-033 Cellular Biophysics

Unit I: General organization of cells: Discovery of Cell, Shape & Size of cell, General organization of prokaryotic and eukaryotic organisms' basic concepts and their detailed structure functions, Prokaryotic cell Wall, Eukaryotic cell wall, functions of cell wall, Physical & Biological properties of cytoplasm for skill enhancement.

Unit II: Cell Differentiation: Cellular differentiation; localization of cytoplasm determinants in egg. Nucleocytoplasmic interaction and cell function, Development of extra cellular matrix, mechanism of alpha adrenergic and related response, modulation of extra cellular matrix by tumor cell- Fibroblast interactions, growth factors in cultured cell-early cytoplasm singles and Cytoskeleton responses for better employability skills.

Unit III: Cell growth and Division: Kinetics of cell growth, Role of protein kinase in cell growth, cell cycle, cell cycle events: G S G2, Cell division, cytokines, control of cell cycle, Role of protein kinase c in cell growth, dividing and non-dividing cell, synchronization of cell growth, cell transformation, malignant tumor growth, Apoptosis for effective development of employability skills.

Unit IV: Cell-Cell Communication: Strategies of chemical signalling: Endocrine, paracrine and synaptic. Signalling mediated by intracellular receptors: Mechanisms of transduction by cell surface receptor protein, role of calmodulin, Ca and cyclic nucleotides, phosphoinisitol cycle, sodium proton exchanger, molecular events involved in during sperm-egg interaction, implications and the mechanisms of spermzone interaction, Role of soluble factors produced by follicle somatic cell on gamete interactions. Factors influencing sperm egg recognition and binding to acquire knowledge for better employability skills.

Unit V : Techniques in Biophysics : Principle, instruments and application of spectroscopic instruments, Principle, instrumentation and application of Microscopy, electrophoresis, electrophoretic mobility (EPM), factors affecting EPM, Paper, PAGE, Ultracentrifugation and their applications in molecular weight, size determination to enhance skills for entrepreneurship development and employability

Recommended Text/ Reference Book:

1. Molecular Biology of the Cell, Bruce Albert, Alexander Jhonson et al (2002), Taylor & Francis Group.
2. The Cell Molecular Approach, G Cooper & R Hausman (2007) ASM Press
3. Molecular Biology , D Roberties, 8th Ed. SAE
4. Molecular Cell Biology, Lodish
5. Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge

Course Outcomes:

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

CO1: To learn about cell and its structure, difference between eukaryotic and prokaryotic cells and functions of cells.

CO2: Understand the **C**ellular differentiation, Nucleocytoplasmic interaction and cell function to enhance skill development

CO3: Understand the Kinetics of cell growth, Role of protein in growth and various cell cycles for effective development of employability skills

CO4: Cell-cell communication, Sodium-Potassium pump, and role of various factors in effective cell communication.

CO5: Principle, instrumentation and application of Microscopy, electrophoresis, electrophoretic mobility (EPM) and various Techniques in Biophysics. to enhance skills for entrepreneurship development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

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SYLLABUS
EBT-034 Plant Cell Bioprocessing

Unit I: Introduction- History of plant tissue culture research - Basic principles of plant tissue - callus culture, Meristem culture, Organ culture, Totipotency of cells, differentiation, dedifferentiation and redifferentiation for skill enhancement.

Unit II: Methodology - Sterilization (physical and chemical methods), Plant cell culture methods, Culture, media, MS and B5, Phytohormones, Medium for micro-propagation, Callus induction, Callus subculture maintenance, Metabolic patterns in callus culture, Harvesting and measurements, Morphogenesis in callus culture - Bioreactors for effective development of employability skills.

Unit III: Plant Genetic Engineering for Productivity and Performance (Biotic & Abiotic Stress): Gene transformation technology- Agrobacterium mediated gene transfer; Agrobacterium based vectors, viral vectors and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment Herbicide resistance, Insect resistance, Disease resistance, virus resistance, Abiotic stress tolerance ;Drought, temperature, salt tolerance to enhance knowledge for development of employability skills

Unit IV: **Secondary metabolites**: Production of secondary metabolites from plants , principles and mechanisms of Processes for enhancing the production of secondary metabolites. Technology of plant cell culture for production of chemicals for skill development.

Unit V: Industrial products: Bioreactors systems and models for mass cultivation of plant cells. Applications of Plant biotechnology principles for the production of quality oil, Industrial enzymes, Antigens (edible vaccine) and plantibodies to acquire skills for the development of entrepreneurship and employability.

Recommended Text/ Reference Book:

1. Karl-Hermann Neumann (2009) Plant cell/tissue culture-A tool in Biotechnology: Basics and Application. Springer-Verlag Berlin.mISBN:978-540-93883-5
2. S. Dutta Gupta (2008) Plant Tissue Culture Engineering. Springer.ISBN:978-1-4020-3594-4
3. J.J. Zhong (2001) Plant cells. Springer. ISBN: 978-3-540-41849-8
4. Plant Cell, Tissue and Organ Culture. Eds., O.L. Gamborg, G.C. Phillips. Springer-VerlagBerlin.

5. Plant Tissue Culture: Theory and Practice. Eds., Bhojawani S.S. and Razdan M.K., Panima Publishing Corporation, New Delhi.
6. Plant Biotechnology, Ed. K.G. Ramawat, S. Chand and Company Ltd., New Delhi.
7. Medicinal Plant Biotechnology, Ed. Ciddi Veeresham, CBC Publishers and Distributors, New Delhi

Course Outcomes:

At the end of the course students will be able to:
CO1: To know History of plant tissue culture research - Basic principles of plant tissue - callus culture, Meristem culture etc for skill enhancement
CO2: Will learn Sterilization (physical and chemical methods), Plant cell culture method Morphogenesis in callus culture - Bioreactors for effective development of employability skills.
CO3: Will learn various global and local Gene transformation technology for development of employability skills
CO4: Understand Production of secondary metabolites from plants , principles and mechanisms of Processes for enhancing the production of secondary metabolites
CO5: Will learn Bioreactors systems and models for mass cultivation of plant cells and their applications.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	2	3	2	2	1	3	2	2	3	1	3	3
CO2	2	2	2	3	2	2	2	3	2	2	2	3
CO3	2	2	2	3	3	3	3	2	1	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	3	3
CO5	3	2	2	3	2	3	3	2	3	2	3	2

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	3
CO2	2	3	3
CO3	2	2	3
CO4	3	2	3
CO5	3	3	3

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SYLLABUS

EBT-035 Introduction to Developmental Biology

Unit I: Introduction: History of developmental biology. Techniques in developmental biology and model organism for skill development.

Unit II: Gametogenesis and Fertilization: Spermatogenesis in mammals, structure of sperm, regulation of sperm locomotion. Types of eggs, oogenesis in amphibians and mammals, Cellular and Biochemical process during fertilization and strategies for monospermy and conservation of species specificity. Acrosome reaction and signal transduction. Egg activation to acquire knowledge for better employability skills.

Unit III: Cleavage: Types of cleavage and blastulation in sea urchin, frog, bird and mammals. Gene expression during early development and mid blastula transition to enhance skills for employability.

Unit IV: Gastrulation: Gastrulation in sea urchin frog and chick. Specifying body axes in amphibian and bird. Nieukoopcenter,primary organizer and mesoderm induction. Early development and axis specification of Drosophila, Hoxcomplex in mammals and flyfor skill enhancement.

Unit V: Cell-cell communication; Cell interaction: Induction and competence. Cell surface receptor and signal transduction pathways. Temporal and positional specificity in neural induction and neural competence in vertebrates. Molecular signalling by inducers and hierarchy in antero-posterior polarity of neural tube. Animal cap model and experiments in Xenopus, Organogenesis, morphogenetic fields and limb for effective development of employability skills.

Recommended Text/ Reference Book:

1. Wolpert, L., Tickle, C. and Arias, A. M. (2015) Principles of Development. 5th edition. Oxford University Press.
2. Gilbert, S. F. and Barresi, M. J. F. (2016) Developmental Biology. 11th edition. Sinauer.
3. Wolpert, L. (2011) Developmental Biology: A Very Short Introduction. Oxford University Press.

Course Outcomes:

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

CO1: Learn History of developmental biology. Techniques in developmental biology and model organism for skill development

CO2: Learn various concept's about spermatogenesis and fertilisation types of eggs and their interaction to acquire knowledge for better employability skills.

CO3: Learn the skills of local Gene expression to enhance skills for employability.

CO4: Gain knowledge of Gastrulation in sea urchin frog and chick and Drosophila

CO5: Cell-cell communication, Sodium-Potassium pump, Induction and competence, and Molecular signalling for effective development of employability skills.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	2	2	3	1	2	2	2	1	1	3	2
CO2	1	2	3	3	2	2	2	3	3	2	2	2
CO3	3	2	2	3	2	2	3	2	2	2	3	3
CO4	2	3	2	3	3	2	3	3	3	3	2	3
CO5	2	3	3	3	2	2	3	2	2	2	1	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	2	2	2
CO3	2	3	3
CO4	3	2	2
CO5	3	2	3

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SYLLABUS
EBT-036 Marine Biotechnology

UNIT I: Introduction to marine environment; Marine Flora – Phytoplankton, seaweeds, sea grasses and mangroves-their characteristics and identification; Biology for skill development.

UNIT II: Marine fauna-zooplankton; major marine invertebrates; vertebrates and marine mammals-characteristics and identification, Biology plantibodies to acquire skills for the development of entrepreneurship and employability.

UNIT III: Marine microbes – Types, classification, methods of culturing and identification; methods of preservation for effective development of employability skills.

UNIT IV: Microbial Nitrogen fixation, their role in carbon, phosphorous and sulphur cycle, degradation of organic matter; Microbial leaching and Biofouling for skill development.

UNIT V: Marine pharmacology – Microbial metabolites; Metabolites from marine flora and fauna

Recommended Text/ Reference Book:

1. Bhakuni, D.S., Rawat, D.S. (2005). *Bioactive Marine Natural Products*. Springer.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the introduction, characteristics and identification of national Marine Flora for skill development.
CO2: Understand the major marine invertebrates and characteristics and identification marine mammals.
CO3: Understand the methods of culturing, identification and preservation of Marine microbes for effective development of employability skills.
CO4: Understand the Microbial leaching and Biofouling for skill development.
CO5: Understand the local Marine pharmacology.

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Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

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SYLLABUS
EBT-041 Molecular Modeling And Drug Design

UNIT I: Introduction to Molecular Modelling. Comparative study of Mechanical and Graphical models. Co-ordinate systems two – matrix, potential energy surface. Postulates of quantum mechanics, electronic structure calculations, ab initio, semi-empirical and density functional to develop skill

UNIT II: Molecular Mechanisms, energy calculations, Electrostatic interaction- Van der waals interactions. Miscellaneous interaction. Introduction to Molecular Dynamics, Dynamics with continuous potentials and Constant temperature . Conformation searching, Systematic search. Applications to protein folding to develop skill.

UNIT III: Protein Modelling by Homology and Threading -the alignment, construction of frame work ,selecting variable regions, side chain placement and refinement, skill based validation of protein models –Ramchandran plot, threading and ab initio modeling.

UNIT IV: Introduction to QSAR. **lead** module, linear and nonlinear modeled equations, biological activities, physicochemical parameter and molecular descriptors, molecular modelling in drug discovery providing employability and entrepreneurship.

UNIT V: skill bsed development of 3D pharmacophores, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies. 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility,

Recommended Text books/ References

1. Andrew R. Leach.Molecular Modelling: Principles and Applications.Prentice Hall, 2001
2. Molecular Modelling by Hans Pieter,Heltje & Gerd Folkens, VCH.
3. Jonathan M. Goodman.Chemical Applications of Molecular Modelling.Royal Society of Chemistry, 1998 Computational Chemistry by Guy H, Grant & W. Graham Richards, Oxford University Press

Course Outcomes:

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

CO1: Get familiar about the concepts of global bioinformatics to be implemented in drug design and development.
CO2: Find new targets to treat disease; mechanism of drug designing
CO3: Understand the concept of molecular modeling, mechanics and interactions
CO4: Develop concepts on bond angle, bond stretching, bond distance and role on different types of bonds in interactions
CO5: Acquire the knowledge about the local and global protein structure prediction and conformational changes throughout the simulation and brief idea of receptor and receptor-ligand complex, inhibition and inactivation of enzyme, receptor theories

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

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SYLLABUS
EBT-042 Bioprocess Engineering-II

Unit I: Introduction to engineering calculations; unit conversion, measurement conventions, Errors in Data and Calculations, Presentation of Experimental Data, Data Analysis, skill based development of General Procedures For Plotting Data, Log-log plot & semi-log plot Process Flow Diagrams.

Unit II: Mass transfer: Molecular diffusion, convective mass transfer, solid-liquid, liquid-liquid and gas-liquid mass transfer oxygen uptake in cell cultures, factors affecting cellular oxygen demand, oxygen transfer from gas bubble to cell, measurement of k_La-oxygen transfer method, sulphite oxidation and Dynamic method, oxygen transfer in bioreactors.

Unit III: Design and operation of various bioreactors for better understanding of entrepreneurial skill development, viz CSTR, fed batch systems, air-lift bioreactors, fluidized bed bioreactors. Scale up of bioreactors providing employability. Skill based development of Criteria for selection of bioreactors providing skill based development Ideal Bioreactors; Fed-Batch Reactor, Enzyme-catalyzed reactions in CSTRs, CSTR reactors with recycle and wall growth, the ideal plug-flow tubular reactor, Dynamics model and Stability of bioreactor**,** Reactors with non-ideal mixing: Mixing time in agitated tanks, Resident time distributions, skill based development of Models for no-ideal reactors, Mixing-Bio reaction interactions

Unit IV: Scale up of bioprocess; some consideration in aeration, agitation, mass transfer and heat transfer, Basic principle of scale-up of bioreactor, Practical considerations for bioreactor construction providing employability and entrepreneurship

Unit V: Control of physical, chemical and biological environment of the bioreactor developing skill Advanced control strategies viz. PID controllers, fuzzy logic based controllers and artificial neural network based controllers, Role of physical, chemical & biological sensors. Sanjay Singh, Vivek Kumar

Recommended Textbooks/ References

1. S.J.Pirt. Principles of Microbial and cell cultivation, Butterworth Publications
2. Pauline M. Doran.Bioprocess Engineering Principles.Second Edition, Publisher -AP
3. Peter F. Stanbury, Allan Whitaker, Stephen J. Hall.Principles of fermentation technology. Pergamon, 1995

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Course Outcomes:

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

CO1: Do calculations in bioprocess engineering by a systematic approach with well-defined methods and rules to develop skill.

CO2: Analyze and apply different modes of mass transfer operations enhancing employability

CO3: Understand the Criteria for selection of bioreactors, design and functioning of various types of reactors viz Batch, Fed-batch CSTR, Airlift, Fluidized bed and PFR for skilling of entrepreneurship

CO4: Understand the scale-up concepts for global bioprocess and work on the scale-up process of the bioprocess plant/industry for development of skill and employability

CO5: Control of physical, chemical and biological environment of the bioreactor for skill development and employability

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	1
CO2	2	3	1
CO3	2	3	3
CO4	3	3	3
CO5	3	3	3

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SYLLABUS
EBT-043 Drug Delivery: Principles and Engineering

Unit I: Pharmacokinetics: Definitions, ADME, concentration time profile, plotting the data, different fluid compartments and blood flow rate compartment models, biological half life, elimination rate constant. Biopharmaceutics and pharmacokinetics in drug research for skill development.

Unit II: Bioavailability and bioequivalence: Definitions, federal requirements, methods of determination of bioavailability using blood and urinary excretion data. Protocol design for bioavailability assessment. Methods for bioequivalence determination to enhance knowledge for better employability skills.

Unit III: Polymeric materials in drug delivery: Polymer classification, physical and chemical characterization techniques of biomaterials, biocompatibility testing of biomaterials and their pharmaceutical/biomedical applications in tissue engineering for skill enhancement.

Unit IV: Biopolymers: Natural and Synthetic, biocompatibility, Biodegradation, commonly used biopolymer-biodegradable polymers, polyesters, polyamides, polyurethanes, biopolymers, biodegradable polymer blends to acquire knowledge for better employability skills.

Unit V: Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications to enhance skills for entrepreneurship development and employability.

Recommended Text/ Reference Book:

1. Applied Biopharmaceutics& Pharmacokinetics, by Shargel, L., S. Wu-Pong
2. Biopharmaceutics and Pharmacokinetics: An Introduction by Notari, R. E.
3. Introduction to Biopharmaceutics, by Gibaldi, M.
4. Biopharmaceutics and Relevant Pharmacokinetics, by Wagner, J. G.

5. Textbook of Biopharmaceutics and Clinical Pharmacokinetics by Niazi, S.K.
6. Handbook of Bioequivalence Testing, by Niazi, S. K.
7. Modeling in Biopharmaceutics, Pharmacokinetics, and Pharmacodynamics: Homogeneous and Heterogeneous approaches, by Macheras, P. and A. Iliadis
8. Comparative Pharmacokinetics: Principles, Techniques and Applications, by Riviere, J. E
9. Foundations of Pharmacokinetics, by Rescigno, A.
10. Clinical Pharmacokinetics and Pharmacodynamics: Concepts and Applications, by Rowland, M. and T. N. Tozer.

Course Outcomes:

At the end of the course students will be able to:
CO1: Learn about definitions of Biopharmaceutics and pharmacokinetics and drug research for skill development.
CO2: know about Protocol design and Methods for bioequivalence determination to enhance knowledge for better employability skills
CO3: Understand the concepts of Polymer classification, physical and chemical characterization techniques of biomaterials for skill enhancement.
CO4: Gain knowledge on Natural and Synthetic, biocompatibility, Biodegradation, commonly used biopolymers for better employability skills.
CO5: Understand and Learn about target drug delivery to enhance skills for entrepreneurship development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	2	1	2	3	2	2	3	2	1	3	3	2
CO2	3	2	3	3	2	3	3	3	3	2	2	2
CO3	3	3	2	1	3	2	2	1	2	3	2	2
CO4	3	3	2	3	3	3	2	3	3	2	3	3
CO5	2	2	3	3	2	2	2	2	2	2	1	2

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	3
CO2	2	2	3
CO3	2	3	2
CO4	3	2	2
CO5	3	3	2

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SYLLABUS

EBT-044 Functional Genomics

Unit I: Introduction: Concepts and applications, Forward genetics and Reverse genetics approaches, Loss of function, Gain of function, Mutagenesis as Functional Genomics Tool: T-DNA insertional mutagenesis, Transposon based mutagenesis (Ac/Ds), Activation tagging, Enhancer trapping, GAL4 mediated over expression, Floxing, Viral mediated transfection for skill enhancement.

Unit II: Genome wide mutation screening: TILLING (Targeted Induced Local Lesion in Genome) - principle and experimental approach, ECO-TILLING; DEALING (Detecting Adducts Local Lesion IN Genome) - principle, experimental approach; Site directed mutagenesis to acquire knowledge for better employability skills.

Unit III : DNA Microarray Technology: Introduction, Types of Microarrays and Advantages, Experimental design- Concepts, principles, Probe design, target preparation, Hybridization and Detection, Specificity, sensitivity, reproducibility, and Data Analysis; RNA silencing: Antisense RNA technology, RNAi and Si RNA; SAGE for transcript profiling. Principle, methodology and applications; Molecular analysis of gene expression (RT-PCR) to enhance skills for entrepreneurship development and employability skills.

Unit IV: Protein microarrays: overview, principle, limitations; Protein microarray. Manufacturing technology, solid supports, different formats, experimental approach and detection, peptidomics; Microarray for protein-carbohydrate interaction (phage display technology); protein domain microarray; protein biochips; Antibody microarray; protein microarray for drug discovery for better employability skills

Unit V: Mass Spectrometry for Protein–Protein Interaction Mapping: Overview, Identification of substrates for E. coli GroEL, Studying the transcriptome and proteome of Escherichia coli and *Saccharomyces cerevisiae*for effective development of employability skills

Recommended Text/ Reference Book:

1. Protein Microarrays, edited by Mark schena, Jones and Bartletpublisher, 2005.

2. Microbial Functional Genomics, Jizhong Zhou, Dorothea K. Thompson, Ying Xu, James, M. Tiedje, A John Wiley & Sons, Inc., Publication, 2004.
3. Microarrays for an Integratiul J. But. Kho and Atte, Published in India by Ane Books, 2003.
4. Gene Cloning and DNA analysis An Introduction, Sixth Edition, T. A. Brown, Wiley Blackwell publications, A John Wiley & Sons, Inc., Publication, 2010.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand Concepts and applications of global Forward genetics and Reverse genetics approaches for skill enhancement.
CO2: Learn the skills of TILLING, ECO-TILLING, DEALING - Genome wide mutation screening
CO3: Understand various type of Microarrays their Advantages and Experimental design, Molecular analysis of gene expression (RT-PCR) to enhance skills for entrepreneurship development and national employability skills.
CO4: Gain knowledge on Protein microarrays for better employability skills
CO5: Learn the skills of Mass Spectrometry for Protein–Protein Interaction Mapping

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	2	3	3	3	3	2	3	2	1	3	3	3
CO2	3	2	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	1	2	2	2	1	2	2	2	1
CO4	3	3	2	3	2	2	3	2	3	2	3	3
CO5	2	2	2	3	1	3	2	2	2	3	1	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	3
CO2	2	3	2
CO3	3	3	3
CO4	3	3	2
CO5	2	3	3

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SYLLABUS
EBT-045 Stem Cell Technology

UNIT I: Developmental biology: The anatomical tradition/Life cycles and the evolution of developmental patterns; principles of experimental embryology; The genetic core of development; for effective development of employability skills. The paradigm of differential gene expression, cell commitment, differentiation & induction of cell fate; concept of morphogen, cell-cell communication in development.

UNIT II: Early Embryonic Development- Fertilization: Beginning a new organism. Early development in selected invertebrates; the genetics of axis specification in Drosophila; Early development and axis formation in amphibians; the early development of vertebrates: fish, birds and mammals for development of employability skills

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UNIT III: Introduction To Stem Cells- Development of differentiated tissues from embryonic germ layers, Function of placenta, amniotic fluid and umbilical cord; Stem cells : Definition, Classification and Properties; Properties and application of Embryonic stem cells; Hematopoiesis – Hierarchy, Properties of Hematopoietic Stem Cells (HSCs) and types for skill development..

UNIT IV: Stem Cell Processing And Transplantation- Sources of stem cells; Cell types for transplantation: Bone marrow, Peripheral stem cells, cord blood stem cells; Types of transplants; Methods of obtaining bone marrow and peripheral blood for transplant, Stem cell processing and storage for effective development of employability skills.; HLA matching; Advantages and drawbacks of autologous and allogeneic transplants.

UNIT V: Stem Cells And Therapy-Overview of embryonic and adult stem cells for therapy; Normal stem cells vs Cancer stem cells, Clinical uses of hematopoietic stem cells in leukemia and inherited blood disorders; Use of stem cells in diabetes, myocardial infarction, Parkinson's disease for conceptual skills.

Recommended Text/ Reference Book:

1. Scott F Gilbert (2000) ,*A companion to Developmental Biology*,(9th Ed), Sunderland (MA): Sinauer Associates;
2. Robert Lonza (2009) *Essentials of Stem Cell Biology*, (2nd Ed) Academic Press.
3. Anthony Atala, Robert Lonza, James A.Thomson, Robert Nerem (2011) *Principles of Regenerative Medicine*, (2nd Ed) , Academic Press.
4. StemBook Cambridge (MA): 2008.Harvard Stem Cell Institute;

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Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the anatomical tradition/Life cycles and the evolution of global biology developmental patterns.
CO2: Understand the early development of vertebrates: fish, birds and mammals for development of employability skills.
CO3: Understand the Stem cells - Definition, Classification and Properties and application of embryonic stem cells.
CO4: Understand the Stem Cell Processing and Transplantation, processing and storage for effective development of employability skills.
CO5: Understand the Clinical uses of hematopoietic stem cells in therapy.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

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SYLLABUS
EHU-701 INDUSTRIAL MANAGEMENT

Unit-I: Introduction: Concept, skill based Development, application and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system Industrial Ownership for better skilling of entrepreneurship.

Unit-II: Management Function: Principle and function of management – Time and motion study, work simplification- process, skill based development of Charts and flow diagrams, production planning.

Unit- III: Inventory control: Inventory Cost Deterministic Models providing employability, and Introduction to supply chain management, Quality control: process control, SQC, Control charts, Double and sequential sampling, skill based introduction to TQM.

Unit- IV: Human and Industrial Relations: Importance and necessity of industrial legislation to inculcate skill, provide employavbility and entrepreneurial skills, Types of labour laws and disputes. Brief description of the following Acts: 1948: payments of wages Act 1936: Workmen Compensation Act 1923: Industrial dispute Act1947, Grievances handling of Grievances, Labour welfare schemes, Accidents & Safety.

Unit-V: Environmental Issues: Environmental pollution- various management techniques to control Environmental pollution- Various control acts for Air, Water, Solid waste and Noise pollution knowledge for better skilling of entrepreneurship.

Recommended Text/Reference Books

1. Industrial engineering and management by TR Banga
2. Industrial Management by VK Sharma, OP Harkut
3. Principles of management by Philip Kotler TEE Publication
4. Industrial Organization and Management by Tara Chand Nem Chand and Brothers, Roorkee

Course Outcome:

Students completing this course will be able to:

CO1: Understand the concept, development, application and scope of national Industrial Management for employability and skill development.

CO2: To apply various management tools in systems of different local industrial configurations to develop entrepreneurship skills.

CO3: Facilitate employability and entrepreneurship skills by understanding the importance of inventory and the concept of supply chain management.
CO4: Analyze the mechanism and tools of quality control enhancing employability and introduction to total quality management for skill development.
CO5: To control and develop models for national environmental pollution by various management techniques gaining insight for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	2	2	2	2	3	3	3	2	2	2
2	3	2	2	2	2	2	3	3	3	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	2	2	2	2	3	3	3	3	2	2
5	3	1	2	2	2	2	3	3	3	1	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	Skill Development	Employability	Entrepreneurship Development
1	3	3	2
2	3	3	2
3	3	3	3
4	3	3	3
5	3	3	2

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SYLLABUS
EBT-801 Environmental Biotechnology

Unit I: Environmental pollution: Land, water, air, and noise (sources, effects and measurements). Types and properties of wastes, and steps involved in aerobic and anaerobic treatments of solid waste, sewage and industrial effluents and its recyclying. providing employability

Unit II: Skill based development of Biological waste treatments and biofuel production Methanogenesis: methanogenic, acetogenic, and fermentative bacteria– anaerobic and aerobic digestion processes and conditions. Minimal national standards for waste disposal.

Unit III: Principles and design aspects of various waste treatments methods providing entrepreneurship with advanced bioreactor configuration: Liquid waste treatment, Introduction Physical Chemical and Biological methods: activated sludge process, trickling filter, fluidized expanded bed reactor, upflow anaerobic sludge blanket reactor, contact process, fixed / packed bed reactor, Stoichiometry and design kinetics for waste treatment processes.

Unit IV: Bioconversion of agricultural and other highly organic waste materials into gainfully utilizable products – biogas, Hydrogen gas, Lignocellulases and food and feed stocks. Economical and social aspects of waste treatment for development of entrepreneurship.

Unit V: Bioremediation: land, water, industries, organic contaminants, Bioremediation of heavy metals and nitrogenous wastes.

Recommended Books:

1. Metcalf, Eddy. "Wastewater Engineering: Treatment, Disposal, Reuse, Metcalf & Eddy.", Third ed., McGraw-Hill, New York (2003).
2. J. Winter, Environmental Processes I-III, Second ed., Wiley Publications.
3. P. D. Sharma, Ecology & Environment, Twelfth ed., Rastogi Publications, 2015.
4. Ramalho, R. Introduction to wastewater treatment processes. Elsevier, 2012.
5. B.C. Bhattacharya and Ritu Banerjee, Environmental Biotechnology, Oxford Press, 2007.
6. SVS Rana, Essentials of ecology and environmental science. PHI Learning Pvt. Ltd., 2013.
7. Anubha Kaushik, Perspectives in Environmental Studies. New Age International, 2006.
8. Pradipta Kumar Mohapatra, Environmental Biotech, I.K. International Pvt. Ltd., 2006.
9. D.P. Singh, S.K. Dwivedi, Environmental Microbiology & Biotechnology, New Age International Publishers, 2004.

Rana, S. V. S. Essentials of ecology and environmental science. PHI Learning Pvt. Ltd., 2013.

Course Outcomes:

At the end of the course students will able to:
CO1: Classify types of local pollutions, pollutants and their adverse health and environmental impacts for the development of skill and employability
CO2: Understand properties of waste and role of microbes in waste metabolism
CO3: Study of analytical technique for environmental monitoring development of skill and employability
CO4: Learn about the type of bioreactors for global liquid waste management providing employment.
CO5: Understand, treatment method of solid waste management socioeconomically for skilling of entrepreneurship

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	2	2	2
CO5	2	2	2

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SYLLABUS
EBT-051 Biotechnology in Health Care

Unit-I: Therapeutic Aspects of Biomacromolecules: skill based development of Endogenous peptides and proteins, Modification of endogenous peptides and proteins. Immune System: Overview, Antibody-mediated response, skill based development of Vaccines, Cell-mediated immune response, Cancer-Immunology

Unit –II: Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozymes Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer vaccines providing better skilling of entrepreneurship.

Unit –III: Radiological Agents: Radiosensitizers and Radioprotective agents providing employability and skills Cardiovascular Drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, anthrombotics and hemostatics

Unit –IV: Chemotherapeutic Agents: skill based development of Synthetic antibacterial agents, Lactam antibiotics, Antihelminthic agents, Anthelmintic agents, Antiamebic agents, Antiviral agents. Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response

Unit –V: Drug Targeting Organ-Specific Strategies: Basic concepts and novel advances providing employability, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery providing skill development.

Recommended Books:

1. Christine Bladon,. Pharmaceutical chemistry: therapeutic aspects of biomacromolecules. John Wiley & Sons, 2002.
2. Donald J Abraham, Burger's medicinal chemistry and drug discovery. Vol. 5. Wiley Interscience, 2003.
3. Grietje Molema, Dirk KF Meijer, Raimund Mannhold, Hugo Kubinyi, and Hendrik Timmerman. "Drug targeting organ-specific strategies."(2001).

Course Outcomes:

At the end of the course students will able to:

CO1: Describe the role of the immune system and endogenous protein in cancer for skill development.
CO2: Explain the basic concepts in gene therapy, antisense therapy, and synthesis of vaccines for skill development, entrepreneurship and employability.
CO3: Describe the use of radiological agents in the diagnosis of diseases and various proteins as therapeutics in order to develop skill.
CO4: Describe the role of different types of chemotherapeutic agents and their properties for skill development.
CO5: Describe the basic concepts and advanced research in site-specific drug delivery systems for skill development, entrepreneurship and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

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SYLLABUS
EBT-052 Nanobiotechnology

Unit I: Introduction: Introduction to nanotechnology and overview of nanoscale materials, effect of length scale on properties, introduction to bionanotechnology, challenges and opportunities associated with biology on the Nanoscale, bionanotechnology systems, biological and medical applications of Bionanomaterials to provide employability and skills

Unit II: Nanomaterials: Introduction to nanomaterials, General surface and colloid chemistry, principles, experimental techniques, surface potential, DVLO theory; skill based development of Characteristics of nanoparticles, Environmental behaviour of nanoparticles, biological activity of nanomaterial.

Unit III: Biosensors: Introduction to biosensors for better skilling of entrepreneurship, the biological component, the sensor surface, Immobilization of the sensor enzyme on electrode, Transduction of the sensor signal: Optical, Electrochemical and Mechanical sensors, Basics of Amperometric sensors; Potentiometric sensors; Optical sensors; Optical sensors; Surface Plasmon Resonance based sensors with relevant exaple

Unit IV: Bioimaging: Overview of imaging biological systems, from the cellular level through to whole-body medical imaging, Nanoparticles based bioimaging with example, QDs ad carbon Dots for tumor targeting fluorescence microscopy, MRI
X-ray CT imaging providing employability and entrepreneurship.

Unit V: Nanomedicine, Nanodrug delivery, Nanotoxicology: Principles of toxicology; toxicology models, experimental toxicology studies; activation and detoxification mechanisms, importance of biological membrane in toxicology; skill based development of Toxicology and bioaccumulation of particles.

Recommended Text / References books

1. Engines of Creation, KE Drexler, Oxford Paperbacks, New York ISBN 0192861492.
2. Nanosystems: Molecular Machinery, Manufacturing and Computation, K E Drexler, Wiley, ISBN 0471575186.
3. Our Molecular Future: How Nanotechnology, Robotics, Genetics and Artificial Intelligence will Transform the World, Prometheus ISBN 1573929921.

Course Outcomes:

At the end of the course students will able to:
CO1: Understand the principles of nanobiotechnology and basic fabrication techniques for the synthesis of nanoparticles for better skilling of entrepreneurship
CO2: Acquire the knowledge to incorporate nanotechnology for developing drug delivery systems like aerosol, inhalants, injectables, etc. providing employability
CO3: Get familiarize with potentialities and concerns associated with nanomaterials usage for targeting tumors and other diagnostics developing employability
CO4: Acquire the knowledge of synthesis and characterization of skill based different classes of biopolymers and their applications in the field of health sciences.
CO5: Acquire the knowledge for designing diagnostic tools, biosensors, and microelectronic devices for various applications in national and global health science developing employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	3
CO2	3	3	3
CO3	2	2	3
CO4	2	2	3
CO5	2	2	3

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SYLLABUS
EBT-053 Fundamentals of micro and nanofabrication

Unit I: Micro fabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate bonding, MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, High- Aspect- Ratio Micromachining for effective development of employability skills

Unit II: Micro-Machining: Material removal at micro-scale: size effect, chip thickness, Micro-Structure and Grain Size Effects; Tool geometry, Tool wear, and Tool Deflections, Tool Stiffness and Deflections under Dynamic Loading, Micro Turing and Micro Milling for skill enhancement.

Unit III: Etching: Characterizing etching processes in bulk micromachining; micro-fabrication of MEMS and semiconductor devices; basics of micro-fabrication, integrated circuit fabrication; crystallography and its effects, silicon as substrate and structural material, stress and strain, crystal plane effects on etching, wet etching process, reaction phenomena, anisotropic etching, isotropic etch curves, masking for anisotropic etchants, etching control, fusion bonding of silicon on an insulator, deep reactive ion etching, fabrication of a cantilever probe, manufacture, microprocessors and applications; problems with etching in bulk micromachining to enhance knowledge fir the development of employability skills.

Unit IV: Lithography: Principle of the soft lithography and applications; principle of micro contact printing and applications; characterizing the surface micromachining process, isolation layer, sacrificial layer, structural material, selective etching – properties, stress, stress measurement, friction; wafer bonding: anodic and fusion, bonding for effective development of employability skills.

Unit V: Micro and nanotechnology: Applications for space micro propulsion, subsystems and devices for miniaturized spacecrafts micro propulsion: microbolomete, micro FEEP, integrated cold-gas microthruster, microturbogas, pyrotechnic actuator and micro valve etc - propulsion systems: solid propellant, ADCS to promote entrepreneurship development and employabilty.

Recommended Text/ Reference Book:

1. The Science and Engineering of Microelectronic Fabrication by Stephen A. Campbell
2. VLSI Fabrication Principles: Silicon and Gallium Arsenide by Sorab K. Gandhi
3. Introduction to Microelectronic Fabrication by Richard C. Jaeger
4. Materials Science of Thin Films by Milton Ohring
5. Fundamentals of Microfabrication and Nanotechnology, by Marc J. Madou
6. Fundamental Principles of Optical Lithography by Chris Mack
7. Electronic Materials by Prof. Dr. Helmut Föll
8. Koc M and Ozel T, Micro-manufacturing: Design and Manufacturing of microproducts, wiley.
9. Mahalik N P, Micro-manufacturing and nanotechnology, Springer.
10. Jackson M J, Micro and nano-manufacturing, Springer.

Course Outcomes:

At the end of the course students will be able to:
CO1: Learn the techniques of Micro fabrication such as Lithography, Thin Film Deposition and Doping etc for effective development of employability skills
CO2: Gain knowledge on Micro-Machining**,** Material removal at micro-scale their process and application for skill enhancement.
CO3: Gain knowledge on Bulk-Machining, to enhance knowledge for the development of employability skills
CO4: Understand Principle of the soft lithography and applications and process
CO5: Learn the concepts of Micro and nanotechnology to promote entrepreneurship development and employability

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	2	3	2	2	2	3	2	2	1	3	3	2
CO2	3	3	2	3	3	1	3	2	2	2	3	3
CO3	3	3	3	3	3	1	3	1	3	2	2	1
CO4	3	2	3	3	2	3	3	2	3	2	2	3

CO5	2	2	2	2	2	3	2	3	2	3	1	1

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	**2**	**3**	**2**
CO3	**2**	2	2
CO4	**3**	**3**	2
CO5	**3**	**3**	2

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SYLLABUS
EBT-054 Nanotechnology in Biomedical

Unit I: Introduction: Introduction to Nanotechnology, Nano-biomimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterisation of nanomaterials for skill development.

Unit II: Nanotechnology: DNA nanotechnology, Protein & glycol-nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications to develop skills and employability.

Unit III: Nanomaterials: Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing for skill enhancement.

Unit IV: Nanotherapeutics: Nanotechnology in point-of-care diagnostics, Nanopharmacology & drug targeting, Cellular uptake mechanisms of nanomaterials, In vitro methods to study antibacterial and anticancer properties of nanomaterials, Nanotoxicology to acquire knowledge for the development of employability skills.

Unit V: Nanomedicine: Basic concepts in the design of nanomedicine, specification and desired features of nanomedicine, nanomaterials and general process steps involved in the preparation of nanomedicines. Nanomedicines for various disease conditions: infectious diseases, neurological diseases to enhance skills for entrepreneurship development and employability skills.

Recommended Text/ Reference Book:

1. Malsch, N.H., “Biomedical Nanotechnology”, CRC Press. (2005).
2. Mirkin, C.A. and Niemeyer, C.M., “Nanobiotechnology II: More Concepts and Applications”, Wiley-VCH. (2007).
3. Kumar, C. S. S. R., Hormes, J. and Leuschner C., “Nanofabrication Towards Biomedical Applications: Techniques, Tools, Applications, and Impact”, WILEY -VCH Verlag GmbH & Co. (2005).
4. Lamprecht, A., “Nanotherapeutics: Drug Delivery Concepts in Nanoscience”, Pan Stanford Publishing Pte. Ltd. (2009).
5. Jain, K.K., “The Handbook of Nanomedicine”, Humana press. (2008).
6. Nanomedicine for Cancer Therapy: From Chemotherapeutic to Hyperthermia-Based Therapy ,Springer, Piyush Kumar, Rohit Srivastava, 2017

7. Nanotoxicology, Materials, Methodologies, and Assessments, Editors: Durán, Nelson, Guterres,Silvia S., Alves, OswaldoLuiz (Eds.),

Course Outcomes:

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

CO1: Understand the basics of Nanotechnology, definition, use, and its applications

CO2: learn the application of nanotechnology in DNA and RNA processing for effective national development of employability skills

CO3: Learn about nanomaterials the applications in medical science, cancer etc. for skill enhancement and to acquire knowledge

CO4: Understand concepts of nanotherapeutics in diets and cellular uptake to acquire knowledge for the development of employability skills.

CO5: Understand Basic concepts in the design of global nanomedicine, specification and desired features of nanomedicine to enhance skills for entrepreneurship development and employability skills.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	2	1	2	3	2	3	3	1	2	3	3	2
CO2	2	3	2	3	2	1	3	2	2	3	3	3
CO3	2	2	2	3	3	1	3	1	2	2	2	3
CO4	3	2	3	3	2	3	3	2	2	3	2	3
CO5	3	3	2	1	1	3	2	3	2	2	1	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	**2**	**3**	**2**
CO3	**2**	2	2

CO4	**3**	**3**	2
CO5	**3**	**3**	2

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SYLLABUS
EBT-055 Design of Industrial waste water management

UNIT I: Waste Water Treatment An Overview- Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents for skill development..

Unit II: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection knowledge for development of employability skills

Unit III: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage for skill development.

Unit IV: Overview of biological Treatment – Microbial metabolism – Bacterial growth and energatus – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing plantibodies to acquire skills for the development of entrepreneurship and employability.

Unit V: Technologies used in advanced treatment – Classification of technologies Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration Absorption – Ion Exchange – Advanced oxidation process for skill development.

Recommended Text/ Reference Book:

1. Industrial waste water treatment by A. D. Patwardhan ·
2. Industrial Wastewater Treatment, Recycling and Reuse by Vinay M. Bhandari, Vivek V. Ranade.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the Health and Environment Concerns in global waste water management for skill development.
CO2: Understand the Components of waste water flows and mass balance analysis on the basis of ideal & non ideal flow in reactors for development of employability skills.
CO3: Understand the role of local unit processes in waste water treatment for skill development
CO4: Understand the waste water treatment and sludge processing for effective development of employability skills.

CO5: Understand the advanced waste water treatment technologies for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

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SYLLABUS
EBT-061 Biomedical Instrumentation

Unit I: Introduction to biomedical instrumentation, Electronics and Medicine. Basic transducer principles, Transducer for Biomedical applications, Sources of bioelectric potentials, Electrodes

Unit II: The Cardiovascular system, Cardiovascular measurements to inculcate skill, Patient care and monitoring providing employability skill based Measurements in the respiratory system.

Unit III: Noninvasive diagnostic instrumentation, the nervous system & measurement of nervous syatem, Instrumentation for sensory measurements and the study of behaviors, Biotelemetry providing employability

Unit IV: Instrumentation for the clinical laboratory, X-ray and radioisotope instrumentation for better skilling of entrepreneurship development

Unit V: The computer in biomedical instrumentation for entrepreneurship and employability, Electrical safety of medical equipment.

Recommended Text / References books:

1. Leslie Cromwell, Fred J. Weibell, and Erich Pfeiffer. "Biomedical instrumentation and measurement, PHI Pvt." (2006).
2. Cromwell, Leslie. Medical instrumentation for health care. Prentice Hall, 1976.
3. Robert B Northrop, Analysis and application of analog electronic circuits to biomedical instrumentation. CRC press, 2012.
4. Clifford D.Ferris. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Applications.Humana Press, 1978.
5. Raghbir Singh Khandpur. Handbook of biomedical instrumentation. Tata McGraw-Hill Education,1992.

Course Outcomes:

At the end of the course students will able to:

CO1: To facilitate employability and entrepreneurship skills and understand the global Biomedical Instrumentation system and types of biomedical equipments.
CO2: Elucidate cardiovascular system and related measurements to develop skill.
CO3: Understand the respiratory and nervous systems and related measurements.
CO4: Measure local non-invasive diagnostic parameters for employability.
CO5: Understand the application of such equipments – Audiometers & Densitometers for entrepreneurship.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	2	2	2
CO5	2	2	2

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SYLLABUS
EBT-062 Genomics & Proteomics

Unit I: Introduction to Genomics- Structure and organization of prokaryotic and eukaryotic genomes nuclear, mitochondrial and chloroplast genomes; Phylogenetics; Tools for genome analysis–PCR, RFLP, DNA fingerprinting, RAPD, Automated DNA sequencing providing employability; Linkage and pedigree analysis; skill based development of Construction of genetic maps; Physical maps, FISH to identify chromosome landmarks.

Unit II: Genome sequencing- to inculcate skill, provide employability entrepreneurial skills Human genome project-landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical map-cytogenetic map, contig map, restriction map, DNA sequence; DNA sequencing and sequence assembly; Taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing.

Unit III: DNA Microarray technology- skill based development of Basic principles and design: cDNA and oligonucleotide arrays;Applications: Global gene expression analysis, Comparative transcriptomics, Differential gene expression; genotyping/SNP detection; Detection technology; Computational analysis of microarray data for better skilling of employability.

Unit IV: Proteomics- Overview of protein structure-primary, secondary, tertiary and quarternary structure; Relationship between protein structure and function; Outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry : ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector; clinical proteomics and disease biomarkers; Prions; proteins in disease; Protein-protein interactions: Solid phase ELISA, Yeast two hybrid system, Protein interaction maps; Protein arrays-definition, applications- diagnostics, expression profiling providing knowledge for better employability in industries.

Unit V: Human disease genes; DNA polymorphism including those involved in disease; Hemoglobin and the anemias; Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information: SSCP; Proteomics and drug discovery; High throughput screening for drug discovery; Identification of drug targets; drug development for employability and entrepreneurship development.

Recommended Text / References books:

1. Introduction to Genomics . Arthur Lesk. Oxford University Press, 2008
2. Brown TA, Genomes, 3rd Edition, Garland Science, 2006.

3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and
4. Bioinformatics, 2nd Edition, Benjamin Cummings, 2007.
5. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
6. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998

Course Outcomes:

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

CO1: Understand the scope and importance of genomics and genome analysis tools for developing skills.

CO2: Understand the concept of genome sequencing and genome assembly for skill development.

CO3: Understand the role of microarray technology and computational analysis of microarray data for better skilling of employability.

CO4: Understand the scope of proteomics and Protein-protein interactions.

CO5: Understand Proteomics and drug discovery; High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharamacogenetics and drug development for employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2

CO5	3	3	2

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SYLLABUS
EBT- 063 Introduction to Protein Engineering

Unit I: Proteins: chemistry of amino acids and peptides, chemical synthesis of peptides, Primary Secondary, Tertiary and Quaternary Structure of proteins; α-helix, β-sheet and collagen structure helix-coil transition, Ramachandran plots, amino acid sequences, allosteric interactions, cooperative ligand binding in Oxygen transporters, Hill equation, Protein folding for skill enhancement.

Unit II: Functional proteomics: Gene functions through protein interactions: Identification of Protein–Ligand Interactions. Yeast Two-Hybrid Selection System: Analysis of genomewide protein–protein interactions in organisms, Use of M13, T7 Phage to Detect Protein–Ligand Interactions, Combining yeast two-hybrid and phage display data, Detecting Interactions with Protein Fragment Complementation Assays to acquire knowledge for development of employability skills.

Unit III: Mass spectroscopy and other techniques: basic principle, ionization sources, mass analyzers, different types of mass spectrometers (MALDI-TOFQ-TOF, LC-MS) Multidimensional proteomics: SELDI-TOF. Quantitative proteomics -stable isotope labelling by amino acids in cell culture (SILAC), isotope-coded affinity tag(ICAT), isobaric tagging for relative and absolute quantitation (iTRAQ); Label-free proteomics for enhanced employability skills.

Unit IV: X-ray Crystallography: Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg's law, special properties of protein crystals, model building, refinement and R-factor for effective development of employability skills.

Unit V: Protein Engineering: Protein sources, Industrial and medical application of proteins, different expression of proteins for large scale purifications, protein engineering strategy, rational and random mutagenesis. Applications of protein engineering protein in Chemical and Medical Industries: Generation of heat stable, pH stable enzymes, application in vaccine development, drug development, sensor development to acquire skills for entrepreneurship development and employability skills.

Recommended Text/ Reference Book:

1. R. D. Appel and D.F. Hochstrasser, Proteome Research: New Frontiers in Functional Genomics, Springer,1997

2. R. M. Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004.
3. P. Michael Conn, Handbook of Proteomic Method. Humana Press, Totowa, New Jersay, USA, 2003
4. C. Branden and J. Tooze, Introduction to protein structure, Garland Publishing, 1998
5. L. Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007.
6. Protein Microarrays, edited by Mark schena, Jones and Bartletpblisher, 2005.
7. Microbial Functional Genomics, Jizhong Zhou, Dorothea K. Thompson, Ying Xu, JamesM. Tiedje, A John Wiley & Sons, Inc., Publication, 2004.
8. Microarrays for an Integratiul J. But. Kho and Atte, Published in India by Ane Books,2003.
9. Gene Cloning and DNA analysis An Introduction, Sixth Edition, T. A. Brown, WileyBlackwell publications, A John Wiley & Sons, Inc., Publication, 2010.

Course Outcomes:

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

CO1: Learn about Proteins, their chemistry of amino acids and their structures and isomerism to acquire knowledge

CO2: Understand Gene functions through protein interactions to acquire knowledge for development of employability skills.

CO3: Learn the techniques of Mass spectroscopy and other techniques their basic principles, ionization sources and mass analyzers for enhanced national employability skills

CO4: Understand the Principle of X-ray diffraction, scattering vector etc for effective development of employability skills.

CO5: Gain knowledge on Protein Engineering: Protein sources, Industrial and medical application of proteins to acquire skills for entrepreneurship development and employability skills

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	1	2	3	2	2	3	2	3	3	3	2
CO2	3	2	2	3	2	1	2	3	3	2	3	3
CO3	2	3	3	2	3	2	2	2	2	3	3	2
CO4	2	2	3	2	3	1	3	2	1	3	2	2
CO5	3	2	2	2	3	3	2	3	2	3	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	3
CO2	3	2	2
CO3	2	2	3
CO4	2	2	3
CO5	2	2	2

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SYLLABUS
EBT-064 Transport Phenomenon in Biological systems

Unit I: Introduction to Momentum and Heat Transport: Newton's Law of viscosity-Non-Newtonian Fluid Models-Pressure and Temperature dependency of viscosity. Introduction to Heat Transport, Fourier's Law – Newton's Law of cooling-Temperature and pressure dependency of9 15%thermal conductivity. Introduction to Mass Transport: Fick's Law of binary diffusion- Temperature and pressure dependency of diffusivity (Only a brief overview is needed) Shell momentum balances and boundary conditions for momentum, heat and mass transport to enhance knowledge for development of employability skills.

Unit II: Molecular theory of viscosity of gases and liquids: at low density, Calculation of viscosity of gas mixture -Numerical examples. Theory of thermal conductivity of gases at low density -Theory of thermal conductivity of liquids and solids-Numerical Examples for skill development.

Unit III: Theory of diffusion in gases at low density: Theory of Diffusion in binary liquids -Numerical Examples. Definitions of various concentration terms, velocities, Mass and Molar fluxes -Notations and relationships for various Mass and molar fluxes. Analogies between Heat mass and Momentum Transfer for effective development of employability skills.

Unit IV: General transport equations for momentum: derivation of continuity equation - Analysis of equation of motion inrectangular coordinates (derivation not desired) –Navier Stoke's equation and Euler equation with significance of each terms(derivation not desired) - transport equation in curvilinear coordinates (derivation not desired) for skill enhancement.

Unit V: Application of shell balances to heat conduction problems: With electric, nuclear & viscous heat sources cooling fins with insulated tip condition. Equations of energy:- energy equation in rectangular coordinates-energy equations in curvilinear coordinates (derivation not desired) to acquire skills for the development of entrepreneurship and employability.

Recomended Text/ Reference Book:

1. Introduction to Chemical Engineering Thermodynamics, J. M. Smith, H. C. Van Ness and M. M. Abbott, McGraw-Hill, 2005.
2. Biological Thermodynamics, D. T. Haynie, Cambridge University Press, 2008.
3. Transport Phenomena, R. B. Bird, W. E. Stewart, E. N. Lightfoot, Wiley India, 2006
4. Transport Processes in Biological Systems, G. A. Truskey, F. Yuan and D. F. Katz, Pearson Prentice Hall, 2010
5. Bird R B, Stewart W E and Lightfoot R N, Transport Phenomena, John Wiley and Sons.

6. John C Slattery, Momentum, Energy and Mass transfer in continua, McGraw Hill, Co.

Course Outcomes:

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

CO1: Learn about Introduction to Momentum and Heat Transport: Newton's Law of viscosity-Non-Newtonian Fluid Models

CO2: Learn about viscosity of gases and liquids, Theory of thermal conductivity of gases for for skill development.

CO3: Understand the concepts of diffusion in gases at low density Analogies between Heat mass and Momentum Transfer for effective development of employability skills.

CO4: Understand the General transport equations for momentum in biological systems for skill enhancement

CO5: Know about Application of shell balances to heat conduction problems to acquire skills for the development of entrepreneurship and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	1	3	3	3	3	3	2	3	3	2	2
CO2	3	3	2	2	3	1	1	3	3	3	3	2
CO3	3	3	3	3	2	2	2	1	3	3	3	3
CO4	2	2	2	2	3	2	3	3	3	3	3	2
CO5	1	3	2	2	2	3	3	3	2	2	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	**2**	2
CO2	**3**	**2**	**2**
CO3	**2**	2	3
CO4	**3**	**3**	3

CO5	**2**	**3**	3

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SYLLABUS
EBT-065 Phyto chemical Technology

UNIT I: Introduction to Medicinal Plants, Classification of secondary metabolites, Medicinal importance of secondary metabolites like Flavonoids, Phenols, Alkaloids, Tannins Terpenes and Saponins for development of employability skills

.

UNIT II: Extraction of Phyto pharmaceuticals – Infusion, Decoction, Digestion, Maceration, Percolation, Successive Solvent Extraction, Super Critical Fluid Extraction for skill development.

UNIT III: Steam Distillation, Headspace Techniques, Sepbox, Selection of Suitable Extraction Process, Carbohydrates, Proteins, Alkaloids, Glycosides for development of employability skills

UNIT IV: Plant drug analysis-Application of Chromotography and Spectroscopy in Plant Drug Analysis – Infrared Spectroscopy, NMR Spectroscopy, Mass Spectroscopy to acquire skills for the development of entrepreneurship and employability.

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UNIT V: Standardization of Herbal Drugs – Importance of Standardization and Problems Involved in the Standardization of Herbs, Standardization of Single Drugs and Compound Formulations, WHO Guidelines for Quality Standardized Herbal Formulation, Estimation of Parameter Limits used for Standardization, Herbal Extracts for skill development.

Recommended Text/ Reference Book:

1. S.S. Agarwal, M.Paridhavi (2007) *Herbal Drug Technology* (1st Ed), University press (India) private limited
2. A.P.Purohit, C.K.Kokate , S.B.Gokhale (2001) *Pharmacognosy* (32nd Edition) NiraliPrakshanpune.
3. TreaseGE , Evans WC *Pharmacognosy* (14th Edition) W.B.Sondars& Co Ltd London.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the importance of global medicinal plants for human health for skill development.
CO2: Understand the extraction of solvent from medicinal plants by using different techniques.
CO3: Understand the techniques to perform the extraction process.

CO4: Understand the application of Chromatography and Spectroscopy in Plant Drug Analysis for effective development of employability skills.
CO5: Understand the Standardization and WHO Guidelines of herbal drugs for Quality for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

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SYLLABUS
EBT-066 Environmental Toxicology

UNIT I: Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide for development of employability skills

.

UNIT II: Mode of entry of toxic substance, biotransformation of xenobiotics detoxification to acquire skills for the development of entrepreneurship and employability.

UNIT III: Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing for development of employability skills

.

UNIT IV: Insecticides, MIC effects, Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements to acquire skills for the development of entrepreneurship and employability.

UNIT V: Biogeochemical factors in environmental health. Epidemiological issues goiter, fluorosis, arsenic poisoning for developing skills.

Recommended Text/ Reference Book:

1. G. S Sodhi (2009) *Fundamental Concepts of Environmental chemistry*, (3rd Ed) Alpha Science International.
2. Stanley E. Manhan (2009) *Principals of Environmental chemistry*,(9th Ed) CRC press.
3. R.B. Philip (2005) *Environmental hazards & human health*, Lewis publishers, Boca Raton.
4. Raymond Niesink, Mannfred A.Hollinger& Jon De Vries, (1996) *Toxicology - Principles & applications*. CRC Press.
5. Chatterjee (2009) *Parasitology*, (13th Ed) CBS
6. K. Perk (2013) *Preventive & Social medicines*, (22nd Ed) Banarsi das Bhanot-Jabalpur publishers.

Course Outcomes:

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

CO1: Understand the biochemical aspects of toxic chemicals and their effects.

CO2: Understand the mode of entry of toxic substances for detoxification to acquire skills for the development of entrepreneurship and employability.

CO3: Understand the mechanism of carcinogenicity and environmental carcinogenicity testing for development of employability skills
CO4: Understand the possible effects of imbalance of some trace elements to acquire skills for the development of entrepreneurship and employability.
CO5: Understand the biogeochemical factors in environmental health for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	2	2	3	2	2	2	3	2	2	2	2
CO2	2	3	3	3	3	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	**2**	**3**	2
CO2	3	**2**	**3**
CO3	**3**	3	2
CO4	2	**3**	2
CO5	3	**3**	3

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SYLLABUS
EBT-081 Non–Conventional Energy Resources

UNIT-I Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant knowledge for better employability in industry, limitations.

UNIT-II: Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance to inculcate skill, provide employability and entrepreneurial skills focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-III: Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: skill based development of the Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV: Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

UNIT-V Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants providing employability.

Recommended Text books/References:

1. John Twideu and Tony Weir, Renewal Energy Resources, BSP Publications, 2006.
2. D.S. Chauhan, Non-conventional Energy Resources, New Age International.
3. C.S. Solanki, Renewal Energy Technologies: A Practical Guide for Beginners, PHI Learning.
4. M.V.R. Koteswara Rao, Energy Resources: Conventional & Non-Conventional, BSP Publications,2006.
5. Raja etal, Introduction to Non-Conventional Energy Resources, Scitech Publications.

Course Outcome:

Students completing this course will be able to:

CO1: Define the basic concepts of global conventional & non-conventional energy resources, Introduction, availability, classification, merits and demerits of conventional & non-conventional energy resources for skill development and entrepreneurship.

CO2: It provides the information about the importance of solar energy, its application, new technology by we can extract the solar energy for entrepreneurship and employability.

CO3: Describe and discuss geothermal energy, MHD power plants and fuel cells. It also provides the information about MHD power plants, fuel cells for national skill development, entrepreneurship and employability.

CO4: This unit of this explorers the world of wind energy, its classification, uses, merits, demerits and designing of wind energy power plant. It also provides a basic knowledge about thermo electrical and thermionic conversions for skill development and entrepreneurship.

CO5: Describe and discuss the importance of local bio mass, classification of biomass, use of biomass for non-conventional energy resources. It also provides the basic information about ocean thermal energy, wave energy and tidal energy for development of entrepreneurship and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	2	2	3	3	2	2	2	2	2	3	3
2	2	2	2	3	3	2	2	2	2	2	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	2	2	2	3	3	2	2	2	2	2	3	3
5	2	2	2	3	3	2	2	2	2	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	2	2	2
CO5	2	2	2

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SYLLABUS
EBT-082 Non-Linear Dynamic Systems

UNIT-I: Dynamic systems: skill based development of the Concept of dynamic systems, importance of non-linearity, nonlinear dynamics of flows (in 1, 2, and 3 dimensions) and Maps (1 and 2 dimensions) in phase space, Equilibrium, Periodicity. Picard‟s theorem, Peano‟s theorem, boundedness of solutions, omega limit points of bounded trajectories.

UNIT-II: Stability-I: Stability via Lyapunov‟s indirect method, converse Lyapunov functions, skill based development of sublevel sets of Lyapunow functions, Lasalle‟s invariance principle.

UNIT-III: Stability-II- Lyapunov‟s direct method, converse Lyapunov‟s theorems, Brokett‟s theorem, applications to control system, stable manifold theorem, centre manifold theorem, normal form theory and applications to nonlinear systems to develop skill

UNIT-IV: Bifurcation: Elementary Bifurcation theory, catastrophe, strange attractor, fractals, fractal geometry and fractal dimension to inculcate skill, provide employability and entrepreneurship.

UNIT-V: Chaos: Deterministic Chaos, routes to chaos (period doubling, quasi periodicity, intermittency, universality, renormalization); skill based development of Measurement of Chaos (Poincare section, Lyapunov index, entropy); control of chaos.

Recommended Text books/References:

1. D.K. Arrowsmith and C.M. Place, “An Introduction to Dynamical Systems” Cambridge University press, London, 1990.
2. K.T. Alligood, T.D. Sauer, and J.A Yorke, “CHAOS: An Introduction to Dynamical System” Springer Verlag, 1997.
3. H.K. Khalis, “Nonlinear Systems” Prentice Hall, 1996.
4. R. R. Mohler, “Non linear systems, Vol-I: Dynamics and Control” Prentice Hall, 1991.
5. J.M. T. Thomson and H.B. Stewart, “Nonlinear Dynamics and Chaos” John Wiley & Sons, 1986.
6. Stanislaw H. Zak, “Systems and control” Oxford University Press, 2003.(15)

Course Outcome:

Students completing this course will be able to:

CO1: Define the skill-based development of the Concept of global dynamic systems, importance of non-linearity, nonlinear dynamics of flows and Maps in phase space for skill development and entrepreneurship.
CO2: It provides the information about Lyapunov functions for developing skills.
CO3: Describe and discuss applications to control system, normal form theory and applications to nonlinear systems to develop skill.
CO4: Understand Elementary Bifurcation theory for skill development and entrepreneurship.
CO5: Understand deterministic Chaos, routes to chaos for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

CO's	PO's											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	2	2	3	3	2	2	2	2	2	3	3
2	2	2	2	3	3	2	2	2	2	2	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	2	2	2	3	3	2	2	2	2	2	3	3
5	2	2	2	3	3	2	2	2	2	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	2	2	2
CO5	2	2	2

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SYLLABUS
EBT-083 Product Development

UNIT-1: Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., providing employability need based developments, technology based developments physical relaibility & economic feasibility of design concepts to inculcate skill, provide employability and entrepreneurial skills

UNIT –II: Morphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional, aesthetics, ergonomics, form, shape, size, colour. Mental blocks, Removal blocs, Ideation techniques for better skilling for entrepreneurship, Creativity, Check list.

UNIT –III: Transformations, Brainstorming & Synetics, Morphological techniques. Utility Concept, Utility Value, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.

UNIT-IV: Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man-machine interface, Compatibility of displays and controls. Ergonomic aspects, Anthroprometric data and its importance in design. Application of Computers in Product development & design knowledge for better employability in industry

UNIT: Existing techniques, such as work-study, skill based development of SQC etc. for improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.

Recommended Text books/References:

1. A.K. Chitab & R.C. Gupta “Product design & Manufacturing” – Prentice Hall (EE)
2. R.P. Crewford, “The Technology of creation Thinking” Prentice Hall.
3. C.D. Cain, “Product Design & Decision” Bussiness Books.
4. C.D. Cain, “Engg. Product Design” Bussiness Books.

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Course Outcomes:

At the end of the course students will able to:

CO1: Develop the concepts of design methods, physical reliability, and economic feasibility providing natioanl employability
CO2: Understand the morphology of design, transformation, and convergence phase, ergonomics and identification of needs.
CO3: Develop the decision-making approach under multiple criteria.
CO4: Check the reliability of the local system, design of the display, and application of computers in for entrepreneurial skill development and product development.
CO5: Forecast technology for improving the method and quality of products for entrepreneurship development

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	3	2	3
CO3	3	2	3

CO4	3	2	3
CO5	3	2	3

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SYLLABUS
EBT-084 Automation and Robotics

Unit I: Introduction**:** Definition, skill based Classification of Robots, geometric classification and control classification.

Unit II: Robot Elements: Drive system, control system, sensors, end effectors, gripper actuators and gripper design.

Unit III: Robot Coordinate Systems and Manipulator Kinematics: Robot co-ordinate system representation, transformation, homogenous transform and its inverse, relating the robot to its world. Manipulators Kinematics, parameters of links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control, skill based advanced techniques of kinematics and dynamics of mechanical systems, parallel actuated and closed loop manipulators.4. Robot Control: Fundamental principles, classification, position, path velocity and force control systems, computed torque control, adaptive control, Seroo system for robot control, and introduction to robot vision.

Unit IV: Robot Programming: Level of robot programming, language-based programming, task level programming, robot programming synthesis, robot programming for welding, machine tools, material handling, assembly operations, collision free motion planning providing knowledge for better employability in industry.

Unit V: Applications-Application of robot in welding, machine tools, material handling, assembly operations parts sorting and parts inspection to inculcate skill, provide employability and entrepreneurial skills.

Recommended Text /References books:

1. Coifet Chirroza, “An Introduction to Robot Technology” Kogan Page.
2. Y. Koren “Robotics for Engineers” Mcgraw Hill.
3. K. S. Fu, R.C. Gonzalez Y& CSG Lee, “Robotics” McGraw Hill.
4. J.J. Craig, “Robotics” Addison-Wesley.
5. Grover, Mitchell Weiss, Nagel Octrey, “Industrial Robots” Mcgraw Hill.
6. Asfahl, “Robots & Manufacturing Automation” Wily Eastern.

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Course Outcomes:

At the end of the course students will be able to:
CO1: Understand the geometric classification and control classification of robotics for skill development.
CO2: Understand the robotic elements for developing skills.
CO3: Understand the Robot Coordinate Systems and Manipulator Kinematics for enhancing skills.
CO4: Understand the application of Robot Programming for effective development of employability skills.
CO5: Understand the Application of robot in welding, machine tools, material handling for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	2	1	2	2	2	2	2	2	2
CO2	2	2	3	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	2	2
CO5	3	3	2	2	2	3	2	2	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	**3**	3
CO2	3	**2**	**3**
CO3	2	2	2
CO4	2	**3**	2
CO5	3	**3**	2

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SYLLABUS

EBT-085 Wildlife Ecology

Unit-I: Ecology: definition, branches of ecology. Ecosystem; Basic concepts and structure of ecosystem, Functioning of ecosystem, energy flow and nutrient cycles, food chains, food webs, trophic levels, autotrophs, heterotrophs, saprotrophs, biological cycles, structure and function of some Indian ecosystems for skill development.

Unit-II: Community ecology: Nature of communities; community structure and attributes; edges and ecotones. Species interactions: Types of interactions, competition, mutualism, commensalism, protocooperation, parasitism and predationknowledge for skill development.

Unit-III: Scope of Wildlife Biology; Physiological Basis of Hibernation, aestivation, Awakening, Migration, Circadian rhythms, Hypothalamo- Hypophysial Axis and its role, Pineal gland and its role Day- length influences on Phenology, Seed dormancy and methods of breaking itknowledge for skill development.

Unit-IV: Adaptations to Habitats ; Animal adaptations to water, temperature, salinity, predation, Deep sea & diving adaptations in animals , Role of blubber in marine mammals “Superspecialised” animal species (e.g. Ant eater) , Plant adaptations to water, temperature, salinity, predation , Association between animals for adaptation , Association between plants & animals for adaptation , Orientation & navigation in animalsknowledge for skill development.

Unit-V: Understanding biological requirements of species; design of facilities, food, hygiene, disease control, breeding. Propagation of threatened plants. Case studies on Conservation Breeding Programme of endangered wild animals. Knowledge to inculcate skills for employability and entrepreneurship.

Recommended Text / Reference Books

1. Sinclair, A. R. E., J. M. Fryxell, and G. Caughley. 2006. Wildlife ecology, conservation and management. Blackwell Science, Cambridge.
2. Brenda C. McComb. 2015. Wildlife Habitat Management.
3. Thomas J. Ryder (Editor).2018. State Wildlife Management and Conservation.

Course Outcomes:

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

CO1: Understand the definition, types, systems,, branches and functions of local and global ecology

CO2: Understand the ecology of community its nature, structure and attributes. knowledge for skill development

CO3: Learn about wildlife biology Hibernation, aestivation, Awakening, Migration etc. knowledge for skill development

CO4: Learn about Adaptation and Thermoregulaton: local Animal adaptations to water, temperature, salinity, predation knowledge for skill development.

CO5: Understand biological requirements of species, design of facilities, food, hygiene, disease control, breeding etc. knowledge for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	1	3	3	3	3	3	2	3	3	2	2
CO2	3	3	2	2	3	1	1	3	3	3	3	2
CO3	3	3	3	3	2	2	2	1	3	3	3	3
CO4	2	2	2	2	3	2	3	3	3	3	3	2
CO5	1	3	2	2	2	3	3	3	2	2	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**

CO1	3	3	2
CO2	3	2	2
CO3	3	2	3
CO4	3	2	2
CO5	3	2	2