Minutes of Meeting
Bachelor of Technology
(Biotechnology)

[Applicable w.e.f. Academic Session 2023-24 till Revised]

FACULTY OF ENGINEERING & TECHNOLOGY
COURSE STRUCTURE
RAMA UNIVERSITY, UTTAR PRADESH, KANPUR

Website: www.ramauniversity.ac.in

Ref:RU/FET/BT/BOS/2023/001 **Dated: 03-06-2023**

Faculty of Engineering & Technology
Department of Biotechnology
Minutes of Meeting
Boards of Studies

A meeting of Boards of Studies of Biotechnology (B. Tech.) held on 03-06-2023 in Dean Office. The following members were present:

1. Dr. Ajay Kumar - Chairperson
2. Dr. Manoj Kumar Mishra - Member
3. Dr. Vivek Srivastava - Member
4. Ms. Rati Bajpai - Member (Invited)
6. Ms. Deeksha Ranjan - Member (Invited)
7. Dr. Rajendra Bhadauria - Member (Invited)

The following members agreed to review the minutes in Delhi.

1. Prof.(Dr.) Sanjay Mishra - External Member

Agenda:

1. Action Taken Report (ATR) on the basis of feedback from Stack holder/External member.

The BOS committee confirmed the minutes of the BOS meeting held on 20/05/2022

2. To consider and approve newEvaluation Scheme and Syllabus.

S. No.	Item No.	Existing	Recommendation /Action Taken
1	RU/FET/ UG /BT/BOS/2022	The existing Evaluation Scheme and Syllabus was recommended and approved the proposed introduction of engineering minor electives, pathway electives in existing CBCS based curriculum	To consider and approve the proposed Evaluation Scheme and Syllabus of B. Tech Biotechnology. BOS is recommended to Applied science,

		along with its Evaluation Scheme and Syllabus concurrence with Model Curriculum released by AICTE for B.Tech. for academic session 2022-2023	verbal ability, Reasoning Ability, Capstone project and Industrial training with the same curriculum for academic session 2022-2023. BOS is recommended to Core biotechnology subjects with the revised evaluation scheme and updated syllabus for academic session 2022-2023. BOS is recommended to Core biotechnology subjects with the new codes (BTE) in the revised evaluation scheme and updated syllabus for academic session 2022-2023. BOS is recommended to Core biotechnology subjects with the inclusion of Biostatistics (BTE-303) and Fermentation technology (BTE-505) in the revised evaluation scheme and updated syllabus for academic session 2022-2023. Engineering Minor Elective I subject have been changed with updated content of Nanobiotechnology and Biosensors (TBT-601), Molecular diagnostics and its applications (TBT-602), Food safety and quality management (TBT-603) and Marine Biotechnology(TBT-604). Pathway Elective I subjects have been changed with updated content of Agro biotechnology (BTE-611), Synthetic Biology (BTE-612), Biotechnology for society (BTE-613) and Biomedical Engineering (BTE-614). Engineering Minor Elective II subject have been changed with updated content of Genomics & Genome Engineering (TBT-701), Food Packaging and Storage (TBT-702), Cancer Biology (TBT-703) and Medical biotechnology (TBT-704). Pathway Elective II subjects have been

			changed with updated content of Applications of Natural Products (BTE-711), Pharmaceutical Biotechnology (BTE-712), Biopharmaceuticals (BTE-713) and Bioentrepreurship (BTE-714).

3. **Result Analysis:** All Final year students have 100 % cleared pass their final exam. 93.10 % students of B.Tech III[rd] year was cleared pass the final exam with good marks. 100 % students of B.Tech II[nd] year was cleared pass the final exam with good marks. All students of B.Tech II[nd] Year and B.Tech III[rd] has to promote in next semester of the session 2022-23 (Annexure -1).

4. **Feedback Analysis:** Feedback from all B.Tech. Students of session 2022-23 were good for academic and at present available infra of the department.

5. **Short term course:** In coming session 2023-24, we have proposed again short term "Plant Tissue Culture Techniques" as per last session.

The meeting concluded with a vote of thanks to the chair.
Date of the Next Meeting: to be decided and intimated thereafter

(Chairman)

Encl.: Recommended Curricula attached for consideration and approval.

Date of the Next Meeting: to be decided and conveyed later

Chairperson
Signature: 23/6/2023
Name: Dr. Ajay Kumar
Date:

Internal Members
Signature: 1..... 2.....
Name: Dr. Manoj Kumar Mishra Dr. Vivek Srivastava

External Members
Signature: 1.....
Name: Prof.(Dr.) Sanjay Mishra
Date:

Encl.: Recommended Curricula attached for consideration and approval.

CC:

1. Dean
2. Registrar Office

Annexure-1

Result analysis B.Tech Biotechnology, Session- 2022-23

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** First Year **(I Semester)** (Batch 2022-23) Main Examination **Session, 2022-23**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BSC-104	APPLIED CHEMISTRY	16	12	4	75
2	PBT-101	CELL BIOLOGY	16	12	4	75
3	HSC-101	COMMUNICATION SKILLS -I	16	14	2	88
4	ESC-103	COMPUTATIONAL THINKING & PROGRAMMING	16	16	0	100
5	BSC-105	FUNDAMENTAL MATHEMATICS	16	10	6	63
6	PBT-102	INTRODUCTION TO BIOTECHNOLOGY	16	16	0	100
7	BSC-154	APPLIED CHEMISTRY LAB	16	16	0	100
8	PBT-153	CELL BIOLOGY LAB	16	16	0	100
9	HSC-151	COMMUNICATION SKILLS -I LAB	16	16	0	100
10	ESC-153	COMPUTER PROGRAMMING LAB	16	16	0	100

Main Results:-

1	No. of Students Appeared	16
2	No. of Students Passed	9
	General/Overall Pass %	**56.25**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** Second Year **(III Semester)** (Batch 2021-22) Main Examination **Session, 2022-23**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below -

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	PBT-302	BIOANALYTICAL TECHNIQUES	7	7	0	100
2	PBT-303	BIOCHEMISTRY	7	7	0	100
3	ESC-303	FLUID MECHANICS	7	7	0	100
4	PBT-301	GENETICS AND MOLECULAR BIOLOGY	7	4	3	57
5	PBT-304	MICROBIOLOGY AND IMMUNOLOGY	7	5	2	71
6	HSC-301	VERBAL ABILITY-I	7	7	0	100
7	PBT-353	BIOANALYTICAL TECHNIQUES LABORATORY	7	7	0	100
8	PBT-351	BIOCHEMISTRY LABORATORY	7	7	0	100
9	ESC-354	FLUID MECHANICS LABORATORY	7	7	0	100
10	PBT-352	MICROBIOLOGY LABORATORY	7	7	0	100

Main Result:

1	No. of Students Appeared	7
2	No. of Students Passed	4
	General/Overall Pass %	**57.14**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** Third Year (V Semester) (Batch 2020-21) Main Examination **Session, 2022-23**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BTPE-202	BIOLOGICAL PROCESS IN WATER & WASTE WATER TREATMENT	7	7	0	100
2	BTPS-108	GENETIC ENGINEERING	7	7	0	100
3	BTPS-109	FERMENTATION BIOTECHNOLOGY	7	7	0	100
4	BTSE-101	PROCESSING TECHNOLOGY OF DAIRY PRODUCTS	7	7	0	100
5	HU-003	ORGANIZATION BEHAVIOUR	7	7	0	100
6	BTPE-222	BIOLOGICAL PROCESS IN WATER & WASTE WATER TREATMENT LAB	7	7	0	100
7	BTPS-128	GENETIC ENGINEERING LAB	7	7	0	100
8	BTPS-129	FERMENTATION BIOTECHNOLOGY LAB	7	7	0	100
9	BTSE-121	DAIRY PROCESSING LAB	7	7	0	100
10	EVS-001	ENVIRONMENTAL STUDIES	2	2	0	100

Main Result:-

1	No. of Students Appeared	7
2	No. of Students Passed	7
	General/Overall Pass %	**100.00**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** Fourth Year **(VII Semester)** (Batch 2019-20) Main Examination **Session, 2022-23**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BTPS-113	BIOSEPARATION & DOWNSTREAM PROCESSING	30	30	0	100
2	BTPS-114	BIOINFORMATICS-II	30	30	0	100
3	BTSE-102	ENTREPRENEURSHIP & PATENTING IN BIOTECHNOLOGY	30	30	0	100
4	CBCH-102	HEAT AND MASS TRANSFER FOR BIOTECHNOLOGY	30	30	0	100
5	HU-002	INDUSTRIAL MANAGEMENT	30	30	0	100
6	BTPJ-602	MINI PROJECT-II	30	30	0	100
7	BTPJ-604	INDUSTRIAL TRAINING VIVA-VOCE	30	30	0	100
8	BTPS-134	BIOSEPARATION & DOWNSTREAM PROCESSING LAB	30	30	0	100
9	BTPS-135	BIOINFORMATICS-II LAB	30	30	0	100

Main Result:-

1	No. of Students Appeared	30
2	No. of Students Passed	30
	General/Overall Pass %	**100.00**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** First Year **(IInd Semester)** (Batch 2021-22) Main Examination **Session, 2021-22**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BSC-204	ADVANCED MATHEMATICS	8	7	1	88
2	BSC-203	BIOENGINEERING PHYSICS	8	8	0	100
3	HSC-201	COMMUNICATION SKILLS-II	8	8	0	100
4	BSC-205	ENVIRONMENT AND ECOLOGY	8	8	0	100
5	PBT-202	HUMAN PHYSIOLOGY	8	8	0	100
6	ESC-206	INTRODUCTION TO DIGITAL SYSTEM	8	8	0	100
7	HSC-202	UNIVERSAL HUMAN VALUES & PROFESSIONAL	8	8	0	100
8	ESC-256	DIGITAL SYSTEM LABORATORY	8	8	0	100
9	PBT-253	ENVIRONMENTAL BIOTECHNOLOGY LABORATORY	8	8	0	100
10	PBT-252	HUMAN PHYSIOLOGY LABORATORY	8	8	0	100
11	BSC-253	PHYSICS LABORATORY	8	8	0	100

Main Result:-

1	No. of Students Appeared	8
2	No. of Students Passed	7
	General/Overall Pass %	**87.50**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** 2nd Year **(IVth Semester)** (Batch 2020-21) Main Examination **Session, 2021-22**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BTPE-103	BIOSTATISTICS	7	7	0	100
2	BTPS-104	MOLECULAR BIOLOGY	7	7	0	100
3	BTPS-105	IMMUNOLOGY	7	7	0	100
4	BTPS-106	ENZYME ENGINEERING & TECHNOLOGY	7	7	0	100
5	BTPS-107	GENETICS	7	7	0	100
6	MOOC-001	BASICS OF BIOLOGY/MOOC'S	1	1	0	100
7	BTPS-124	MOLECULAR BIOLOGY LAB	7	7	0	100
8	BTPS-125	IMMUNOLOGY LAB	7	7	0	100
9	BTPS-126	ENZYME ENGINEERING & TECHNOLOGY LAB	7	7	0	100
10	BTPS-127	GENETICS LAB	7	7	0	100

Main Result:-

1	No. of Students Appeared	7
2	No. of Students Passed	7
	General/Overall Pass %	**100.00**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** 3rd Year **(VIth Semester)** (Batch 2019-20) Main Examination **Session, 2021-22**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BBOE-401	HUMAN RESOURCE MANAGEMENT	29	29	0	100
2	BTPE-303	ANIMAL BIOTECHNOLOGY	29	29	0	100
3	BTPS-110	BIOPROCESS ENGINEERING	29	27	2	93
4	BTPS-111	PLANT BIOTECHNOLOGY	29	29	0	100
5	BTPS-112	BIOINFORMATICS-I	29	29	0	100
6	MOOC-001	BASICS OF BIOLOGY/MOOCS	2	2	0	100
7	BTPJ-501	MINI PROJECT-I	29	29	0	100
8	BTPS-130	BIOPROCESS ENGINEERING LAB	29	29	0	100
9	BTPS-131	PLANT BIOTECHNOLOGY LAB	29	29	0	100
10	BTPS-132	BIOINFORMATICS-I LAB	29	29	0	100

Main Result:-

1	No. of Students Appeared	29
2	No. of Students Passed	27
	General/Overall Pass %	**93.10**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-Chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Bachelor of Technology (Biotechnology)** 4th Year **(VIIIth Semester)** (Batch 2018-19) Main Examination Session, 2021-22

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	BBT-813	ENVIRONMENTAL BIOTECHNOLOGY	23	23	0	100
2	BBT-814	STEM CELL SCIENCE	23	23	0	100
3	BBT-816	ADVANCED VIROLOGY	23	23	0	100
4	MOOC-001	STRUCTURAL BIOLOGY/MOOC'S	1	1	0	100
5	BBT-861	MAJOR PROJECT	23	23	0	100

Main Result -

1	No. of Students Appeared	23
2	No. of Students Passed	23
	General/Overall Pass %	**100.00**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

Program Educational Objectives

At Rama University Biotechnology program will prepare its graduates to:

PEO 1: To prepare biotechnology graduates for a successful technical and professional career as per the needs of the biotechnology industry.

PEO 2: To provide students with a strong foundation in scientific, engineering and mathematical fundamentals necessary to design, analyze and solve technical problems in the biotechnology industry.

PEO 3: To inculcate professional and ethical attributes in the students and to promote lifelong learning of attributes related to biotechnology.

PEO 4: To encourage students to pursue higher education and research.

PEO 5: To develop graduates with enhanced technical acumen, aptitude, communication and professional skills.

Program Specific Outcomes

PSO 1: Graduate shall have the ability to apply fundamental knowledge of mathematics, biology, biological processes, and the scientific method to solve problems in biotechnology.

PSO 2: Graduate shall have the ability to integrate biological knowledge and concepts with the ethical and industrial perspectives of biotechnology and life sciences.

PSO 3: Graduate shall have the ability to work in groups or individually to develop written and oral presentations skills for effective communication of scientific concepts. Students are expected to engage in independent and lifelong learning in the context of biotechnological advancements.

PSO 4: Graduate shall have the ability to apply major quantitative and computational skills and tools to solve problems in the biotechnology industry.

Program Outcomes:

PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem analysis: Identity, formulates, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 - The engineer and society: Apply to reason informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in thebroadestcontext of technological change.

ORDINANCE, RULES, REGULATIONS

for

Bachelor of Technology Programmes

1. Title

This ordinance shall be called as "The Rama University Uttar Pradesh, Faculty of Engineering &Technology Ordinance Governing Four Years B.Tech. Degree Course"

2. Duration of the Course

i. The Course shall consist of regular study for a minimum period of 8 semesters in four academic years, after +2 and 6 semesters in three academic years, after Diploma.
ii. The course of study shall be by regularly attending the requisite number of lectures, tutorials and practical training.
iii. The 3rd, 5th, and 7th semesters shall ordinarily be from 1st July to 31stDecember; however, the First semester shall ordinarily begin from 1st August. The remaining semesters shall be from 1st January to till 30th June subject to change, if any notified by the Vice Chancellor and other competent authorities; from time to time. The periods are inclusive of the time for examinations.
iv. Total duration of the B.Tech. Course shall be 4 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by UGC from time to time.
v. A candidate, who has failed twice in first year due to any reason (either due to his/her non-appearance or he/she being not permitted to appear in semester examinations) shall not be allowed to continue his/her studies further subject to clause 9.
vi. The maximum time allowed for a candidate admitted in I /III semester (for diploma holders) for completing the B.Tech. Course shall be 7 (seven) / 5 (five) years respectively, failing which he/she shall not be allowed to continue for his/her B.Tech. Degree.

3. Medium of Instruction

The medium of instruction and examination shall be in English only.

4. Number of seats

Number of students to be admitted each year and the number of batches shall be decided and notified by the University from time to time; based upon the Rules, instructions and Notifications issued by UGC.

5. Admission

5.1. Admission to B.Tech. First year in Isemester and lateral admission in B.Tech. Second year in III semester (for diploma holder candidates only) will be made as per the rules prescribed by the Academic Council of the Rama University, Kanpur.

5.2. Admission on migration of a candidate from any other University to the University is permitted.

6. Eligibility for Admissions:

6.1. Admission to B. Tech. First Year:

Candidates who have passed 10+2 from CBSE/ISC/Any state board/NIOS (with minimum 50% marks in PCM or PCB) standard from other board with Physics and Mathematics along with any one of Chemistry/Bio-Technology/Computer Science/ Biology are eligible for admission to first year of 4 yearsB.Tech. Courses offered by Faculty of Engineering &Technology affiliated to Rama University, Kanpur.

6.2. Admission to B.Tech. Second Year through Lateral Entry Scheme:

Candidates who have passed 3/ 4 Year Diploma (with minimum 50% marks) from institutions recognized by the Board of Technical Education or University in any branch of Engineering/Technology except Agriculture Engineering. are eligible for admission to Second year in any branch of Engineering /Technology except Agriculture Engineering.

7. Procedure for Admission

At the relevant time admission to the course shall be governed by The Acts, Statutes and Ordinances in force and issued by the University. Admission to the Course shall be made strictly on the basis of the merit of the Entrance Test.

Provided that while making admission to the course reservation policy of the Government of Uttar Pradesh governing admission to higher educational Institutions issued from time to time shall be applied

8. Fee

A student shall pay the fee prescribed by the University from time to time

9. Attendance

9.1 Every student is required to attend all the lectures, tutorials, practicals and other prescribed curricular and co-curricular activities. The attendance can be condoned up to 25% on medical grounds or for other genuine reasons beyond the control of students.

9.2 A further relaxation of attendance up to 10% for a student can be given by Dean provided that he/she has been absent with prior permission of the Head of Department for the reasons acceptable to him. Vice Chancellor may further condone attendance shortage up to 5% on genuine grounds. However, under no circumstances, a student with an attendance of less than 60% in a subject shall be allowed to appear in the semester-end examination of that subject. Provided that the late admitted students in the first semester of any course maintain at least 75% attendance (including medical and other reasons) from the date of their admission.

9.3 No student will be allowed to appear in the end semester examination if he / she do not satisfy the overall average attendance requirements of Clause Nos. 9.1, and 9.2 and such candidate(s) shall be treated as having failed and will be further governed by clause no. 2.5 & 2.6.

9.4 The attendance shall be counted from the date of admission in the college or start of academic session whichever is later.

10. Curriculum:

10.1 The 4 Year curriculum has been divided into 8 Semesters and shall include lectures, tutorials, practicals, seminars and projects etc. in addition to industrial training and educational tour etc. as defined in the scheme and executive instructions issued by the University from time to time.

10.2 The curriculum will also include such other curricular, co-curricular and extra- curricular activities as may be prescribed by the University from time to time.

11. Change of Branch:

11.1 Change of branch may be allowed against the vacant seats in the following two stages, provided criteria at following sub clauses is satisfied:

(i) In first year, after the last date of admission to the B.Tech. I semester, on the basis of merit of (10+2) examination marks on vacant seat subject to clause 11.2.

(ii) In the second year, on the basis of merit at the B.Tech. First year examination for those who are pass without any carry over paper.

11.2 After change of branch, number of students in branch(s) shall neither increase over the intake approved by UGC or A.I.C.T.E. nor it will decrease below 75% of intake approved by UGC or A.I.C.T.E.

11.3 Change of branch facility is not applicable to following:

Candidates admitted in second year of B.Tech. Courses as per clauses 6.2.

11.4 The change of branch if allowed will become effective from B.Tech. III semester.

11.5 Further change of branch shall not be permitted.

12. Teaching

The objective of classroom education is to awaken the curiosity of the student, generate habits of rational thinking in him, gear his mind to face the unfamiliar and train him to stand on his own. Classroom instruction helps the student in the organization and correlation of facts, comprehension of ideas and the creative use of knowledge.

The teacher also has the additional responsibility to make the student search for knowledge on his own and induce him to use additional facilities like the library, laboratory and the environment, to optimize his learning process. Self-study by the student would therefore form an important factor in the planning of teaching and evaluation. The student is required to cooperate and respond to this challenge.

Every course whether single-section or multi-section is conducted by a member of the faculty called instructor-in-charge, with the assistance, wherever necessary, of the required number of instructors who will be partners with him in meeting the full academic perceptions and organizational needs of teaching the course and evaluating the students. Wherever the instructor-in-charge is mentioned hereafter, it connotes the team of instructors, acting as one entity under his captainship.

The instructor-in-charge should make a comprehensive plan in respect of conducting the course even before the semester begins. In a multi-section course, all instructors must remain in continuous interaction in order to ensure a smooth operation of the course. While recognizing variations due to personal attitudes and styles, it is important that these are smoothened out so that the operation and grading in different sections in a course, indeed between courses across the faculty, are free from any seeming arbitrariness.

At the beginning of class work, the instructor, in-charge/instructor must announce to his class/ section through a Course Handout/Lesson Plan, the necessary information in respect of (i) the operations of the course (its pace, coverage and level of treatment, textbooks and other reading assignments, home tasks etc); (ii) various components of evaluation, such as tutorials, laboratory exercises, home assignment, several quizzes/tests/examinations (announced or unannounced, open book or closed book), regularity of attendance, etc. (iii) the frequency, duration, tentative schedule, relative weightage etc., of these various components; (iv) the broad policy which governs decisions about make-up; (v) mid-semester grading; (vi) grading procedure (overall basis, review of border line cases, effect of class average etc.) vii) Chamber consultation hours and (viii) other matters found desirable and relevant.

13. Examination:

13.1 The performance of a student in a semester shall be evaluated through continuous evaluation and end semester examination. The continuous evaluation shall be based on Mid Term Examination, assignments/tutorials, quizzes/viva-voce and attendance. The marks for continuous evaluation (Sessional marks) shall be awarded at the end of the semester. The end semester examination shall be comprised of written papers, practicals and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

13.2 The distribution of marks for sessional, end semester theory papers, practicals and other examinations, seminar, project, industrial training shall be as prescribed.

13.3 The marks obtained in a subject shall consist of marks allotted in end semester theory paper, practical examination and sessional work.

13.4 To qualify a subject a student is required to secure a minimum of 30% marks in both internal as well as external separately and grand total required for a subject is minimum 40%. A student who secure less than 50% of marks in aggregate in a semester shall be deemed to have failed in that semester.

13.5 The minimum pass marks in a project/practical subject (including sessional marks if any) shall be 50% (internal 50%, External 50% and aggregate 50%).

13.6 A candidate, in order to pass, must secure 50% marks in the aggregate in a particular academic year inclusive of each semesters of the academic year.

13.7 The minimum pass marks in Seminar, Industrial Training and Educational Tour, Viva-Voice etc shall be 50%.

13.8In Non Credit Courses (Non grading courses) a student's must secure 40% marks to qualify the courses.

14. Evaluation Feedback

Just as evaluation is done in continuous manner, feedback should also be available in a continuous manner. Thus, the answer scripts must be promptly evaluated, shown to the students for them to obtain any clarification on their performance and returned to the students whenever practical. The performance of the students in the examination should be discussed in the class giving as much details as possible like the highest, lowest and average performances. Solutions with marking schemes are displayed soon after a test.

15. Promotion:

15.1 A candidate satisfying all the requirements under clause 13 shall be promoted to the next academic year of study.

15.2. (a) A candidate shall be eligible for provisional promotion to the next academic year of study provided:

(i) He/ She should either completely clear all the subject of any of the semester of an academic year or earn the credit greater than or equal to the minimum credits of either of the semester of that academic year.

(ii) In yearly result, A student shall be declared PASS only of he/ she secures above grades in all the subjects and minimum Semester Grade Point Average (SGPA) of 5.0, in each semester of an academic year.

(b) If a candidate satisfies the requirement of clauses 13.4, 13.5 & 13.7 but fails to satisfy the requirement of clause 14.6, he/she shall be eligible for provisional promotion with carry over. He/she may choose up to a maximum of any four theory papers of that particular academic year as per his/her choice to pass the examination of that year.

15.3 A candidate shall not be promoted to third year unless he/she passes all the subjects of first year. Similarly, a candidate shall not be promoted to fourth year unless he/she passes all the examinations of second year.

15.4 All other candidates who do not satisfy conditions laid down in clause 8 shall be declared fail and shall be required to repeat the whole academic year after taking re- admission. This facility is, however, subject to the time limits stipulated in clause-2.

16. Carryover System:

16.1 (a) A candidate who satisfies the requirements of clause 16.2 (a) will be required to appear in those theory papers / practicals in which he/she failed. However, a candidate of first year will be allowed to appear in the second semester examination in those theory/ practical subjects in which he/she failed in the first semester examination, provided examination of those theory/practical subjects are held in second semester.

(b) A candidate satisfying clause 16.2 (b) shall be required to exercise his/her choice up to a maximum of Six theory papers in which he/she desires to appear in the examination to fulfill the requirements of clause 14.6. He/she shall inform the college about his/her choice within 15 days after the start of new session.

16.2 The highest marks secured in any subject in various attempts (end semester and carryover examinations) shall be considered.

17. Ex-studentship:

17.1 A candidate opting for ex-studentship shall be required to appear in all the theory & practical subjects in the end semester examinations of both semesters of the same academic year. However, the marks pertaining to Sessional, Industrial Training, and Seminar shall remain the same as those secured earlier.

17.2 A candidate opting for ex-studentship shall be required to apply to the FET by paying only examination fee within 15 days from the start of new session.

18. Re-admission:

A candidate may be allowed for re-admission provided he/she satisfies one of the following conditions:

18.1 A candidate is declared fail.

18.2 A candidate did not appear in a semester examination / or he/she was not granted permission to appear in the examination.

18.3 A candidate has been detained by the department and subsequently has been permitted to take re-admission.

Students failing to obtain 75% attendance shall be required to repeat the course in the subsequent year, along with the next batch, to make up for the shortage of attendance.

Under extraordinary circumstances, a student with attendance below 75% shall be allowed to appear in the term exams / viva voce. This will be at the discretion of the Vice Chancellor of the University. Circumstances when such leniency shall be shown include:

a. Death of a blood relative – father, mother, grandfather, grandmother, brother or sister.
b. Extreme cases of health adversity requiring hospitalization of the student.

In such cases, the student shall be required to give a written application to the Vice Chancellor of the University, along with appropriate proof. In case of death of blood relative, an application from the parent(s) shall be considered.

All faculty members shall maintain appropriate records and make them available to the University's examination centre at the end of the semester.

Credit System:

The B. Tech. Program has a total of 184 credits (164 Credit Course curriculum and 20 MOOCs Course) and students are required to complete all courses. On completion of all courses, the students shall earn 200 credits and would be eligible for award of the B. Tech. Degree.

Seminar(B. Tech.)

Each student shall select on one recent or hot topic for seminar. The students are required to prepare three copies of their seminar reports of which two have to be submitted to the Faculty. The reports shall be submitted within two weeks of commencement of the seventh semester. The report shall carry 30 marks, out of which 50 shall be evaluated by an External Examiner appointed by the University while the remaining 20 marks shall be evaluated by a Board of Internal Examiners (minimum two) appointed by the Dean, Faculty of Engineering & Technology. The Seminar shall be evaluated in the following manner:

Criteria	Internal	External	
Project Report	20	-	
Viva Voce	20	50	
Attendance	10		
Total	50	50	100

External evaluation will be conducted during seventh end semester practical exam.

Summer Industrial Training (B. Tech.)

Each student shall undergo practical training of six to eight weeks during the vacations after the sixth semester. The students are required to prepare three copies of their project reports of which two have to be submitted to the Faculty. The reports shall be submitted within two weeks of commencement of the seventh semester. The report shall carry 30 marks, out of which 50 shall be evaluated by an External Examiner appointed by the University while the remaining 20 marks shall be evaluated by a Board of Internal Examiners (minimum two) appointed by the Dean, Faculty of Engineering & Technology. The summer training Project shall be evaluated in the following manner:

Criteria	Internal	External	
Project Report	30	-	
Viva Voce	20	50	
Total	50	50	100

External evaluation will be conducted during seventh end semester practical exam.

Final Year Mini Project Report (B. Tech. 7th semester)

During the seventh semester, each student shall undertake a project to be pursued by him/her under the supervision of a faculty guide/supervisor. The guide/ supervisor shall be appointed by the Dean, Faculty of Engineering & Technology. Minimum four copies of project report along with one soft copy in a CD shall be submitted at least two weeks prior to the commencement of the 7th End Term Examination. The mini project report shall carry 50 marks, out of which 25 shall be evaluated by an External Examiner appointed by the University while the remaining 25 marks shall be evaluated by a Internal Examiner appointed by the Dean, Faculty of Engineering & Technology. The mini project report shall be evaluated in the following manner:

Criteria	**Internal**	**External**	
Project Report	40	100	
Viva Voce	40	100	
Attendance	20		
Total	100	200	300

Final Year Major Project Report (B. Tech.)

The final year major project may be extension of seventh semester mini project. During the eight semesters, each student shall undertake a project to be pursued by him / her under the supervision of a guide/supervisor. The guide/supervisor shall be appointed by the Dean, Faculty of Engineering & Technology. Minimum four copies of project report along with one soft copy in a CD shall be submitted at least two weeks prior to the commencement of the 8th End Term Examination. The major project report of 650 marks and shall be evaluated by a Board of Internal & External Examiners. The Board shall consist of a minimum of two Internal Faculty Members supervisor shall be appointed by the Dean, Faculty of Engineering & Technology and External Examiner shall be appointed by the University. The major project report shall be evaluated in the following manner:

18.4 A candidate as an ex-student passed the examination of the academic year or qualified for carryover system.

18.5 A candidate promoted with carry over subjects and he/she opted for re- admission.

19. Results:

19.1 The result of a candidate shall be declared on the basis of performance of both semesters of the same academic year. However, a final year student, who is not permitted in any one of the final year semester examinations due to shortage of attendance, will be permitted in that particular semester of the next academic session to study as a regular student and appear at that semester examination.

19.2 Result of the final year shall be declared on the basis of working out Grand Total by adding marks of all the years of study in the following ways:

(a) For candidates admitted to B.Tech. Course as per clause 6.1

I Year 100% of aggregate marks

II Year 100% of aggregate marks

III Year 100% of aggregate marks

IV Year 100% of aggregate marks

(b) Candidates admitted in III semester of B.Tech. Course as per clause 6.2

II Year 100% of aggregate marks

III Year 100% of aggregate marks

IV Year 100% of aggregate marks

20. Award of Division: The division shall be awarded on the basis of final year result.

20.1 Calculation of Grade Point and Grade Point Average

Relative grading shall be adopted at the Faculty of Engineering & Technology, Rama University. The list of letter grades, the grade points associated with them are given below:

Grade	Grade Point
O	**10**
A	**9**
B	**8**
C	**7**
D	**6**
E	**5**
F	**0**

In order to arrive at alphabet grades, the total marks in a particular course for all the students pursuing the course are tabulated in the descending order (equivalently a histogram).
The performance of the course is analyzed in terms of the highest, lowest and the average marks and the dividing lines between the clusters of students. Gaps and dips between the clusters and the nature of the clusters guide in drawing the dividing lines between the grades. In a normal class of large size, the C grade usually covers the average performance. This is, however not a hard and fast rule and exceptions may arise in case of small classes, skewed histogram etc. Borderline cases may be considered individually on the basis of regularity and the attendance, class room discussions, progressive good performance throughout the semester, etc.

20.2 Calculation System of Semester Grade Point Average:

- Computation of the Semester Grade Point Average (SGPA) and Cumulative Performance Index (CPI):

  The SGPA is an indicator of the overall academic performance of a student in all the courses he/she has registered during a given semester. It is computed as follows: If the grades awarded to a student are G_1, G_2 etc in courses with corresponding credits C_1, C_2 etc, the SGPA is given by:

$$SGPA = \frac{C_1 \times G_1 + C_2 \times G_2 + \cdots + C_n \times G_n}{C_1 + C_2 + \cdots + C_n}$$

- The CPI indicates the overall academic performance of a student in all the courses registered upto and including the latest completed semester/summer term. It is computed in the same manner as the SGPA, considering all the courses (say, n) and is given by:

$$CPI = \frac{\sum_{i=1}^{n} C_i \times G_i}{\sum_{i=1}^{n} C_i}$$

- Percentage conversion of CPI:

$$Percentage\ of\ marks = \left(\frac{SGPA}{CGPA} \times 10\right) - 4.5$$

- Students should get a minimum grade E in each subject with 5CPI to clear the semester.

- CPI conversion

≥8 CPI	**I Division with Honours**
≥6 CPI	**I Division**
≥5 CPI	**II Division**
<5 CPI	**Fail**

21. Award of Rank:

On the basis of final year result, the top ten candidates in each branch shall be awarded rank according to their merit provided they pass all the examinations in first attempt.

22. Reports

At the end of the course, in certain situations, the instructor-in-charge may report certain events/facts in suitable words, in place of grades discussed earlier. These reports are not to be construed as grades. The various reports listed below are elaborated in the subsequent clauses.

- Incomplete (I)
- Grade Awaited (GA)
- Withdrawn (W)
- Registration Cancelled (RC), Required to Register (RR), Discontinued from the Program (DP)
- Not Cleared (NC)

Incomplete (I)

If the instructor-in-charge finds a student having not fulfilled some of the requirements of a course before the final deadline for transmitting the grade, and he is satisfied that he is able to transmit some grade or a report with or without this particular fulfillment, but at his discretion wishes to give the student an

opportunity, he may, within the deadline, send a report 'I' (Incomplete) and also inform the student of the same. It shall be the responsibility of the student to contact the instructor-in-charge in time for replacement of the 'I' report within two weeks after the end of the semester (and within one week after the end of summer term, for a summer term course) which the instructor-in-charge will communicate whatever grade/report is possible for the situation. Whenever such relaxation is made, the Dean/Director will specify at his discretion, with the consent of the instructor-in-charge, the date by which 'I' report has to be converted.

The requirement envisaged in the above clause must be completed within the time allowed. If the extra time given goes beyond the registration in the next semester/term, registration in the next semester/term is not possible. The student in such a situation should seek permission to stay away as per the above clause

Grade Awaited (GA)

There are many situations where operational and practical difficulties may cause a delay in the communication of a grade. Certain situations which are visualized in this connection are: (i) where a case of unfair means is pending; (ii) where a case of indiscipline is pending, and (iii) where the courses are being conducted at an off campus centre for IP students, where precise co-ordination between the Institute and these centers may not work in a timely manner. In these circumstances the Dean may authorize the instructor-in-charge to report GA (Grades Awaited).

A student may also get a "GA" report if he has, due to a genuine reason not been able to appear for an examination on the scheduled date and his request for make-up has been granted. In such a case, the student should ensure by the end of the term that either:

- He takes the make-up examination and convert the "GA" report onto a letter grade or
- He makes an application to the Dean/Director, through Instructor in Charge to convert "GA" report into a "NC" report.

Whenever the report GA appears in the grade sheet, a student will not be allowed to register for the subsequent semester, until the student takes steps to convert "GA" report into a letter grade or "NC" report.

Withdrawn (W)

A student may seek withdrawal from the course(s) in a semester for any of the following reasons:

- The student is unable to register for the course(s) for a genuine reason.
- The student is unable to cope up with the normal load and withdraws from the course(s) to reduce his academic load for a particular semester.

The request for withdrawal should be made to the Dean of the faculty, within two weeks of the commencement of the semester in case of (i) above and within the stipulated duration as specified in the academic calendar in the case of (ii) In such cases the grade sheet/transcript of the student will indicate 'W' (Withdrawn against the course(s) from which the student has withdrawn his registration. The student will have to register for the course(s) when it is offered next and obtain a valid letter grade. If the course with 'W' report is a prerequisite course for another course, the registration to the course is possible only on obtaining a valid letter grade in the prerequisite course with 'W' report. If the withdrawal is made after the due date, the event will be reported as "RC" or "DP" as the case may be.

Registration Cancelled (RC) or Required to Register (RR) or Discontinued from the Programme (DP)

If a student's registration for a course has to be cancelled, this fact will be reported in the grade sheet as RC (Registration Cancelled). Registration would be cancelled and an RC is issued in the following cases:

- Cancellation is recommended as a part of disciplinary action for resorting to unfair means during examination or other unprofessional behaviour.
- Cancellation is recommended due to less than the minimum required percentage of attendance.
- Cancellation is recommended if a provisionally admitted student fails to submit the proof of necessary documents required for registration and/or does not satisfy the minimum eligibility requirements for the admission within the prescribed time limit.
- Cancellation is recommended when a student persistently and/or deliberately does not pay his dues.

RC itself has many meanings and may be reported as the following:

- When it is clearly known that the student will be required to register again in the same course, the event will be reported as RRA (Required to Register Again).
- If RC amounts to discontinuation from the program it will be reported as DP (Discontinued from the Program)
- If the cancellation of registration is not reported either as RRA or as DP but is reported as RC, it does not necessarily mean that it is free from any constraint. The meaning of the constraint has to be construed from the context in which the RC is reported.

Not Cleared (NC)

If a student continued to remain registered in a course but gave the instructor inadequate opportunity to evaluate him by absenting himself from quizzes/tests/examinations/other components of evaluation, or by appearing in the same for the sake of appearance without applying himself to the task in hand or by submitting a blank script (answer book), these events would be reported as NC (Not Cleared).

Whenever a student gets a NC report in a course irrespective of whether he has a grade in the course or not earlier to this event, the following will govern further action. It is to be noted that a NC cannot be ignored, except under the situations described below:

- Whenever a student gets a NC report in a course which is in the compulsory package of his program, he is required to register again in the some course and get a valid grade therein.
- If a student has a NC report in a course taken as elective, he can either repeat the course to get a valid grade or ignore it to choose another course. However, a student must get valid grades in at least the prescribed number of electives in his program.
- Whenever a student's record has an NC in a course which remains unaccounted after a process of transfer has been completed it will not be possible for him to wipe out the NC report in such a course because this course is not a part of his program anymore; and he can graduate with this NC.
- If a student is reported NC in a project course, it will be administratively converted to RC by the Dean and future registration in project courses will be done only if the Dean is satisfied with the genuineness of the candidate's interest in the course.

- If a student is reported NC in Thesis or Seminar, he will be required to register in the same for one more semester. Operationally, this is to be achieved by requiring him to register once again in as many units of Thesis or Seminar in which he had registered when he was awarded NC. If these two courses get separated due to NC in one of them, there is no need to register in the other.

23. Grade Sheet

A student's grades, reports, CGPA, etc., at the end of every semester/term will be recorded on a grade sheet, a copy of which will be issued to him. The grade sheet will be withheld when a student has not paid his dues or when there is a case of breach of discipline or unfair means pending against him.

While registration with approval of appropriate authority consistent with these regulations is a token of permission to pursue studies, the grade sheet is a complete record of the outcome of what was intended in the original/amended/ revised registration. The various grades and reports discussed above would be appropriately used to tally the grade sheet with original/ amended/revised registration. It would be evident that this tally between what was registered for and what was obtained in terms of grades and reports will apply to all courses except the course, which was originally registered for, but subsequently replaced by another course through substitution.

The tally is made on a course basis at the end of semester/term to determine which of the courses have been cleared. A course is deemed to have been cleared if the student obtains a grade in the course. However, mere clearing of the prescribed courses does not tantamount to fulfilling the requirements of graduation.

While all the grades secured and other pertinent information for semesters are given in a grade sheet, the chronologically organized information from the grade sheets of a student with the necessary explanation constitutes his transcript which is issued at the time he leaves the Institute or at an intermediate point on request.

24. Scrutiny and Revaluation:

26.1Scrutiny shall be allowed in maximum three theory papers only as University norms.

26.2Revaluation shall be allowed in maximum three theory papers only as University norms.

25. Unfair means:

Cases of unfair means shall be dealt as per the rules of the University and The U.P. Public Examination (Prevention of Unfair means) Act if any in prevalence.

26. Award of Sessional Marks:

Sessional marks for theory subjects, practicals and project shall be awarded as will be prescribed and at present the break-up of sessional marks shall be as follows:

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 10 Marks
2. Assignments/Quiz / Seminar/Term paper:10Marks

MTE - Mid Term Examination: 20 Marks
a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks
c. Pre University Test: 10 marks

*** Best of Two will be selected from First Mid Term Examination, Second Mid Term Examination and Pre University Test**

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks
a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks
c. Pre University Test: 10 marks

*** Best of Two will be selected from First Mid Term Examination, Second Mid Term Examination and Pre University Test**

ETE - End Term Examination: 50 Marks

Make-up test may be held only for those students who could not appear in any one of mid-term class tests due to genuine reasons for which the prior permission from the Head of Department was taken. Make up test shall ordinarily be held about two weeks before the semester examination. The syllabus for the make-up test shall be the whole syllabus covered by the subject teacher up to that time.

27. Award of Seminar, Industrial Training, Educational Tour Marks at Department level:

27.1 The marks of Seminar, Industrial Training, Educational tour marks shall be awarded on the following basis:

Criteria	Internal	External	
Project Report	20	-	
Viva Voce	20	50	
Attendance	10		
Total	50	50	100

27.2 The marks in Seminar, Industrial Training and Educational Tour shall be awarded by a committee consisting of following members:

(i) Head of the Department or his/her nominee.

(ii) Concerned Officer – In charge.

(iii) Senior Faculty Member of the department nominated by the Head of Department.

28. Cancellation of Admission:

The admission of a student at any stage of study shall be cancelled if:

(i) He / She is not found qualified as per UGC/AICTE / State Government norms and guidelines or the eligibility criteria prescribed by the University.

or

(ii) He / She is found unable to complete the course within the stipulated time as prescribed in clause 2.vi

or

(iii) He / She are found involved in creating indiscipline in the FET or in the University.

29. The Academic Council shall have the power to relax any provision provided in the ordinance in any specific matter/situation subject to the approval of Executive Council of the University & such decision(s) shall be reported to the Chancellor of the University.

Assessment Criteria

All courses of B. Tech. shall be evaluated by 100 marks. The subject shall be evaluated by 100 marks, out of which 40 marks shall be internal assessment and 60 marks for external assessment. Internal Assessment for 40 marks shall be as per the criteria given below:

Criteria	Marks
Mid Term Examination (Best of two out of MID-1, MID-2 and PUT)	20
Assignments/ Quiz / Seminar/Term paper	10
Attendance	10
Total Internal Assessment	**40**

Marks for Attendance shall be awarded as per the criteria given below:

Attendance Percentage	Marks
75% to 100%	10
71% to 74%	9
66% to 70%	8
61% to 65%	7
56% to 60%	6
11% to 55%	5
0% to 10%	0

All students should have a minimum of 75% attendance in all subjects, in order to appear in the end term examination / viva voce. The 75% criterion includes all leaves of absence – whether approved or not approved.

Criteria	Internal	External	
Project Report	75	100	
Viva Voce	75	300	
Attendance	50		
Total	200	400	600

Note:

From 2nd year onwards, students will take up **(Human Values &Scientific Reading and Writing)** as an audit subject. The student shall have to clear this audit subject with minimum E grade during 2nd Year to 4th year but its grade shall not be considered in SGPA/CGPA.

However, a student may opt more than two audits subject (with approval of Dean) for which shall not be compulsion to clear the subject, and the grade of these subjects shall not be considered in SGPA/ CGPA.

Calculation of Grade Point and Grade Point Average

Relative grading shall be adopted at the Faculty of Engineering & Technology, Rama University. The list of letter grades, the grade points associated with them are given below:

Grade	Grade Point
O	**10**
A	**9**
B	**8**
C	**7**
D	**6**
E	**5**
F	**0**

In order to arrive at alphabet grades, the total marks in a particular course for all the students pursuing the course are tabulated in the descending order (equivalently a histogram).

The performance of the course is analyzed in terms of the highest, lowest and the average marks and the dividing lines between the clusters of students. Gaps and dips between the clusters and the nature of the clusters guide in drawing the dividing lines between the grades. In a normal class of large size, the C grade usually covers the average performance. This is, however not a hard and fast rule and exceptions may arise in case of small classes, skewed histogram etc. Borderline cases may be considered individually on the basis of regularity and the attendance, class room discussions, progressive good performance throughout the semester, etc.

Calculation System of Semester Grade Point Average:

- Computation of the Semester Grade Point Average (SGPA) and Cumulative Performance Index (CPI):

  The SGPA is an indicator of the overall academic performance of a student in all the courses he/she has registered during a given semester. It is computed as follows: If the grades awarded to a student are G_1, G_2 etc in courses with corresponding credits C_1, C_2 etc, the SGPA is given by:

$$SGPA = \frac{C_1 \times G_1 + C_2 \times G_2 + \cdots + C_n \times G_n}{C_1 + C_2 + \cdots + C_n}$$

- The CPI indicates the overall academic performance of a student in all the courses registered upto and including the latest completed semester/summer term. It is computed in the same manner as the SGPA, considering all the courses (say, n) and is given by:

$$CPI = \frac{\sum_{i=1}^{n} C_i \times G_i}{\sum_{i=1}^{n} C_i}$$

- Percentage conversion of CPI:

$$Percentage\ of\ marks = \left(\frac{SGPA}{CGPA} \times 10\right) - 4.5$$

- Students should get a minimum grade E in each subject with 5CPI to clear the semester.

- CPI conversion

≥8 CPI	**I Division with Honours**
≥6 CPI	**I Division**
≥5 CPI	**II Division**
<5 CPI	**Fail**

- In case a student gets a F grade in more than one subject, he / she has to repeat one or more of the subjects by registering for "Guided Study" in that semester. Registration for Guided Study shall be made on the payment of Rs. 500 per subject as well as registering for the examination with a payment of Rs. 1000 per subject.
- If the students get F grade in six theory subjects in an academic session, then he/ she will repeat the year.
- Whenever a student is permitted to repeat, the new grade with star will replace the old grade and computation of the SGPA will done by considering the new grade.

B. Tech. Course should be completed within seven years. If a student does not complete the B. Tech. program in Seven years, he / she will have to appear in the program as a fresh.

Chairperson

Signature: .....

Name: Dr. Ajay Kumar

Date:

Internal Members

Signature: 1..... 2.....

Name: Dr. Manoj Kumar Mishra Dr. Vivek Srivastava

Date:

External Members

Signature: 1.....

Name: Prof.(Dr.) Sanjay Mishra

Date:

COURSE STRUCTURE

B. TECH.

BIOTECHNOLOGY

2023-24

Credit distribution summary and comparison with AICTE 2018 Model Curriculum

Year	1st Year		2nd Year		3rd Year		4th Year	
Sem	1st Sem	2nd Sem	3rd Sem	4th Sem	5th Sem	6th Sem	7th Sem	8th Sem
Credit*	22	22	22	22	22	21	19	17
Contact Hour*	26	26	26	26	26	24	26	25

**Excluding MOOCs*

S. No	Category	Course Code	Credit As per AICTE	RU New
1	Humanities and Social Sciences including Management courses	HSC	12	13
2	Basic Science courses	BSC	25	18
3	Engineering Science courses including workshop, drawing, basics of electrical/ mechanical/ computer etc	ESC	24	16
4	Professional core courses	PBT	48	84
5	Professional Elective courses relevant to chosen specialization/branch	PBT	18	6
		EBT		6
6	Open subjects – Electives from other technical and /or emerging subjects	OBT	18	12
7	Project work, seminar and internship in industry or elsewhere	LBT	15	12
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	MC	0	0
9	MOOC	MOOC	0	12*
		NCC	0	24*

Salient Features

Engineering Minor Elective
A set of four elective courses in any engineering stream to enhance competency in the core area

Pathway Elective
A set of four elective courses as per the path that student wants to opt after graduation

1. Corporate Jobs
2. Government Jobs
3. Higher Studies (GATE)

Open Elective
A set of four elective courses in an unrelated area to develop additional skills enhancing employment opportunities.

MOOC Course are run parallel to regular courses and a student have to complete 12 Credit course via MOOCs.

Mini-Project
Mini-Project is offer in the penultimate year so as to give students a head starts towards their B. Tech final project. Thestudents will have two choice

1. Select a bigger project and complete it in four phases (Two in 3rd year and Two in 4th year)
2. Do a small project in 3rd year but not related to 4th year final project.

1st Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	BSC-104	Applied Chemistry	BSC	3	0	0	3	20	20	60	100
2	BSC-105	Fundamental Mathematics	BSC	3	1	0	4	20	20	60	100
3	BTE-101	Cell Biology & Signalling	BTE	3	0	0	3	20	20	60	100
4	ESC-103	Computational Thinking & Programming	ESC	3	0	0	3	20	20	60	100
5	BTE-102	Exploring the Biotechnology	BTE	3	0	0	3	20	20	60	100
6	HSC-101	Communication Skill - I	HSC	2	0	0	2	20	20	60	100
7	BSC-154	Applied Chemistry Laboratory	BSC	0	0	2	1	30	20	50	100
8	ESC-153	Computer Programming Laboratory	ESC	0	0	2	1	30	20	50	100
9	BTE-153	Cell Biology Laboratory	BTE	0	0	2	1	30	20	50	100
10	HSC-151	Communication Skill - I Laboratory	HSC	0	0	2	1	30	20	50	100
Total				17	1	8	22	240	200	560	1000

Contact Hr	**26**			
Theory	**6**	**Lab**	**4**	

Course Curriculum (w.e.f. Session 2023-24)
B.Tech. Biotechnology
FET, Rama University

2nd Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	BSC-203	Bioengineering Physics	BSC	3	0	0	3	20	20	60	100
2	BSC-204	Advanced Mathematics	BSC	3	0	0	3	20	20	60	100
3	ESC-206	Introduction to Digital System	ESC	3	0	0	3	20	20	60	100
4	BTE-201	Biochemistry	BTE	3	1	0	4	20	20	60	100
5	BSC-205	Environment and Ecology	BSC	3	0	0	3	20	20	60	100
6	HSC-201	Communication Skill - II	HSC	2	0	0	2	20	20	60	100
7	ESC-256	Digital System Laboratory	ESC	0	0	2	1	30	20	50	100
8	BSC-253	Bioengineering Physics Laboratory	BSC	0	0	2	1	30	20	50	100
9	BTE-252	Biochemistry Laboratory	BTE	0	0	2	1	30	20	50	100
10	BTE-253	Basic Environmental Biotechnology Laboratory	BTE	0	0	2	1	30	20	50	100
Total				17	1	8	22	240	200	560	1000

Contact Hr	26			
Theory	6	Lab	4	

***Non Credit Compulsory Course**

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	HSC-202	Universal Human Value and Professional Ethics	HSC	2	0	0	0	20	20	60	100

3rd Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	BTE-301	Genetics	BTE	3	0	0	3	20	20	60	100
2	BTE-302	Modern Techniques and Instrumentation	BTE	3	0	0	3	20	20	60	100
3	BTE-303	Biostatistics	BTE	3	0	0	3	20	20	60	100
4	BTE-304	Microbiology & Virology	BTE	3	0	0	3	20	20	60	100
5	ESC-307	Fluid Mechanics & Mechanical Operations	ESC	3	1	0	4	20	20	60	100
6	HSC-301	Verbal Ability - I	HSC	2	0	0	2	20	20	60	100
7	BTE-351	Genetics Laboratory	BTE	0	0	2	1	30	20	50	100
8	BTE-352	Modern Techniques and Instrumentation Laboratory	BTE	0	0	2	1	30	20	50	100
9	BTE-353	Microbiology & Virology Laboratory	BTE	0	0	2	1	30	20	50	100
10	ESC-355	Fluid Mechanics & Mechanical Operations Laboratory	ESC	0	0	2	1	30	20	50	100
Total				17	1	8	22	240	200	560	1000

Contact Hr	**26**			
Theory	**6**	**Lab**	**4**	

**MOOC Course I–*

Wild life Ecology **UG *https://nptel.ac.in/courses/102/104/102104073/* Credit 5**

4th Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	BTE-401	Molecular Biology	BTE	3	0	0	3	20	20	60	100
2	BTE-402	Stem cells & Animal Tissue culture	BTE	3	0	0	3	20	20	60	100
3	BTE-403	Developmental Biology	BTE	3	0	0	3	20	20	60	100
4	BTE-404	Plant Tissue Culture and Plant Biotechnology	BTE	3	0	0	3	20	20	60	100
5	BTE-405	Immunotechnology	BTE	3	1	0	4	20	20	60	100
6	HSC-401	Verbal Ability - II	HSC	2	0	0	2	20	20	60	100
7	BTE-451	Molecular Biology Laboratory	BTE	0	0	2	1	30	20	50	100
8	BTE-452	Immunotechnology Laboratory	BTE	0	0	2	1	30	20	50	100
9	BTE-453	Plant Tissue Culture & Plant Biotechnology Laboratory	BTE	0	0	2	1	30	20	50	100
10	BTE-454	Animal Tissue culture Laboratory	BTE	0	0	2	1	30	20	50	100
Total				17	1	8	22	240	200	560	1000

Contact Hr	**26**		
Theory	**6**	**Lab**	**4**

**MOOC Course-II*

Cell Biology: Cellular organization, division and processes UG **https://nptel.ac.in/courses/102/108/102108086/** **Credit 5**

5th Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	BTE-501	Enzymology & Enzyme Technology	BTE	3	0	0	3	20	20	60	100
2	0	Open Minor/Open Elective 1	OBT	3	0	0	3	20	20	60	100
3	BTE-502	Recombinant DNA Technology	BTE	3	0	0	3	20	20	60	100
4	BTE-503	Bioinformatics-I	BTE	3	0	0	3	20	20	60	100
5	BTE-504	Fermentation Technology	BTE	3	1	0	4	20	20	60	100
6	HSC-501	Reasoning Ability - I	HSC	2	0	0	2	20	20	60	100
7	BTE-551	Fermentation Technology Laboratory	BTE	0	0	2	1	30	20	50	100
8	BTE-552	Recombinant DNA Technology Laboratory	BTE	0	0	2	1	30	20	50	100
9	BTE-553	Enzyme Technology Laboratory	BTE	0	0	2	1	30	20	50	100
10	BTE-554	Bioinformatics-I Laboratory	BTE	0	0	2	1	30	20	50	100
Total				17	1	8	22	240	200	560	1000
			Contact Hr	**26**							
			Theory	**6**	**Lab**	**4**					

***Non Credit Compulsory Course**

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	ESC-505	Scientific Reading and Writing	EBT	2	0	0	0	20	20	60	100

MOOC Course-III
Genetic Engineering: Theory and Applications U G /PG : https://nptel.ac.in/courses/102/103/102103074/Credit5

6th Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	TBT 601-604	Engineering Minor Elective 1	TBT	3	0	0	3	30	20	50	100
2	0	Open Minor/Open Elective 2	OBT	3	0	0	3	20	20	60	100
3	BTE611-614	Pathway Elective 1	BTE	3	0	0	3	20	20	60	100
4	BTE-601	Bioinformatics II	BTE	3	0	0	3	20	20	60	100
5	BTE-602	Bioprocess Engineering	BTE	3	1	0	4	20	20	60	100
6	HSC-601	Reasoning Ability -II	HSC	2	0	0	2	20	20	60	100
7	BTE-651	Bioprocess Engineering Laboratory	BTE	0	0	2	1	30	20	50	100
8	BTE-652	Bioinformatics II Laboratory	BTE	0	0	2	1	30	20	50	100
9	LBT-601	Mini Project	LBT	0	0	2	1	30	20	50	100
Total				17	1	6	21	240	180	480	900

Contact Hr	**24**			
Theory	**6**	**Lab**	**3**	

Engineering Minor Elective I	**Specialization**			
Course Code	TBT 601	TBT 602	TBT 603	TBT 604
Course Name	Nanobiotechnology and Biosensors	Molecular diagnostics and its applications	Food safety and quality management	Marine Biotechnology
Pathway Elective I	**Pathway**			
	Corporate Job			
Course Code	BTE611	BTE612	BTE613	BTE-614
Course Name	Agro biotechnology	Synthetic Biology	Biotechnology for society	Biomedical Engineering

*MOOC Course-IV
Forests and their management UG https://nptel.ac.in/courses/102/104/102104082/ Credit 5

7th Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	TBT 701-704	Engineering Minor Elective 2	TBT	3	0	0	3	20	20	60	100
2	0	Open Minor/Open Elective 3	OBT	3	0	0	3	20	20	60	100
3	BTE711-714	Pathway Elective 2	BTE	3	0	0	3	20	20	60	100
4	ESC-701	Heat and Mass Transfer	ESC	3	0	0	3	20	20	60	100
5	BTE-701	Bio separation technology	BTE	3	0	0	3	20	20	60	100
6	LBT-701	Capstone Project Phase - I	LBT	0	0	4	2	0	100	200	300
7	LBT-702	Presentation on Industrial Training	LBT	0	0	2	1	0	50	50	100
8	BTE-751	Bio separation technology Laboratory	BTE	0	0	2	1	0	50	50	100
Total				15	0	8	19	100	300	600	1000

Contact Hr	**23**			
Theory	**5**	**Lab**	**3**	

Engineering Minor Elective II	**Specialization**			
Course Code	TBT 701	TBT 702	TBT 703	TBT 704
Course Name	Genomics & Genome Engineering	Food Packaging and Storage	Cancer Biology	Medical biotechnology
Pathway Elective II	**Pathway**			
	Corporate Job			
Course Code	BTE-711	BTE-712	BTE-713	BTE-714
Course Name	Applications of Natural Products	Pharmaceutical Biotechnology	Biopharmaceuticals	Bioentrepreurship

8th Semester

S. No	Course Code	Course Name	Category	L	T	P	Cr	CA	MTE	ETE	Total
1	BTE-801	Environmental Biotechnology	BTE	3	0	0	3	20	20	60	100
2	0	Open Minor/Open Elective 4	OBT	3	0	0	3	20	20	60	100
3	BTE-802	IPR, Bioethics and Biosafety	BTE	3	0	0	3	20	20	60	100
4	LBT-801	Capstone Project Phase - II	LBT	0	0	16	8	0	200	400	600
Total				9	0	16	17	60	260	580	900
			Contact Hr	**25**							
			Theory	**3**	**Lab**	**1**					

Open Elective I, II, III, IV (A student will opt any 4 from below)

1. Accounting Fundamentals
2. Geography
3. Applied Geography
4. Banking and Financial Services
5. Computer Hardware and Networking Systems
6. History
7. Digital Marketing
8. Chemistry of Soap and Detergents
9. Chemistry of Start and Sugars
10. English
11. Financial Markets
12. Foundation and Applications of Psychology
13. Fundamentals of Finance
14. Environment
15. Computer Hardware and Networking System
16. Bioterrorism and National Security
17. Food and Nutrition Technology
18. Human Resource Management
19. Artificial Intelligence
20. International Business
21. International Politics
22. Robotics
23. Management Fundamentals
24. Marketing Management
25. Political Science
26. Crop production, processing and Consumption
27. Virtual Reality
28. Water Chemistry
29. Public Administration
30. Nutrition and Life Style

		L	T	P	C
BSC-104	APPLIED CHEMISTRY	3	0	0	3
Pre-requisite	General Chemistry				

COURSE DESCRIPTION:

This course is to acquaint the students with the basic phenomenon/concepts of chemistry,

Course Educational Objective

1. Students are able to understand and explain scientifically the various chemistry related problems.
2. Understand the new developments and breakthroughs efficiently in engineering and technology.

UNIT-1

Molecular orbital theory and its applications in diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application

UNIT-2

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet & Visible, 1HNMR and Raman spectroscopy.

UNIT-3

Stereochemistry with special reference to chirality, E - Z and R - S nomenclature. Elementary idea of inductive effect, mesomeric effect, reaction intermediate (carbcation, carbanion and free redical, carbene). Types of organic reactions with special reference of nucleophilic substitution reaction.

UNIT-4

Hardness of water. Disadvantage of hard water. Techniques for water softening; Zeolite, Lime-Soda, Ion exchange resin, Reverse osmosis. Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific values (Bomb calorimeter and Boy's Gas Calorimeter).

UNIT-5

Rate, order and molecularity of reaction, Integrated rate equation of zero order, first order and second order reactions, activation energy. Galvanic cell. Corrosion: Electrochemical theory of corrosion and its protection. Phase Rule and its application to one component system (water and sulfur).

Text Books/ Reference Books:

University Chemistry By B.H. Mahan

University Chemistry By C.N.R. Rao

Organic Chemistry By I.L. Finar

Physical Chemistry By S. Glasstone

Polymer Chemistry By Fre W., Billmeyer

Engineering Chemistry By Dr. Sunita Rattan

Engineering Chemistry By R. K. Agrawal

Course Outcome:

Students will be able to

1. Understand the concepts in molecular interactions and nanomaterials
2. Understand the synthesis and applications of polymer science
3. Identify the structure of organic molecules using chemical spectroscopy
4. Apply the concepts of organic chemistry for synthesis
5. Understand and apply the concepts of chemical kinetics, electrochemistry and corrosion science

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	2	3	1	1	2	2	3	1	3	2
CO2	3	2	1	1	3	3	3	2	1	1	3	3	1	3	3
CO3	3	2	1	1	2	3	2	2	1	1	2	3	3	1	2
CO4	3	2	2	1	2	3	3	2	2	1	2	3	3	2	2
CO5	2	2	1	2	3	3	2	2	1	2	3	2	3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BSC-154	APPLIED CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Intermediate Chemistry				

List of Experiments:-

1. Determination of alkalinity in the given water sample.
2. Determination of Temporary and Permanent hardness in water sample using EDTA as standard solution.
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in the given water sample by Mohr's method.
5. Determination of Iron content in the given Iron ore sample by using $[K_3Fe(CN)_6]$ as an external indicator.
6. Determination of solubility of salt (NaCl) at room temperature.
7. Determine the viscosity of a given solution.
8. Element detection and Functional group identification in organic compounds.
9. Preparation of Bakelite & Urea Formaldehyde resin.
10. Verification of Beer's law.
11. Determination of surface tension of given liquid.
12. Determination of rate constant of hydrolysis of esters.

NOTE: Choice of any 10 experiments from the above.

Text/Reference Books:

1. Laboratory Manual on Engineering Chemistry, Sudharan, Dhanpat Rai Publishing Company.
2. Advanced Inorganic Analysis, Agarwal &Keemti Lal, Pragati prakashan, 13th Edition
3. Vogel's Textbook of Quantitative chemical analysis, J. Mendham et.al., Pearson Education

Course Outcomes:

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

1. Standardize solutions using titrations and understand basic working of pH meter and UV-Visible spectrophotometer
2. Analyze ores and bleaching powder
3. Estimate the Hardness of water in terms of Calcium and Magnesium ions
4. Determine the solubility, surface tension and viscosity of solutions
5. Identify the elements and functional groups present in organic compounds
6. Estimate the rate constant of reaction

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	2			1	2	2	3	1	3	2
CO2	3	2	1	1	3	3			1	1	3	3	1	3	3
CO3	3	2	1	1	2	3	2	2	1	1	2				
CO4	3	2	2	1	2	3			2	1				2	2
CO5	2	2	1	2	3	3			1	2	3	2	3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BSC-105	FUNDAMENTAL MATHEMATICS	3	1	0	4
Pre-requisite	Basic Mathematics, NCERT				

COURSE DESCRIPTION:

Basic idea of the course is to aware the students with basic mathematics who have non mathematical background so that they can use these mathematical tools in biotechnology and higher research.

Course Educational Objective

1. To explain the concepts of Trigonometry.
2. To explain the basic concepts of differentiation and differential equations
3. To teach the evaluation of definite and indefinite integrals.
4. To explain the basic concepts of differential equations, multivariable and vector calculus

UNIT-1

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-2

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 parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretations.

UNIT-3

Integrals: Integration as inverse process of differentiation. Integration of a variety of functions by substitution method, by partial fractions method and by parts method 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 integrals and its evaluation.

UNIT-4

Differential Equations: Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type: $dy/dx + p\,y = q$, where p and q are functions of x.

UNIT-5

Sequence and Series: Definition of 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. Remodeling

Text Books/ Reference Books:

1. Mathematics - Textbook for Class XI, NCERT Publication
2. Mathematics Part I - Textbook for Class XII, NCERT Publication
3. Mathematics Part II - Textbook for Class XII, NCERT Publication
4. B.V.Rammana:Higher Engineering Mathematics (Tata Macgraw Hill)
5. Glynjames :Advanced modern Engineering Mathematics (Pearson education)

Course Outcome:

Students will be able

1. Apply Rolle's and Lagrange's mean value theorem in problems of differential calculus.
2. Determine the Continuity and Differentiability of function.
3. Determine the integral of different functions.
4. Estimate the characteristics of wave in different parameters.
5. Estimate the maxima and minima of functions.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-101	CELL BIOLOGY & SIGNALING	3	0	0	3
Pre-requisite	Elementary Biology				

COURSE DESCRIPTION:

This course is to familiarize the students with basic concepts of cell Biology. This is essential for taking further courses in Biotechnology during the next couple of years.

Course Educational Objectives:

1. Provide a perspective on recent advances in cell biology
2. Familiarize the different approaches of cell biology
3. Impart the concept of cell signaling cascades
4. Introduce the mechanism of cell – cell communication
5. Explore the models and case-studies of signal transduction

UNIT 1

Pre-cellular evolution: artificial evolution of cells, Postulates of cell theory, Endosymbiotic theory, Broad classification of cell types, Comparative study on Prokaryotic cell and Eukaryotic Cell (Animal and Plant Cell)

UNIT 2

Light Microscopy, Phase contrast Microscopy, Fluorescence Microscopy, Confocal Microscopy Electron Microscopy, Atomic Force Microscopy, Flow cytometry and Cell sorting, Subcellular Fractionation.

UNIT 3

Cell wall and extracellular matrix. Cell membrane: Structure and functions, Membrane proteins, lipids and sugar modifications for different membrane types. Ion channels. Transport across the membrane, Exo and Endocytosis cell to cell interaction, Cytosol, Golgi bodies, ER (smooth and rough), Ribosomes, Cytoskeleton structures (Actin and cell movements, Microtubules and cell division, cytoskeleton dynamics), Nucleus (Structure of nuclear envelop, internal organization, nucleolus), Mitochondria (Structure, respiratory chain complexes, ETC, ATP synthase structure, Mitochondrial biogenesis, maternal inheritance, anterograde and retrograde signaling), Chloroplasts, Lysosomes, Peroxisome. Different diseases in relation to cell organelles

UNIT 4

Cell cycle & regulation-Fission and fusion, budding. Eukaryotic Cell cycle stages (mitosis and meiosis), Nuclear organization during mitosis, Events of M phase, Regulators of cell cycle. **Protein transport**- Transportation of proteins into the nucleus and Mitochondria, Vesicular transportation

UNIT 5

Cell receptors and signal Transduction- Signaling molecules and their receptors. Function of surface and intracellular receptors, Different pathways of signal transduction, Signaling in development and differentiation. **Programmed cell death and Cellular senescence**- Apoptosis (intrinsic and extrinsic pathways), Necrosis, Necroptosis, Autophagy (macroautophagy and microautophagy), Cellular senescence, Methods to study cell death.

Course Outcome:

At the end of the course, students will have the ability to:

1. Outline the structure and functions of prokaryotic and eukaryotic cells and cellular components
2. Observe and correctly identify different cell types, cellular structures using different microscopic Technique
3. Understand the cellular components and processes underlying cell cycle, cell division and
4. Apoptosis
5. Demonstrate the significance of cell receptors and cell signaling in biological system

Text Books:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter, Molecular Biology of the Cell, 6th Edition, 2014
2. Geoffrey M. Cooper, The Cell: A Molecular Approach 7th Edition, Oxford University Press; 2015.

References:

1. Francisco V. Sepiilveda and Francisco Bezanilla, Pumps, Transporters, and Ion Channels Studies on Their Structure, Function, and Cell Biology, Kluwer Academic /Plenum Publishers, 2005.
2. P.S. Verma, Cell Biology, Genetics, Molecular Biology: Evolution and Ecology, Chand (S.) & Co Ltd, India 2004.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1									2			3			
CO2		2									2		3			
CO3			3							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-153	CELL BIOLOGY LABORATORY	0	0	2	1
Pre-requisite	Basic Biology				

COURSE DESCRIPTION:

By doing this course well, students will develop basic knowledge and skills in cell biology and become aware of the complexity and harmony of the cell.

Experiments Details:

1. To learn the parts of Microscope.
2. Cross-sectioning of monocot and dicot plant root, stem and leaf staining and slide preparation
3. To differentiate the stages of mitosis using onion root tip.
4. Identification of blood group and Rh factor.
5. Isolation and visualization of buccal cavity cell.
6. Differentiation of white blood cells using Leishman's stain.
7. Isolation of monocytes from blood

Course Outcomes:

After the completion of the course the student should be able to

1. Understand the working of Microscope
2. Understand the concepts of Mitosis and meiosis
3. Students should be able to differentiate between prokaryote, eukaryote cells.
4. A classical method for identification of blood cell preparation

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

ESC-103	COMPUTATIONAL THINKING & PROGRAMMING	L	T	P	C
		3	0	0	3
Pre-requisite	Basic Computer and its Applications				

COURSE DESCRIPTION:

The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course Educational Objectives:

1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

UNIT I

Introduction to Number System and Programming Concepts: Computer basics, Classification of computers, Operations of computer, Components of a computer, Operating system concepts, Binary, Octal and hexadecimal number systems, Binary arithmetic Approaches of problem solving, computer algorithms and flow charts. Introduction of computer languages - machine language, assembly language and high level language. Information storage: data sizes, addressing, Error handling, program execution time

UNIT 2

Programming Structure, Execution and Concepts in C : Integer representation and arithmetic, Boolean algebra, logical, shift and bit level operations, Standard input and output in C, Fundamental data types and sizes: character, integer, Short, long, unsigned, single and double floating point. Storage classes: automatic, register, static and external. Operators and expressions: arithmetic, Relational and logical operators, Operator precedence and order of evaluation.

UNIT 3

Control Flow and Functions: Statements and blocks, 'If-Else', 'Else-If', 'Switch', nesting 'If-Else' Loops 'While', 'Do-while' and 'For', use of 'Break' and 'Continue' 'Goto' and 'Labels'. Basics of functions, Types of functions, Functions with array, Passing values to functions, Recursive functions

UNIT 4

Arrays, Structure and Pointers: Introduction to Array, 2-D and 3-D array, Introduction Structures Structures of functions, Pointers and addresses, Pointers and functions arguments, Pointers and arrays, Address arithmetic, Pointers arrays, multidimensional arrays, Pointers to functions, Pointers of structures

UNIT 5

File Handling and Introduction of Android : Standard C preprocessors, File access, defining, Calling macros and standard libraries, Introduction of Android, History and Version, Installing software's, Basic Android concepts, Using more Android capabilities.

Course Outcomes:

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

1. Understanding a functional hierarchical code organization.
2. Ability to define and manage data structures based on problem subject domain.
3. Ability to work with textual information, characters and strings.
4. Ability to work with arrays of complex objects.
5. Understanding a defensive programming concept. Ability to handle possible errors during program execution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

ESC-153	COMPUTER PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Intermediate Basic Computer				

COURSE DESCRIPTION-

This course designed to develop simple algorithms for arithmetic and logical problems and to decompose a problem into functions and synthesize a complete program using divide and conquer approach.

Experiments Details:

1. Computer basics
2. Brief Introduction of MS-Word which includes formatting, editing of a document.
3. Brief Introduction of MS-Power point which includes animated presentation for a seminar/report.
4. Input a string and find the number of each of the vowels appear in the string.
5. Accept N words and make it as a sentence by inserting blank spaces and a full stop at the end.
6. Printing the reverse of a string.
7. Searching an element in an array using pointers.
8. Checking whether the given matrix is an identity matrix or not.
9. Finding the first N terms of Fibonacci series.
10. Declare 3 pointer variables to store a character, a character string and an integer respectively. Input values into these variables. Display the address and the contents of each variable.
11. Define a structure with three members and display the same.
12. Declare a union with three members of type integer, char, string and illustrate the use of union.
13. Recursive program to find the factorial of an integer.
14. Finding the maximum of 4 numbers by defining a macro for the maximum of two numbers.
15. Arranging N numbers in ascending and in descending order using bubble sort.
16. Addition and subtraction of two matrices.

17. Multiplication of two matrices.
18. Converting a hexadecimal number into its binary equivalent.
19. Check whether the given string is a palindrome or not.
20. Demonstration of bitwise operations.
21. Applying binary search to a set of N numbers by using a function

Text/Reference Books:

1. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill

Course Outcomes:

1. Understanding Students will be able to write simple programs
2. Students will be able to write branching and looping based programs
3. Students will be able to write little complex programs like digit based, prime nos, etc
4. Students will be able to write array based programs including searching and sorting
5. Understanding Students will be able to write file, structure macros based programs

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-102	EXPLORING THE BIOTECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Elementary Biology				

COURSE DESCRIPTION:

This course introduces the student to the Applications of Biotechnology in plant, animal and industrial development

Course Educational Objectives:

1. Describe the concept of Central Dogma of Molecular Biology
2. Describe the transfer of genetic information.
3. Introduce recombinant DNA technology
4. Introduce the techniques used for modification of living organisms

UNIT 1

Biotechnology: Concept, scope and importance. Origin of life-theories. Structure of bacterial, plantand animal cells-functions of cell organelles. Biomolecules, structure and functions of proteins, nucleic acids, lipids and carbohydrate and enzymes

UNIT 2

The central dogma of molecular biology. Concepts of genetic engineering, Restriction endonucleases, cloning vectors, methods of gene transfer. Polymerase Chain Reaction. Introduction to bioinformatics and biological databases

UNIT 3

Biotechnology for Plant improvement: Strategies for engineering stress tolerance, transgenic plants. Micropropagation of novel varieties. Production of secondary metabolites and their importance. Molecular pharming.

UNIT 4

Biotechnology for improvement of animals: Applications in animal husbandry, medicine and animal husbandry. Transgenic animals. Gene therapy and genetic counseling. Bioethics.

UNIT 5

Industrial and Microbial Biotechnology: Overview of industrial fermentation process and products. Fermentation technology for production of Penicillin. Introduction to patents. Biotech industry in India and abroad.

Textbooks:

1. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society ofchemistry, 2009.
2. W. Godbey, An Introduction to Biotechnology, The Science, Technology nd Medical Applications, 1/e, Woodhead Publishing, 2014.

References

1. P.K. Gupta, Elements of Biotechnology, 2/e, Rastogi Publications, 2014.
2. B. Albert's, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts and P.Walter, MolecularBiology of the Cell, 6/e, Garland Publishers, 2014.
3. H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, Amon and M. P. Scott,Molecular Cell biology, 7/e, W.H Freeman and Company, 2014.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain the scope and importance of biotechnology
2. Explain the importance & significance of various biomolecules
3. Understand the application of biotechnology in transgenic plant development.
4. Understand the role of biotechnogy in animal husbandry and livestock improvement
5. Explain the potential of biotechnology in industry in strain improvement

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1									2			3			
CO2		2									2		3			
CO3			3							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

HSC-101	COMMUNICATION SKILLS-I	L	T	P	C
		2	0	0	2
Pre-requisite	Basic English Language				

COURSE DESCRIPTION:

Communication Skills in English (Beginner) is the first of the three-level courses for a developmental enhancement of learners' communication skills in English. This course focuses on giving learners exposure to factual level of comprehension (listening and reading) and application of the learning (Speaking/Writing) with awareness for social and personality-based variationsin communication.

Course Educational Objectives:

1. Train learners to listen actively, follow what is spoken in standard English, and answer questions to demonstrate their understanding of the main points of the speech, repeat part of what someone has said to confirm mutual understanding, though occasionally,
2. Equip learners with the skills to read and comprehend straightforward texts and simple argumentative writing to identify the topic, the desired/relevant information, the main points of the argument, and the major conclusion/s.
3. Help learners apply their knowledge and language skills to make mini oral presentations and produce short coherent written texts using appropriate cohesive devices, suitable vocabulary, and grammatical structures.
4. Enable learners to communicate with reasonable accuracy in familiar contexts with adequate fluency and generally good control by equipping them with a repertoire of frequently used vocabulary, structures, and speech patterns.

UNIT-1

Essentials of Grammar & Composition- Syntax Words formation and parts of speech, Usage of foreign words, idioms and phrases in correspondence, Vocabulary including antonyms, synonyms, homophones and common prefixes and suffixes, Subject-verb agreement, punctuation and error detection

UNIT-2

Reading and Comprehension- Employing different reading skills, Comprehension passage – Understanding the author's point of View, he art of condensation- Summarization, paraphrasing, précis and abstract writing, Reading short stories (Rabindranath Tagore, Munsi Premchand, Mulk Raj Anand and James Joyce), Writing business letters and reports.

UNIT-3

Communication- concept, styles and its types- Process and principles of effective business communication Types of Communication- (Verbal Communication, Non-verbal Communication, Interpersonal Communication, Extra personal Communication, Intrapersonal Communication, Mass Communication and Media Communication etc. Barriers to communication Remedies to overcome from the barriers of Communication.

UNIT-4

Listening and Speaking

Listening vs. hearing and poor listening vs. effective listening, Advantages of good listening
Five steps to active listening, Conduction of job interviews and meeting, Public Speaking

Text/Reference Books:

1. Remedial English Grammar. F.T. Wood. Macmillan.2007
2. Communication Skills. Sanjay Kumar and Pushp-Lata. Oxford University Press. 2011.
3. Oxford Guide to Effective Writing and Speaking. John Seely. Oxford University Press, 2013.
4. English for Engineers. NP Sudharshana, C. Savitha.CUP.2018
5. Dubliners (Modern Classics), James Joyce, Penguin, 2000.
6. The Home-Coming, Rabindranath Tagore, CI Publisher, 2014.
7. The Lost Child and Other Stories, Mulk Raj Anand, Orient, 2004. Optional Materials:
8. English Vocabulary in Use (Intermediate) Michael McCarthy & Felicity O'Dell, 2002.
9. A Comprehensive Grammar of the English Language.R.Quirk, Pearson Education India, 2010

Course Outcomes:

1. Listen actively, understand and extract the essential information from short talks/conversations/discussions that are delivered in clear, standard speech.
2. Read, understand, and extract specific information from straightforward factual and simple argumentative texts on general topics and subjects of interest
3. Speak clearly with some confidence on matters related to his/her interests and academic work and make short structured oral presentations on topics of personal interest.
4. Write short straightforward connected texts on a range of familiar/general topics using appropriate linking devices to achieve a clear sequence of ideas.
5. Acquire sufficient language competency to express oneself in speech and writing with some confidence, using appropriate vocabulary and simple grammatical structures though lexical limitations and/or difficulty with formulation might be evident at times.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	3	3	2	3	0	0	2	0			
CO2	3	0	0	0	3	3	2	3	0	0	2	0			
CO3	3	0	0	3	3	3	0	3	0	3	3	0			
CO4	3	0	0	3	3	3	3	3	0	3	3	0			
CO5	0	4	0	4	0	0	2	0	4	4	2	0			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
HSC-151	COMMUNICATION SKILLS-I LABORATORY	0	0	2	1
Pre-requisite	Basic Communication Skills				

COURSE DESCRIPTION:

This course has designed to improve the fluency in spoken English.

LIST OF PRACTICALS

1. Group Discussion, Conversations and dialogue- Practical based on relevant Grammatical Patterns.
2. Practice of Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic /Kinesics.
3. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics
4. Public Speaking practice by conducting elocution, extempore, debate and speech competition
5. Theme Presentation/ Keynote Presentation based on correct methodologies
6. Individual Speech Delivery/Conferencing with skills to defend Interjections/Quizzes
7. Argumentative Skills/Role Play Presentation with Stress and Intonation.
8. Comprehension Skills based on Reading and Listening Practical's on a model Audio

Course Outcomes:

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

1. the frame correct sentences with illustrations the comprehend the language correctly
2. Understand and apply to develop listening and writing skills
3. Understand to inculcate descriptive and explanatory skills
4. Understand and apply to communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an organized context

Text/Reference Books:

1. Improve Your Writing ed. V.N.Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi
2. Technical Communication: A Practical Approach: Madhu Rani and Seema Verma- Acme Learning, New Delhi-2011
3. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press,2007, New Delhi. Reference Books.
4. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt.Ltd, 2011, New Delhi.
5. Business Correspondence and Report Writing by Prof. R.C.Sharma& Krishna Mohan, Tata

McGraw Hill & Co.Ltd.,2001, New Delhi.

6. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors, 2009,Delhi Communication Skills, by Sanjay Kumar and Pushp Lata Oxford Publications, Oxford Univ. Press, 20011, 2015, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	3	3	3	0	3	0	0	3	0			
CO2	3	0	0	3	3	3	2	3	0	2	2	0			
CO3	3	4	0	4	3	3	0	3	0	4	3	0			
CO4	3	0	0	3	3	3	0	3	0	3	3	0			
CO5	0	0	0	5	0	0	0	0	5	5	0	0			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BSC-203	BIOENGINEERING PHYSICS	L	T	P	C
		3	0	0	3
Pre-requisite	Elementary Physics, NCERT				

COURSE DESCRIPTION:

This course is designed with fundamentals of Medical-imaging and basic principles of Nuclear Medicine & its Diagnostic uses, as well as learns biomechanics and Ergonomics.

Course Educational Objectives:

1. To introduce medical-imaging.
2. To familiarize students with biomechanics and Ergonomics systems.
3. To impart knowledge engineering problems on Quantum mechanics and its applications.
4. To introduce principles of nuclear medicine & its diagnostic uses.

UNIT-1

Relativistic Mechanics: Frame of reference, Inertial & non-inertial frames, Galilean transformations. Michelson- Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem Variation of mass with velocity. Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle

UNIT-2

Electricity and Electromagnetism: Nature of electricity, Voltage, Current, resistance and their units, Flow of electricity in solids, electrolytes, gases and vacuum, Electricity and human body, ECG, EEG, EMG,ECT, Pace makers and defibrillation, Plane Magnetism and electricity, M.R.I Scanning, CAT scan

UNIT 3

Quantum Mechanics: Wave particle duality, Matter waves, Time-dependent Schrodinger wave equation, Time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave, Equations for one-Dimensional particle in a box

UNIT 4

Wave Optics: Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications, Fraunhoffer diffraction at single slit,

Fraunhoffer diffraction at double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power, resolving power of grating, Rayleigh's criterion of resolution, resolving power of grating

UNIT 5

Fibre Optics & Laser Optics: Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres, Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications

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

1. To solve the classical and wave mechanics problems, identify the basic mechanism of Relativistic Mechanics and construct and Calculate the variation of mass with velocity calculate. Degrees of Freedom (DoF) of various mechanisms identify basic mechanism of machine and construct and its inversions also draw their velocity and acceleration image.
2. To understanding of laws of ECG, EEG, EMG, ECT and their application in various parameters. Sketch cam profile &compute various parameters involved in gear system.
3. To formulate and solve the engineering problems on Quantum mechanics and its applications. Perform force analysis in various mechanisms
4. To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams. Analyze the balancing problems in rotating and reciprocating machinery & understand various governors.
5. Basic behind optical fiber and lasers, To understand the basic behind brakes and dynamometer

Text/Reference Books:

1. Concepts of Modern Physics – AurthurBeiser (McGraw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics – Brijlal& Subramanian (S. Chand)
4. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New) 6. Engineering Physics-Malik HK and Singh AK (McGrawHill)
5. Biophysics -Dillon Patrick F.Cambridge University Press

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	1	1							1			1	1		
CO3	1	1							1			1	1		
CO4	1	1							1			1	1		
CO5	1	1							1			1	1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BSC-253	BIOENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	NCERT, Physics				

COURSE DESCRIPTIONS:

This course is designed to

1. Train students with basic idea on measurement techniques & related error
2. Train students with handful of experiments in the domain of Classical & Quantum mechanics, optics & electromagnetic theory.

List of Experiments

Any ten experiments (at least four from each group).

Group A

1. To determine the wavelength of sodium light by Newton's ring experiment.

2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.

3. To determine the specific rotation of cane sugar solution using polar-meter.

4. To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses.

5. To measure attenuation in an optical fiber.

6. To determine the wavelength of He-Ne laser light using single slit diffraction.

7. To study the polarization of light using He-Ne laser light.

8. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.

9. To determine the coefficient of viscosity of a given liquid.

10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

1. To determine the energy band gap of a given semiconductor material.

2. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor Material using Hall Effect setup.

3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and Estimate the radius of the coil.

4. To verify Stefan's law by electric method.

5. To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge.

6. To study the resonance condition of a series LCR circuit.

7. To determine the electrochemical equivalent (ECE) of copper.

8. To calibrate the given ammeter and voltmeter by potentiometer.

9. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its Hysteresis loss.

10. To measure high resistance by leakage method.

11. To Observation of different component of ECG.

12. To Observation of different component of M.R.I Scanning.

13. To Observation of different component of CAT scan

Text/Reference Books:

1. Practical Physics- K. K. Dey& B. N. Dutta (Kalyani Publishers New Delhi)

2. Engineering Physics-Theory and Practical- Katiyar& Pandey (Wiley India)

3. Engineering Physics Practical- S K Gupta (KrishnaPrakashan Meerut)

4. Biophysics -Dillon Patrick F.Cambridge University Press

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BSC-204	ADVANCED MATHEMATICS	L	T	P	C
		3	0	0	3
Pre-requisite	Engineering Maths, Basic Physics				

COURSE DESCRIPTION:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

1. To describe the basic concepts of matrices
2. To introduce complex numbers and their properties.
3. To teach the techniques based on partial fractions
4. To explain the concepts of straight lines and circles
5. To impart knowledge on solid geometry.

UNIT-1

Differential Equations of nth order- Linear differential equations of nth order with constant coefficients, Second order linear differential equations with constant coefficients, Complementary function, Particular integral, Method of variation of parameters

UNIT-2

Partial Differential Equations- Introduction of partial differential equations, Order of PDE. Method of forming Partial Differential Equations, Solution of PDE by direct integration, Solution of first order partial differential equations by Lagrange's method

UNIT-3

Laplace Transform-First &Second Shifting theorems, Laplace transform of derivatives, Initial and final value theorems , Laplace transform of integrals Multiplication by tn, Division by t

UNIT-4

Integral Calculus- Double and triple integrals, Change of order of integration, Change of variables, Application of integration to lengths, Volumes and Surface areas in Cartesian coordinates

UNIT-5

Probability- Definition of random experiments, sample space, events, occurrence of event and types of events, Definition of probability, Addition theorem of probability with examples, Multiplication

theorem of probability with illustrate examples, Probability Distribution, Binominal Distribution, Poisson"s Distribution, Normal Distribution

Text/Reference Books:

1. E. Kreyszig : Advanced Engineering Mathematics-Volume-I,JohnWiley& Sons.
2. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw- Hill Publishing Company Ltd.
3. R.K.Jain& S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.
4. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
5. Rukmangadachari, Engineering Mathematics – I, Pearson Education

Course out Come

1. Analyze and subsequently solve physical situations, whose behavior can be described by ordinary differential equations construct,
2. Structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients
3. Learn to solve the partial Differential Equations , apply partial derivative equation techniques to predict the behavior of certain phenomenon
4. Understand Laplace transforms and its properties and finding the solution of ordinary differential equations, Apply the Laplace transformations for different types of functions
5. Perform evaluate multiple integrals in various coordinate systems, Analyze convert line integrals into area integrals and surface integrals into volume integrals
6. Understanding, The concepts of probability in comprehensive manner. Apply the probability to evaluate addition, multiplication and conditional law of probability

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
ESC-206	INTRODUCTION TO DIGITAL SYSTEM	3	0	0	3
Pre-requisite	Engineering Physics, Computer Knowledge				

COURSE DESCRIPTION:

This course is designed with evaluate digital circuits, of medium complexity, that are based on SSIs, MSIs, and programmable logic devices.

Course Educational Objectives:

1. To introduce logic gates and simplify Boolean equations.
2. To familiarize students with Sensors and Displays and its characteristics.
3. To impart knowledge of various electronic audio and video devices and systems
4. To introduce principles of various electronic audio and video devices and systems.

UNIT-1

Introduction to Digital Systems: Analog & Digital signals - Need for digital instruments', Elements of digital instruments – Number systems: Binary, Hexadecimal , Logic gates, Boolean algebra (Identities and Properties) , Digital controllers (ON-OFF), Combinational Circuits-Binary adder-subtractor, Multiplexers, Demultiplexers.

UNIT-2

Sensors and Displays: Sensors and Transducers, Classification, Potentiometer, Strain Gauge Piezoelectric Sensor, Linear Variable Differential Transformer, Resistance temperature detectors (RTD), Thermocouples, Tactile transducers – Displays, Light Emitting Diode (including OLED) displays

UNIT-3

Signal Conditioning Circuits, D.C. Bridge- Unbalanced, Push-Pull configuration, Operational amplifiers- Inverting, Non-Inverting, Instrumentation Amplifier, Active filters: - Low pass, High pass Analog to Digital Converter – Successive Approximation, Digital to Analog Converter - Weighted Resistor.

UNIT-4

Introduction to Micro Controllers Introduction: Memory types, peripheral devices- Microcontroller (8 bit), Architecture, Graphics, Processing Unit (GPU) Applications: -Interfacing of Digital Input/Output, Analogue Input/Output Introduction to Programmable Logic Controller (PLC) and PID (Proportional + Integral + Derivative) Controller.

UNIT 5

Consumer Electronics and Communication System : Consumer Electronics: Television, Mobile Phones, Air conditioners Refrigerators, Washing Machine. (Block diagram approach only), Communication System: Satellite communication, Global Positioning Systems, Global System for Mobile. (Block diagram approach only)

Course Outcomes:

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

1. Know about design various logic gates and simplify Boolean equations
2. Know about Sensors And Displays and its characteristics
3. Know about Operational Amplifiers and its characteristics
4. Know about Introduction To Micro Controllers and its application
5. Depth knowledge of various electronic audio and video devices and systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	2	1							1			2	1		
CO3	1	1							1			2	1		
CO4	2	1					1		1			2	1		1
CO5	2	1					1		1			2	1		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

ESC-256	DIGITAL SYSTEM LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Digital System Theory				

COURSE DESCRIPTION:

This course is designed to understand the digital logic and create various systems by using these logics.

List of Experiments:

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications,
2. Study of the data sheet, Concept of Vcc and ground, verification of the truth tables of
3. Logic gates using TTL ICs.
4. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
5. Implementation of multiplexer using logic gates.
6. Design the following using Op-Amp:

a) A unity gain amplifier.

b) An inverting amplifier with a gain of "A".

c) A non-inverting amplifier with a gain of "A"

7. Measurement of Op-amp Parameters. (Open Loop Gain, Input offset Voltage, CMRR, Slew rate).
8. Determination of Frequency response of Op-Amp.
9. Characteristics of resistance transducer
10. Potentiometer
11. Strain Gauge/ Measurement of Strain using quarter, half and full bridge.

Text/Reference Books:

1. Morris Mano and Michael D. Ciletti, Digital Design, 5th edition, Pearson (ISBN-13: 9780132774208), 2013.
2. H. Katz, G. Borriello, Contemporary Logic Design, 2nd ed., Prentice Hall (ISBN 0201308576), December 2004.
3. E. Thomas, P. R. Moorby, The Verilog Hardware Description Language, 5th ed., Kluwer Academic Publishers (ISBN 1402070896), June 2002. http://link.springer.com.library.sutd.edu.sg:2048/book/10.1007/978-0-387-85344-4
4. S. Palnitkar, Verilog HDL, 2nd ed., Prentice Hall (ISBN 0130449113), 2003. http://proquestcombo.safaribooksonline.com.library.sutd.edu.sg:2048/book/electrical-engineering/semiconductor-technology/0130449113

Course Outcomes:

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

1. Ability Learn nomenclature of digital ICs, specifications, study of the data sheet, concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs
2. Ability Learn Boolean function using logic gates
3. Ability Implement and learn verification of decoder, de-multiplexer and encoder, using logic gates.

CO-PO Mapping:

	PO1	PO2	PO3	'O4	PO5	'O6	'O7	'O8	PO9	'O10	'O11	PO12	'SO1	'SO2	'SO3
CO1	2	3	2		1				2			2			
CO2	2	2	2		1				2			2			
CO3	2	3	2		1				2			2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-201	BIOCHEMISTRY	L	T	P	C
		3	1	0	4
Pre-requisite	Biology background , Chemistry, Basic knowledge of biomolecules				

COURSE DESCRIPTION:

All living beings consist of assemblies of molecules. Few of these molecules serve as structural elements, others are responsible for production, storage, and transfer of energy, encoding anddecoding of genetic information. This course introduces the structure, properties and function of molecules that are the constituents of biological systems. This course is prerequisite for molecular biology and biochemical engineering.

Course Educational Objectives:

Introduce the biochemical basis of life from biomolecules.

1. Impart knowledge of enzymes and kinetics
2. Understanding how changes in structure affect function.
3. Summarize structure and properties of biomolecules
4. Explain the metabolic pathways with significance.
5. Discuss the biological importance of lipids, proteins, nucleic acids, and hormones.

UNIT-1

Introduction to Biochemistry: Organization of life, Chemical foundations of biology, non-Covalent bonds, Amino acids and peptides: Structure and properties of amino acids, Classification of amino acids, peptide bond structure. Proteins: Structure and classification of proteins, Structural organization of protein: primary structure of proteins, secondary structure of proteins – helix and pleated sheets, tertiary structure of protein. Structure and functions of hemoglobin.

UNIT-2

Classification, structure, and functions of monosaccharide (ribose, glucose, and galactose), disaccharides (Maltose, sucrose and lactose), polysaccharides (starch, cellulose and glycogen). Structure of nucleic acids (DNA and RNA), structure and functions of purines, pyrimidines, nucleotides, Types of DNA and RNA

UNIT 3

Metabolic pathways: Glycogenesis and glycogenolysis, glycolysis and TCA cycle HMP shunt

pathway, gluconeogenesis, Electron transport chain and Oxidative phosphorylation Amino acid metabolism- Transamination, deamination and decarboxylation reactions, Urea cycle, Lipid Metabolism Biosynthesis of amino acids and its regulation Glutamate, glutamine, arginine from α-ketoglutatrate., Biosynthesis and degradation of purine and pyrimidinenucleotides.

UNIT- 4

Classification, structure and physiological functions of triglycerides, fatty acids, β-oxidation of monounsaturated and polyunsaturated fatty acids, Energetics of β oxidation phospholipids, cerebrosides and cholesterol. Digestion and absorption of fats.Synthesis and degradation of fatty acids. Nutritional aspects fatty acids.

UNIT- 5

Inborn errors of metabolism (amino acids, carbohydrates, and nucleic acids), Classification of hormones and their functions.

Text Books :

1. Donald Voet, Judith G. Voet, Charlotte W. Pratt Voet's PRINCIPLES OF BIOCHEMISTRY 5/e, John Wiley, 2018.Language: English, Country of origin: USA, ISBN-10: 1119451663
2. David L. Nelson and Michael M. Cox, Lehninger Principles of Biochemistry, 8/e, W. H. Freeman, 2021, Language: English, Country of origin: Germany, ISBN-10: 1319381499; ISBN-13 : 978-1319381493
3. U Satyanarayana, U. Chakrapani, Biochemistry, 5/e, Elsevier, 2020. Language: English, Country of Origin: India, ISBN-10: 8131262537; ISBN-13 : 978- 8131262535

References:

Jeremy M. Berg, LubertStryer, John Tymoczko, and Gregory Gatto, Biochemistry 9/e, WH Freeman, 2019.Language: English, Country of Origin: India, SBN-10: 1319114652; ISBN-13:978-1319114657

Course Outcomes:

After completion of this course, the student will be able to

1. Describe the structure and properties of common biomolecules
2. Describe standard metabolic pathways
3. Explain the functional properties of enzymes
4. Explain role of hormones in human body.
5. Explain nutritional aspects of proteins and fatty acids.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-252	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Biology and Chemistry				

COURSE DESCRIPTION:

This lab Provide concept in preparation of buffers, tests for identification of bio molecules, quantification methods and enzyme assay. Understand the separation of bio molecules by various chromatography techniques. Demonstrate absorption spectra of proteins and nucleic acids.

Experiments Details:

1. Preparation of buffers: Phosphate buffers
2. Qualitative analysis of mono and disaccharides
3. Qualitative analysis of amino acids
4. Estimation of total carbohydrates by Anthrone method
5. Estimation of proteins by Bradford method
6. Determination of Iodine value of lipids
7. Separation amino acids by paper chromatographic techniques
8. Separation of sugars / amino acids by thin layer chromatographic technique
9. Demonstration of SDS-PAGE

Course Outcomes:

After the completion of the course the student should be able to

1. Understand the working of biochemical analysis
2. Understand the concepts of Protein estimation
3. Students should be able to working on chromatographic techniques.
4. Demonstration of various biochemical analysis instruments.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2									1	
CO2	3		1	1	2									1	
CO3	3		1	1	2									1	
CO4	3	2	2	1	2									1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BSC-205	ENVIRONMENT AND ECOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Biology				

COURSE DESCRIPTION:

This course is design to develop an understanding of how science and the scientific method work to address environmental problems.

Course Educational Objective

1. The student will become familiar with the Earth's major systems (ecosystems and biogeochemical cycles), how they function and how they are affected by human activity (population growth, air, water and soil pollution, ozone depletion, global warming, solid waste disposal).
2. Students will learn about the interaction of human society (urban sprawl, energy use/generation, resource consumption and economics) with the Earth's systems.

UNIT -1

Introduction to Environmental Science – Definition and scope and need for public awareness; Ecosystem: Concept, Structure and Function of Ecosystem, Productivity and Food chain and Food web, Ecological Pyramids, Energy flow in Ecosystem, Restoration of Damaged Ecosystem.

UNIT-2

Biodiversity: Definition, Description at National and Global level, Levels, Gradients and Use of Biodiversity, Hot Spots of Biodiversity, Threats and Conservation of Biodiversity. Extinction of species, Biodiversity assessment, Biosphere Reserves, International Efforts to conserve Biodiversity.

UNIT-3

Natural Resources: Renewable and Non-renewable and their equitable use for sustainability, Material Cycles: Carbon, Nitrogen and Sulphur Cycle, Conventional and Non-Conventional Energy Resources – Fossils fuel based, Hydroelectric, Wind, Nuclear and Solar Energy, Biomass, Biodiesel, Hydrogen as an alternative fuel, Resettlement and Rehabilitation.

UNIT-4

Environmental Changes and Human Health: Social issues related to environment – sustainable development, urban problems related to water and energy conservation and waste management, resettlement and rehabilitation, Environmental ethics. Environmental pollution – causes and effect, control measures for water, air and soil, marine, land, noise, thermal pollution, Climate change, green house effect, Global Warming Acid Rain, Ozone layer formation and depletion, Impact on human

health – Water and Air borne diseases induced residual impurities in drinking water (fluoride and arsenic), toxic waste and carcinogen; Nuclear hazards.

UNIT-5

Environmental Protection through Assessment and Education: Indicators and impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact Assessment through Inventorying and Monitoring. Environmental Protection – Role of individuals, organizations and government in pollution control. Laws, Conventions and treaties – National legislations, issues in the enforcement of government.

Text Books/ Reference Books:

1. Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India.
2. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
3. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
4. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.

Course Outcome:

Students will be able to

1. Integrate the various disciplines and fields related to the environment to solve the environmental issues
2. Create an awareness, knowledge, and appreciation of the intrinsic values of ecological processes and communities.
3. Adopt integrative approach towards the environmental issues with a special focus on sustainability.
4. Describe human population characteristics and growth, and recognize the impacts of human society on Earth's systems and resources
5. Describe ecosystems in terms of how they vary, are structured, and function both internally and as part of the larger biosphere.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-253	BASIC ENVIRONMENTAL BIOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Basic Knowledge of Environmental Science & Chemistry				

COURSE DESCRIPTION:

The main objective of environmental biotechnology Lab is the conservation of resources via the recycling of waste materials

Experiments Details:

1. Dissolved Oxygen in waste water
2. Biochemical oxygen demand in waste water
3. Chemical Oxygen demand in waste water
4. Hardness of water
5. Total, dissolved and suspended solid in waste water
6. Alkalinity of waste water
7. Acidity of waste water
8. Hexavalent chromium in waste water
9. Nitrate in waste water
10. Sulphate in waste water

Course Outcomes:

After the completion of the course the student should be able to

1. Understand the working of Physical and Chemical analysis of waste water
2. Understand the concepts of Hardness of water
3. Students should be able to working on heavy metal identification.
4. Demonstration of various biochemical parameters in waste water.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2			1		1							1	
CO2		3	2		2		1							1	
CO3	3	3	3	3	3		1							1	
CO4	3	3	3	3	3		1							1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

HSC-201	Communication Skill-II	L	T	P	C
		2	0	0	2
Pre-requisite	Basic Knowledge of Grammar & Composition				

COURSE DESCRIPTION:

The course is intended to familiarize students with the basics of English language and help them to learn to identify language structures for correct English usage.

UNIT -1

Essentials of Communication Skills: Communication Skills: Types: Verbal; Non-Verbal, Process of Communication; Levels of Communication, Intrapersonal; Interpersonal; Mass Communication, Barriers of Communication, Remedies to overcome from the barriers of communication, Essential Elements; Nuances of Delivery, Listening: Active; Passive

UNIT 2

Constituents of Technical written communication: Basic review of Grammar and Composition, Transformation of sentences, Synonyms, Antonyms and homophones etc. The art of condensation-Summarization, paraphrasing, précis and abstract writing, Requisites of Techniques and Method, Inductive Method, Deductive, spatial, linear, chronological etc. Vocabulary of about 1000 words.

UNIT 3

Forms of Technical Communication: Business letters: Sales letter, acknowledgement letters, Letter of Enquiry, letter of quotation, order, Claim and adjustment letters etc. Job application and Resumes. Official letters: D.O letters, Govt. letters, letters of Authorities etc., Reports: Types, Significance, structure, style & writing of Reports. Proposals: parts, types, writing of Proposal, significance Technical paper, project. Dissertation and Thesis Writing, Features, Methods & Writing

UNIT 4

Presentation Strategies: Defining purpose, audience &locale, Organizing Contents, Preparing Outlines, Audio-Visual Aids, Nuances of delivery, Body language, space, Setting, Nuances of voice Dynamics, Time Dimension

UNIT 5

Writing & Speaking Skills: Paragraph writing, Drafting essay, reports, official letters and CV writing, Group Discussion, Job Interview, Public Speaking-Speeches, Conversations, dialogues and debates

Course Outcomes:

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

1. Frame correct sentences with illustrations
2. Comprehend the language correctly, Interpret the language correctly
3. Use given material in new situations

4. Correspond effectively using various types of writing like letters, memos etc.
5. Communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an organized context

Text/Reference Books:

1. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
2. Technical Communication: A Practical Approach: Madhu Rani and Seema Verma- Acme Learning, New Delhi-2011
3. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press,2007, New Delhi. Reference Books.
4. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt.Ltd, 2011, New Delhi.
5. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co.Ltd.,2001, New Delhi.
6. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. &Distributors, 2009,Delhi
7. Communication Skills, by Sanjay Kumar and Pushp Lata Oxford Publications, Oxford Univ. Press, 20011, 2015, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	3	3	3	0	3	0	0	3	0			
CO2	3	0	0	3	3	3	2	3	0	2	2	0			
CO3	3	4	0	4	3	3	0	3	0	4	3	0			
CO4	3	0	0	3	3	3	0	3	0	3	3	0			
CO5	0	0	0	5	0	0	0	0	5	5	0	0			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-301	GENETICS	L	T	P	C
		3	0	0	3
Pre-requisite	Biology Background				

COURSE DESCRIPTION:

The students would understand Mendelian Genetics, its extensions, Non-Mendelian genetics, Sex determination, Genetic diseases, Syndromes, Chromosomal Aberrations, and Population Genetics

Course Educational Objective

1. Define gene and allele.
2. Describe the relationship between genotype and phenotype.
3. Show how to predict genotype and phenotype ratios in offspring for simple traits.
4. Identify ways traits may be more complex than those studied by Mendel.

UNIT-I

Principles of Heredity and Variation: Mendel concept of genetics and his experiments, monohybrid crosses, dihybrid crosses, back cross and test cross. multiple alleles(blood group systems)

UNIT-II

Gene Interaction: Concept of gene interaction, co-dominance and incomplete Dominance, Complementary factors, Supplementary factors, Inhibitory factors, Duplicate dominant factors, Lethal genes (dominant and recessive), Epistatis.

UNIT-III

Genes and Chromosomes: General features of chromosomes. Chromosomal theory of inheritance, Sex determination. Sex-linked, Sex-limited and Sex-influenced inheritance. Variation in chromosome number and structure, Inherited disorders - Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and cri-du-chat syndrome)

UNIT-IV

Gene Linkage and Chromosome Mapping: Linkage and recombination of genes in a chromosome, Crossing over and genetic mapping, Gene mapping. Cytogenetic techniques. Penetrance and expressivity, Pleiotropy. Position effect and genomic imprinting

UNIT-V

Population Genetics and Evolution: Allele frequencies and genotype frequencies, random mating and Hardy-Weinberg principle. Inbreeding. Genetics and evolution.

Recommended Text/Books

1. S.R. Maloy, J.E. Cronan, D. Friefelder, Microbial Genetics, 2nd Edition, Jones and Bartlett Publishers, 1994.
2. N. Trun and J. Trempy, Fundamental Bacterial Genetics, Blackwell publishing, 2004.
3. Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios, 2006.
4. Mange E J and Mange A. P., Human genetics, 2nd Edition, Sinauer Associates publications, 1999.
5. Hartl L D and Jones B, Analysis of genes and genomes, 3rd Edition, Jones and Bartlett Publishers, 1994

Course outcome:

On completion of this course, the students will be able to:

1. Describe the molecular principles of Mendelian genetics and chemical basis of heredity.
2. Understand the effect of different factors such as environment & physical factors on regulation of gene expression.
3. Gain knowledge about the chromosomal basis of inheritance and pedigree analysis.
4. Demonstrate the basics of genetic mapping and sex determination.
5. Explain the key concepts of population and quantitative genetics

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2											1	3		
CO2	3	2		3								1	3	2	2
CO3	3												3	2	
CO4	3											1	3		
CO5	3												3		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-351	GENETICS LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Biology Background				

COURSE DESCRIPTION:

The main objective of Genetics Lab is the practical study of cell division study and karyotyping.

1. To study the shape and structure of various eukaryotic cells
2. To stain the nucleus of adherent cells by Giemsa staining method.
3. To determine the viability of the given cell suspension using haemocytometer.
4. To observe different stages of mitotic cell division in onion root tip
5. To culture leucocytes and to prepare metaphase chromosome spread for karyotyping.
6. To calculate the mitotic index of the given metaphase spread.
7. To identify the banding patterns in metaphase chromosome using Giemsa stain.
8. To remove the salivary gland chromosome of Chironomide larvae and to observe the polytene chromosomes.

Text Books:

1. Laboratory manual
2. Arsham. M., Lawce H and Barch M. "The AGT Cytogenetic Laboratory Manual", Wiley Blackwell, 2016.

Course outcome

After the completion of the course the student should be able to

1. Microscopic analysis of eukaryotic cell
2. Separate and differentiate the cell organelles by sub cellular fractionation.
3. Examine chromosome in a sample of cells

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												3		
CO2	3	2		3									3		
CO3	3												3		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-302	MODERN TECHNIQUES AND INSTRUMENTATION	3	0	0	3
Pre-requisite	Physics, Chemistry and Biology				

COURSE DESCRIPTION:

Instrumental methods of analysis are extensions of the human senses for perceiving the world. Some of these methods enable us to observe the organization of biological systems at a much higher level of resolution than the human eye, whereas others provide information for which there is no human equivalent sense, such as information regarding identity, purity and composition. The objective of this course is to describe the principles of instrumental methods for quantitative and qualitative analysis in biotechnology with examples related to quality control, process monitoring, biomolecular system characterization and diagnostic applications.

Course Educational Objectives:

1. Summarize methods for quantitative and qualitative analysis of bimolecular and bimolecular systems
2. Compare methods for determination of molecular mass and particle size distribution
3. Explain the principles of the methods for determination of molecular structure
4. List methods for studies of bimolecular interactions
5. Identify methods for high throughput analysis.

UNIT-I

Principles of Centrifugation, Analytical Centrifugation. Preparative centrifugation. Principles of Chromatography. Types of Chromatography. Principles of Electrophoresis, Gel Electrophoresis.

UNIT-II

UV-Visible spectroscopy. Vibrational spectroscopy. Fluorescence spectroscopy. Refractometry, Polarimetry and Circular Dichroism. Microscopy: Confocal light microscopy. Cryo-electron microscopy. Determination of particle number and particle size from light scattering data. Structure determination of biomolecules and biomolecular assemblies from X-ray diffraction data.

UNIT-III

Principles and components of mass spectrometers. Ionization methods. Determination of empirical formula. Determination of structure of small organic molecules. Oligonucleotide sequencing. Peptide and protein sequencing. Mass spectroscopy for Metabolomics and Proteomics

UNIT-IV

Principles of Magnetic Resonance. Principles and components of Fourier Transform NMR spectrometer. Chemical shift, coupling constants and peak areas. Structure determination of small organic compounds using NMR spectroscopic data. Multidimensional NMR spectroscopy. Application of solution NMR spectroscopy for protein structure determination. NMR spectral fingerprinting. Principles of MRI.

UNIT-V

Principles, applications and types of Biosensors. Glucose Biosensors. Principles and applications of Microarrays. Microarray fabrication. Detectors for microarrays. Introduction to Micro Electro Mechanical systems. Fabrication of MEMS. Principles and applications of Microfluidic systems. Lab-on-a-chip devices exemplified with PCR-chips. Point of care devices for diagnostic applications.

Text Books

1. Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce,'Spectrometric Identification of Organic Compounds. ',8th Edition,Wiley,USA,2015,9788126556595,
2. Andreas Manz, Petra S Dittrich, Nicole Pamme, Dimitri Iossifidis,'Bioanalytical Chemistry ',2nd Edition, World Scientific.,USA,2015,1783266724,

References:

1. David A. Wells. ,'High Throughput Bioanalytical Sample Preparation: Methods and Automation Strategies. 2nd ed. ',2nd Edition,Elsevier,Europe,2020,1,
2. Xiujun James Li, Yu Zhou,'Microfluidic Devices for Biomedical Applications.',2nd Edition,Woodhead Publishing. Elsevier,Europe,2021,0128199717,
3. Jaime Castillo-León, Winnie E. Svendsen,'Lab-on-a-Chip Devices and Micro-Total Analysis Systems: A Practical Guide ',1st Edition,.Springer,USA,2014,9783319086866,Unit-5

Journal (s)

1. Rienzoetal.'Lab on a Chip: High-throughput optofluidic screening for improved microbial cell factories via real-time micron-scale productivity monitoring',2021,2901,Unit-5

Course Outcomes:

Students will be able to learn the

1 Compare methods for determination of mass and particle size
2 Explain the principles of optical methods for characterization of biomaterials
3 Determine the sequence of proteins from mass spectrometry data
4 Analyze data from NMR spectroscopy
5 List the applications of high-throughput and miniaturized devices in biotechnology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-352	MODERN TECHNIQUES AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Elementary Biology				

COURSE DESCRIPTION:

This course introduces spectroscopic methods for matrix characterization, principles of electrophoresis, isoelectric focusing, capillary electrophoresis, centrifugation methods, and chromatography.

Experiments Details:

1. Developing competence and encourage hands on usage and maintenance of facilities and equipment's.
2. Compute component of given percentage solution, molarity solution, PRN, PPS solution and stock solution.
3. List uses of pH meter, measurement, detailed diagram of pH electrode and reference electrode (combined electrode also), find pH of a solution giving detailed account of pH meter operation, troubleshooting. Preparation of solution using pH meter. Demonstration of the effect of the solution.
4. To determine maximum absorption spectra of mixtures (potassium dichromate and potassium permanganate) solution.
5. Measure components and working of centrifuges, solving g and RPM of centrifuge with respect to various heads. Rotors. Isolation of cellular organelles by differential centrifugation.
6. Solvent-solvent extraction of plant pigments,
7. Use of paper chromatography for separation of plant pigments
8. Use of thin-layer chromatography for amino acid (TLC)
9. Electrophoresis of protein by SDS-PAGE
10. Demonstration of Sterilization of solution by filtration.
11. Demonstration of Dialysis
12. Sulphate in waste water

Course Outcomes:

After the completion of the course the student should be able to

1. Explain and interpret the principles of different bioanalytical methods for their appropriate application.
2. Compare and contrast the function of each analytical instrument with their potential application in research as well as industries
3. Work in group to solve biochemical calculation assignment related to analytical instrument
4. Demonstrate mapping of different instrument with their applications in biological studies
5. Apply fundamental calculation in analytical biochemistry

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-301	BIOSTATISTICS	3	0	0	3
Pre-requisite	Mathematics				

COURSE DESCRIPTION:

Graduates should be able to use statistical reasoning, formulate a problem in statistical terms, perform exploratory analysis of data by graphical and other means, and carry out a variety of formal inference procedures.

Course Educational Objectives

1. Demonstrate knowledge of probability and the standard statistical distributions.
2. Demonstrate knowledge of fixed-sample and large-sample statistical properties of point and interval estimators.
3. Demonstrate knowledge of the properties of parametric, semi-parametric and nonparametric testing procedures.

UNIT-I

Data and Classification: Data type, Classification and summarization of data, Diagrams and Graphs, Measures of central tendency, Measures of dispersion, Moments, Skewness, kurtosis

UNIT-II

Probability and Distributions: Introduction to probability, Laws of probability, Baye's theorem, Expectation and Random variable, Binomial distribution, Poison distribution, Normal distribution

UNIT-III

Correlation, Regression and Tests: Correlation, Pearson and Mathew correlation, Coefficient, Co-efficient of correlation, Rank Correlation, Lines of regression, Linear and Non linear regression, Multiple regression, Non-Parametric tests, Sign test, Mann-Whitene Wilcoxon test

UNIT-IV

Tests of Hypothesis and ANOVA: Hypothesis tests, Student's t-test, Chi squire test, F-test and ANOVA, One way and two way analysis of variants.

UNIT-V

Design and Quality Control: Principles of experimental design and analysis, Completely randomized design, Randomized block design, Latin square design, Statistical quality control, Types of quality control, Control chart for variables, Control chart for attributes.

Text Books:

1. S. P. Gupta, Statistical Methods; Sultan Chand & Sons Publishers.
2. Georgr W. and William G., Statistical Methods; IBH Publication.
3. Ipsen J et al; Introduction to Biostatistics, Harper & Row Publication.
4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

Reference Books:

1. N. T. J. Baily; Statistical methods in Biology; English University Press.
2. R. Rangaswami; A Text book of Agricultural statistics; New Age Int.Publication.
3. P. S. S. Sundar Rao; An Introduction to Biostatics; Prentice Hall.
4. Zar J; Biostatistics; Prentice Hall, Londan.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

HSC-301	VERBAL ABILITY – I	L	T	P	C
		2	0	0	2
Pre-requisite	English at Intermediate level.				

COURSE DESCRIPTION:

To make the students ready in core grammar concepts that will eventually help them when they appear for any competitive exam or interview in future.

Course Educational Objective:

To help them enhance their written English & also Spoken Communication.

UNIT 1

Sentences: Structure, Types of sentences, Statements, questions, imperatives and exclamations, Questions and answers, Leaving out and replacing words, Information and emphasis, Spoken English and written English (from sentence point of view)

UNIT 2

Parts of speech: Vocabulary, Verbs, Parts of Speech: Types & Application based approach, Vocabulary-I: Understanding word structure, common roots, prefixes, suffixes, Vocabulary-II: Mnemonic method, Verbs: Forms, The verb phrase, The future, Be, have and do, Modal verbs

UNIT 3

Tenses and Subject: Verb agreement, Tenses: Understanding all types of tenses and aligning them with the various question types, Subject-Verb Agreement: Rules and Applications, Commonly confused words-II, Gerunds, Active and Passive voice, Direct and Indirect Speeches

UNIT 4

Speed Reading: Idioms-Phrases, Speed Reading: Easy to medium passage techniques & practical applications, Idioms and Phrases; Antonyms & Synonyms, One word substitutions, Homophones.

UNIT 5

Creative Writing: Essay, Report Writing, Article writing, Letters writing, E-mail writing, difference between formal and informal tone, appropriate use of transition words, Creating a signature, understanding different situations and the responses they require (situation- based writing), Proper use of connectors

Course Outcomes:

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

1. Make grammatically correct sentences and will be able to point out the error quickly by looking at any sentence.
2. Use vocabulary correctly while writing and speaking.
3. Solve various different questions based on basic subject-verb and translation rules asked in various exams.
4. Read article/essay/write-ups speedily using various techniques like skimming and scanning discussed in the course.
5. Write articles, emails, and cover letters easily with the help of techniques explained.

Text book [TB]:-

English is Easy- Chetanand Singh (BSC Publication)-2018

Reference books [RB]:-

1. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood (Oxford University Press)

2. Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL; 21295th edition (1994)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		2			
CO2				2		2				2		3			
CO3									1	2		3			
CO4	2	2	3			2						1			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-304	MICROBIOLOGY AND VIROLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Biology				

COURSE DISCRIPTION:

This course is designed to understanding the cell structure of microorganism, classification, pathogenesis, control and their commercial use.

Course Educational Objectives:

1. Familiarize the students with microorganisms and viruses, their structures,
2. Diseases caused by bacteria and viruses and their control.
3. Photosynthesis and Nitrogen fixation

UNIT 1

History, and important developments in Microbiology. Contributions of Nobel Laureates in Microbiology (Robert Koch, Emil, A.Von Behring, Ronald Ross and Barry Marshall). Microbial Taxonomy and diversity of Bacteria. Microbial Taxonomy and diversity of Archea. Molecular approaches to Microbial Taxonomy. Physiology and adaptation of extremophiles. Physiology and significance of Thermophiles, Psychropiles, Halophiles, and Methanogens.

UNIT 2

Bacteria: Ultra structure of Bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell. Bacterial growth kinetics. Yeasts and Molds: life cycle, economic importance of Yeast and Aspergillus. Multiple drug resistant bacteria. Microbial diseases of skin and eye, nervous system, cardiovascular & lymphatic system, respiratory, and digestive system.

UNIT 3

Nutrition requirements, nutritional types of bacteria, uptake of nutrients by cell. Microbial metabolism: Respiration, Photosynthesis and Nitrogen fixation.

UNIT 4

Sterilization and Disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents. Antibiotics: classification, mode of action and resistance. Water, Food and Milk borne contamination and remedy. Basic microbial genetics - conjugation, transformation and transduction. Strain improvement of microbes of industrial importance.

UNIT 5

Morphology of Viruses ; size, shape, symmetry, replication of viruses- lytic and lysogenic cycle, viroids and prions. Bacteriophages Morphology, reproduction of ds DNA phages, ssDNA phages and RNA phages.plant virus nomenclature and classification, viruses infecting fruits and vegetables.

Text Books :

1. Reba Kanungo,'Ananthanarayan and Paniker's Textbook of Microbiology',11,Universities Press (India) Pvt. Ltd.,India,2020,978-9389211436 - All Units
2. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R.,'Microbiology: Application Based Approaches. ',10,Tata Mc Graw Hill Education,India,2009,978-0070151475 - All Units
3. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., Stahl, D. A. ,'Brock Biology Of Microorganisms, Microbiology ',14,Pearson Education,India,2017,978-9332586864 - All Units

References:

1. Alberts, et. al.,'The Molecular Biology of the Cell',6,W. W. Norton & Company,USA,2014,978-0815344322 - Unit- II, III, IV
2. Gerard J. Tortora, Berdell R. Funke and Christine L. Case,'Microbiology: An Introduction',13,Pearson,India,2020,9780134605180 - All Units
3. Joanne M Willey; Linda M Sherwood; Christopher J Woolverton; Lansing M Prescott; John P Harley; Donald A Klein,'Prescott, Harley, and Klein's Microbiology',7,New York : McGraw Hill Higher Education,USA,2008,0071267271 9780071267274 - All Units
4. Stanier RY, Ingraham JL, Wheelis ML, Painter P,,'General Microbiology ',5,Palgrave Macmillan,USA,1999,978-0333763643 - All Units
5. Simon Baker, Carolone Griffiths and Jane Nicklin,'BIOS Instant Notes in Microbiology',4,Taylor& Francis,India,2012,978-0415607704 - All Topics

Course Outcomes:

By the end of the course, students will have sufficient scientific understanding and will be able to:

1. Understand the basic microbial & viral structure and function and comparative characteristics of prokaryotes and eukaryotes.
2. Demonstrate the processes in microorganisms and viruses for their replication, survival, and
3. Interaction with their environment, hosts, and host populations
4. Know how viruses can be used as tools to study biological processes, as cloning vectors and for gene transfer.
5. Demonstrate practical skills in the use of technologies, tools, and approaches common to microbiology & virology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	1	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	1	1	1	1	2	3	2	2
CO3	3	1	1	2	3	1	3	1	2	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	1	2	1	1	2	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-353	MICROBIOLOGY AND VIROLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	Biology				

COURSE DESCRIPTION:

Provide students with an understanding of important facts, concepts, and the investigative procedures of a microbiology laboratory.

Experiments Details:

1. To study the microscope and to observe different microorganisms like bacteria, protozoa, fungi and yeasts, algae – from natural habitat.
   b) Demonstration: Students will get familiar with different microscopic techniques such as TEM, SEM, Confocal- Microscopy, Flow cytometry and applications of these microscopic techniques in observation of bacterial biofilms.
2. Preparation of nutrient both, nutrient agar, Sterilization and inoculation of bacteria (Microwave Oven, Heating mantles, Fridge, Heating Oven, Tube racks) .
3. Simple and differential staining procedures, endospore staining, flageller staining, cell wall staining, capsular staining, negative staining. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
4. Bacterial colony counting. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
5. Isolation of microbes from soil samples and determination of the number of colony forming units. (U.V. spectrophotometer, Colony counter etc.)
6. Testing of microbiological quality of milk.
7. Testing of microbiological quality of water.
8. Microbial assay of antibiotics.
9. Isolation of bacteriophages by plaque method

Text Books:

Laboratory Manual & Workbook in MICROBIOLOGY, Applications to Patient Care, 9th Edition, Morello, Mizer, Granato, mcgraw-Hill, 2008, ISBN: 978-0-0-299575-6

Course Outcomes:

After the completion of the course the student should be able to

1. The safe methods for isolation, subculture, and maintenance of bacterial, fungal.
2. An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal
3. An understanding of the uses of various media and testing protocols with focus on clinical applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2						1	1	2	1	1	
CO2		1	1	2	1		1				1	1	1	1	
CO3				1	3	1				1				2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

ESC-307	FLUID MECHANICS AND MECHANICALOPERATIONS	L	T	P	C
		3	1	0	4
Pre-requisite	None				

COURSE DESCRIPTION:

Fluid mechanics explains the relationships between force, pressure and fluid movement. Fluid mechanics can be used to understand the flow of fluids in pipes and mixing in bioreactors. Mechanical operations are applied in down-stream processing. This course introduces the principles of fluid mechanics and mechanical operations that are relevant for industrial biotechnology. The instruments used for measurement and control of fluid flow are also described.

Course Educational Objectives:

1. Explain basic concepts of fluid flow
2. Describe the devices for measurement of fluid flow
3. Discuss the application of fluid mechanics to bioprocess industries
4. Explain principles of mechanical operations
5. Discuss construction and working of equipment for mechanical operations.

UNIT 1

Definition and scope of Fluid Mechanics in Biotechnology with simplified examples: Basic properties of fluids: Density, viscosity, and their practical significance in biotechnological processes. Fluid statics: Pressure, hydrostatic forces, and simple applications in bioprocessing. Types of fluids: Newtonian and Non-Newtonian fluids with straightforward illustrations. Basic concepts of fluid dynamics: Types of flows, and their relevance in biotechnology.

UNIT 2

Fluid Flow in Bioprocessing : Introduction to fluid flow through pipes: Laminar and turbulent flows with basic equations. Basic pressure drop and head loss in pipes, and their impact on bioprocess design. Introduction to pumps in biotechnology: Types and their applications in simple bioprocesses. Flow through packed beds and porous media: Basic concepts and applications in bioreactors. Basic understanding of fluidization and its importance in bioprocesses.

UNIT 3

Mixing and Agitation: Basic concepts of mixing and agitation in bioreactors and their significance in simple processes. Basic principles of aeration and agitation in fermentation processes and their importance. Simple introduction to sedimentation and centrifugation in bioprocessing.

UNIT 4

Rheology and Fluid Behavior: Simple introduction to rheology: Viscosity and its importance in biotechnological processes. Basic understanding of Newtonian and Non-Newtonian fluids and their behavior in bioprocessing. Basic flow properties of non-Newtonian fluids in bioreactors and pipelines. Basic mixing and flow considerations for non-Newtonian fluids in biotechnological applications.

UNIT 5

Applications of Fluid Mechanics in Biotechnology: Fluid flow in bioreactors: Design considerations and optimization. Importance of mixing and agitation in various bioprocesses. Flow through porous media and packed beds in biotechnological applications. Sedimentation and centrifugation for bioparticle separation. Importance of fluid mechanics in bioprocessing equipment and scale-up considerations.

Text Books :

W.L. McCabe, J.C. Smith, and P. Harriot, Unit Operations of Chemical Engineering, 7/e, McGraw-Hill International Edition, 2017.

References:

1. J.M. Coulson, and J.F. Richardson, Chemical Engineering-Volume One, 6/e, The English Language Book Society and Permagon Press,1999.
2. G.G. Brown, Unit Operations, CBS Publishers,2005.

Course Outcomes:

After the completion of the course the student should be able to

1. Identify the types of non-Newtonian fluids
2. Characterize and describe fluid-particle systems in terms of their basic physical properties.
3. Impart the f concepts of fluid statics, pressure distribution and dimensional analysis

4. Learn basic principles of particle preparation and their characterization
5. Study and understand the principles of various size reduction

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

ESC-355	FLUID MECHANICS AND MECHANICALOPERATIONS PRACTICAL	L	T	P	C
		0	0	2	1
Pre-requisite	None				

COURSE DESCRIPTION:

Provide students with an understanding of important facts, concepts, and the investigative procedures of a fluid mechanics.

Experimentals:

1. Calibration of Rotameter.
2. Determination of orifice coefficient.
3. Determination of venturi coefficient.
4. Verification of Bernoulli's equation.
5. Friction losses in fluid flow in pipes
6. Determination of pressure drops in a packed bed for different fluid velocities.
7. Determination of pressure drop and void fraction in a fluidized bed.
8. Determination of centrifugal pump efficiency
9. Sampling of materials (Riffle sampling and cone quartering sampling).
10. Determination of energy consumption in size reduction using roll crusher.
11. Determination of energy consumption in size reduction using ball mill.
12. Determination of effectiveness of a given screen.

Text Books:

Laboratory manual of fluid mechanics

Course Outcomes:

After the completion of the course the student should be able to

1. Basic principles of Fluid mechanics and its applications
2. An understanding of Bernoulli's equation.

3. To understand different types of centrifugal pumps

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2						1	1	2	1	1	
CO2		1	1	2	1		1				1	1	1	1	
CO3				1	3	1				1				2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-401	MOLECULAR BIOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Biology and Biochemistry				

COURSE DISCRIPTION:

The objective of the course is to familiarize the students with the basic concept in molecular biology

UNIT -1

Concept of genes, Central dogma of Molecular Biology, DNA as the genetic material, Structure of DNA and RNA, Genome, cot analysis, C value paradox, Repetitive DNA, Satellite DNA, Gene families and gene clusters, Nuclear and organelle genome, Nucleosome structure, Higher order chromatin structure Chromosome structure in prokaryotes & eukaryotes.

UNIT 2

Types of mutations. Replication errors and their repairs. DNA damage, DNA repair – Single step and multistep, Models of homologous recombination in eukaryotes and prokaryotes, Non homologous and end joining (NHEJ) recombination, Genetic consequences of mechanism of recombination. Site specific recombination and transposition of DNA: conservative site specific recombination, biological roles of sites recombination Gene conversion.

UNIT 3

Models of DNA replication, Replication fork, continuous and discontinuous DNA synthesis. Enzymes and proteins in replication, Replication of DNA and different models of replication Telomeres. Inhibitors of DNA replication, Components of transcriptional machinery in prokaryotes and eukaryotes: Promoters and Enhancer sequences and transcription units RNA polymerases - E. coli and eukaryotic RNA polymerases. Transcription process: Chromatin remodeling, Initiation, elongation and termination of RNA synthesis. Monocistronic and polycistronic RNAs Posttranscriptional modifications/processing of eukaryotic RNA:Capping and poly-adenylation, RNA splicing and splicing mechanisms. RNA editing Inhibitors of transcription.

UNIT 4

General features of genetic code tRNA & aminoacyl tRNA synthetases, Ribosomes, Translation process-Initiation, Elongation & termination of translation in prokaryotes and eukaryotes, Translational factors Inhibitors of protein synthesis – antibiotics and other inhibitors.Post-translational modifications: Covalent and enzymatic modification of proteins Protein folding,

UNIT 5

Regulation of gene expression in prokaryotes: The operon model- lac, trp operons. Transcriptional control by attenuation in trp operon. Regulation of gene expression in eukaryotes, Regulatory proteins (Transcription factors)- DNA-binding motif of regulatory proteins. Role of zinc fingers, leucine zippers, helix-turn-helix.

Books recommended:

1. Instant notes in Molecular Biology by Turner, Viva Publication, 1997.
2. Microbial Genetics by D. Freifelder, Jones & Bartlett, 2004.
3. Molecular Biology by D. Freifelder, Jones & Bartlett, 2008.
4. Molecular Biology of Gene Watson, by Baker et.al. 7th Edition, Pearsons Publication, 2013.
5. Molecular Biology of the Cell by B. Alberts, Talor & Francis, 2008.
6. Genes by Lewin and Benjamin, Editions IX, Jones & Bartlett, 2010

Course Outcomes:

Upon completion of this course students will be able to:

1. Discuss regarding significant discoveries through the historical progress and their impacts on the development of molecular biology.
2. Demonstrate the mechanisms of DNA replication, damage and repair in applied molecular genetics.
3. Understand storage of genetic information and its transcription, translation and regulation at molecular level in prokaryotic and eukaryotic systems.
4. Demonstrate a clear understanding on basic concepts of molecular biology and will be able to apply in different fields of Biotechnology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2											1	3		
CO2	3	2		3								1	3	2	2
CO3	3												3	2	
CO4	3											1	3		
CO5	3												3		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-451	MOLECULAR BIOLOGY LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Biology				

COURSE DESCRIPTION:

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

Experiments Details:

1. Isolation of Plasmid DNA
2. Isolation of Plant DNA
3. Isolation of bacterial genomic DNA.
4. Isolation of genomic DNA from blood cells.
5. Estimation of DNA content in the given sample by spectrophotometer
6. Determination of Tm of DNA.
7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.
8. Polyacrylamide/Agarose gel electrophoresis of DNA.
9. PCR amplification of DNA and visualization by gel electrophoresis.

Text Books:

Sambrook et al, "Molecular Cloning-A laboratory Manual"

Course Outcomes:

1. Understand the DNA isolation and amplification techniques
2. Familiar with the basic techniques of proteomics, DNA & RNA
3. Understanding various molecular biology instruments

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3		3			3	1	1	
CO2	3	3	2	3	3	2	3		3			3	1	1	
CO3	3	2	3	3	3	2	2		3			3	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

HSC-401	VERBAL ABILITY II	L	T	P	C
		2	0	0	2
Pre-requisite	HSC 301 (Verbal Ability - I)				

COURSE DESCRIPTION:

This course designed to learn the advanced grammar skill.

Course Educational Objective:

To make the students ready in core grammar skills to help them prepare for CRTs(In campus & off campus) and various government exams like SSC, Bank PO, IBPS, RBI etc.

UNIT 1

Clauses and Vocabulary (advanced): Subordinate Clauses- The noun clause, the adjective clause, the adverb clause, Analysis of simple and complex sentences, prepositional phrases, transformation of sentences. Revisiting vocabulary- high, medium and low frequency words, Revisiting vocabulary- organization of ideas and thoughts in order to understand the text- The Pyramid Principle.

UNIT 2

Reading Comprehension: Basics of Comprehensions, different tones of comprehensions, Cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, Cracking question types like contextual vocabulary, fill in the blanks, true/false questions, Question types like reference to context, summary and title of the passage, paraphrasing the text

UNIT 3

Cloze test, Auxiliaries, Modals, Words: Intricacies of Cloze Test, Correct use of specific adjectives, concept of sentence improvement, Writing concept, auxiliaries and modals, Concept of consistency, precision, concision in terms of reading and writing, Advance word choice with respect to placement papers, SAP (Subject-Audience-Purpose) approach. Understanding the basic approaches of all the various question types

UNIT 4

Introduction to Question types – I: Fill in the blanks, One word Substitution, Spellings, Understanding the right word choice, Concept of Para-Jumbles and Para-completion, Verbal analogies, Odd man out, phrases and idioms

UNIT 5

Introduction to Question types-II: Error identification, Usage of the various figures of speech, commonly confused words and phrases, Techniques for tackling synonyms and antonyms

Text book [TB]:-

English is Easy- Chetanand Singh (BSC Publication)-2018

Reference books [RB]:-

1. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood (Oxford University Press)
2. Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL; 21295th edition (1994)

Course Outcomes:

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

1. Analyze simple and complex sentences, and transform sentences from one form to the other. Also, will be able to use high frequency vocabulary in spoken and written English.
2. Solve comprehension based questions easily.
3. Use right kind of word with respect to placements, and also will be able to solve previous year placement papers using different approaches.
4. Solve various different types of questions asked in verbal ability section in various government and MNCs' placement tests.
5. Speak Grammatically Sound English.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3		2	3	2		2						2			
CO4		3	2	2		2						2			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-402	STEM CELLS & ANIMAL TISSUE CULTURE	3	0	0	3
Pre-requisite	Biology and Biochemistry				

COURSE DISCRIPTION:

This course is designed to understanding of the science of animal tissue culture and stem cells, with emphasis on Mammalian Cells.

UNIT -1

History, Cell culture techniques, Equipment and sterilization methodology, Nutritional and physiological: Growth factors and growth parameters, General metabolism and Growth Kinetics, Establishment and maintenance of primary cell cultures of adherent and non-adherent cell lines with examples. Establishment and maintenance of secondary and continuous cell cultures

UNIT -2

Karyotyping, biochemical and genetic characterization of cell lines, Identification of cells, adventitious agents, Bioreactors for large-scale culture of animal cells, Vaccine production, e.g. Measles, Rabies , Use of Hybridoma for production of monoclonal antibodies. Therapeutic biological products, cytokines etc.

UNIT -3

Principle and theory of tissue engineering Applications of tissue engineering, Cryopreservation, Tissue culture applications

UNIT- 4

Stem Cells Introduction,, Stem Cells from Early, Mammalian Embryos,Adult stem cells, Mesenchymal stem cells and Embryonic Stem cells, Stem Cells to Functional Tissue Architecture

UNIT 5

Therapeutic and reproductive cloning, Nuclear Transfer method Application of NT ES cells.

Safety of NT ES cells. Medical treatment Organ regeneration Ethical consideration, Regulating issues

BOOKS RECOMMENDED:

1. Culture of Animal Cells – A manual of basic technique and specialized applications by R. I. Freshney, 6th edition, Wiley-Blackwell, 2010.
2. Animal Cell Technology: From Biopharmaceuticals to Gene Therapy. L. R. Castilho et. al. Taylor & Francis Group, 2008.
3. Animal Biotechnology, by A. Akbarsha et. al., 1st edition, Pearson Education 2012.
4. Basic Cell Culture by J. M. Davis, 2nd Edition, Oxford University Press, 2002.
5. Stem cell handbook, by Stewart Sell, Humuna Press. Inc. 2004.

Course Outcomes:

1. By the end of the course, students will have sufficient scientific understanding and will be able to:
2. Understand the basics of stem cells and animal tissue culture techniques
3. Understand the usefulness of in-vitro cell culture model for various biological questions
4. Know the preparation of media, assessment of cell growth and cryopreservation
5. Demonstrate the ability to establish and maintain animal cell lines in culture
6. Demonstrate the precautions to be taken to maintain aseptic cell cultures

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1									1			3		
CO2											1		2		
CO3		2	2										2		
CO4					3		2							3	
CO5										3	3				3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-454	STEM CELLS & ANIMAL TISSUE CULTURE LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-402				

COURSE DESCRIPTION:

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps the students in understanding to advance skills of animal biotechnology, cell culture and stem cell culture techniques.

Experiments Details:

1. Sterilization techniques: Theory and Practical: Glassware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium.
5. Isolation of lymphocytes for culturing.
6. DNA isolation from animal tissue
7. Quantification of isolated DNA.
8. Resolving DNA on Agarose Gel.

Text Books:

R.Ian Freshney, "Animal cell Culture"

Course Outcomes:

1. Learnt aseptic handling of tissues as well as various animal tissue culture methods.
2. Understand the various sterilization process and Lab practice for animal culture
3. Understanding various cell culture process and their instrumentation process and handling

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1									1			3		
CO2			2								1		2		
CO3		2	2								1		2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-403	DEVELOPMENTAL BIOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Biology and Biochemistry				

COURSE DISCRIPTION:

This course is designed to basic understanding of embryonic development of animals.

Course Educational Objectives:

1. The objective of the course is to develop a basic understanding of animal development,
2. Emphasizing on various stages in embryonic development.
3. The course would also give an insight on the influences of environment in animal development.
4. Applications of basic research in developmental biology.

UNIT -1

Introduction to Developmental Biology, Spermatogenesis and Oogenesis in placental mammals (mouse/human), Comparison of internal and external fertilization, Steps in the fertilization process in mouse/human: Capacitation of sperm, Acrosome Reaction, Sperm-egg fusion, Activation of the egg, Fusion of sperm and egg pro-nuclei, Prevention of polyspermy (with reference to placental mammals and sea urchin)

UNIT-2

Embryonic Clevage- Cytoskeletal mechanisms in cleavage Maternal-zygotic transition Types of cleavage based on potentiality of blastomeres, position and amount of yolk, and position of mitotic spindles, Emphasis on cleavage in embryos of echinoderms (sea urchin), molluscs (snail), amphibians (frog) and placental mammals (mouse/human), Stages after embryonic cleavage and Gastrulation.

UNIT -3

Origin of gene theories in development, Genomic equivalence: Evidences with emphasis on metaplasia and animal cloning, and exceptions to the rule, Differential gene expression: Regulation at the level of genome, transcription, translation and post-translation, Gene silencing: Antisense RNA and Gene

knockouts, Cell fate specification based on position and lineage in early embryogenesis, Lateral inhibition in Drosophila neurogenesis, Axes formation and early embryonic patterning in Drosophila and vertebrates, Homeotic genes.

UNIT -4

Development of the germ layer derivatives with emphasis on the formation of central nervous system and epidermis, fore-limb and hind-limb in vertebrates. Complete and incomplete metamorphosis, metamorphosis in insects and Anurans, Epimorphosis, Morphallaxis and Compensatory regeneration

UNIT-5

Environmental disruption of normal development Teratogens, with emphasis on alcohol, retinoic acid and pathogens, Applications of stem cells in regenerative medicine-Assisted reproductive technology on in vitro fertilization (IVF) and intra cytoplasmic sperm injection (ICSI), Genetically modified organisms (GMOs) and their applications in biomedical research

Text Book / References

1. Developmental Biology 7th Edition by Scott F. Gilbert (Author)
2. Developmental Biology 12th Edition by Michael J.F. Barresi (Author), Scott F. Gilbert (Author)
3. Developmental Biology: Diverse Aspects by Leonard Roosevelt, Syrawood Publishing House

Course Outcomes:

Upon completion of this course students will:

1. Acquire knowledge about the fundamental aspects in animal development.
2. Demonstrate a clear understanding of different developmental aspects in major groups of organisms.
3. Understand the concepts of differential gene expression, which leads to generation of complexity in organisms.
4. Understand the importance of developmental biology in sex and reproduction including in-vitro Fertilization and cloning of animal cells etc.
5. Demonstrate the importance of environmental influences on development and the translational aspects of developmental biology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1									1			3		
CO2											1		2		
CO3		2	2										2		
CO4					3		2							3	
CO5										3	3				3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-404	PLANT TISSUE CULTURE AND PLANT BIOTECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Elementary Biology				

COURSE DESCRIPTION:

The plant biotechnology course is an essential component of biotechnology program. The course enables students to explore the skills of basic operations such as media preparation, plantlet regeneration and acclimatization. The technique expose student for large scale propagation of plants, their adaptations to climatic changes as well as selection and genetic modifications for disease resistance, herbicide tolerance, abiotic stress tolerance.

Course Educational Objectives:

1. Introduce the concepts of screening, isolation and maintenance of industrially important microorganisms.
2. Describe the production of organic acids and fermented beverages
3. Describe the applications of secondary metabolites, antibiotics and enzymes.
4. Introduce the commercial aspects of fermented foods.
5. Describe the application of recombinant DNA technology for production of therapeutics

UNIT 1

Plant tissue culture and biotechnology-Introduction, significance, history, plant tissue culture media, plant growth regulators, Principle and pathways of in vitro plant regeneration- totipotency, cell differentiation, callogenesis, rhizogenesis, organogenesis, somatic embryogenesis, Clonal (Micro) propagation- business and opportunity.

UNIT 2

Applications of plant tissue culture technique, Haploid plant production, Protoplast technology- isolation, culture, somatic hybrids and cybrids production, Germplasms conservation- cryopreservation, Gene banks, Synthetic seeds technology, Somaclonal variations- origin, cause and in vitro selection, Virus indexing.

UNIT 3

Scale-up propagation Callus and cell culture system- isolation, culture, growth, viability and applications, Secondary metabolite production, biotransformation, Bioreactor- design and models for mass cultivation of plant cells, Hairy root bioreactor for secondary metabolite production, Automation in plant tissue culture.

UNIT 4

Genetic Transformation-basic principles and applications Plant genetic transformation technology: chimeric gene construction, Methods of gene transfer, Vectors of genetic transformation- Ti based vectors, T-DNA, mechanism of Agrobacterium gene transfer, , viral vectors, Chloroplast transformation, Gene Silencing- RNA editing, Field techniques for transgenic plants.

UNIT 5

Transgenic plants status Delayed ripening, Disease resistance-fungal, bacterial, viral, Herbicide resistance, Stress tolerance, Enhanced nutritional properties- Iron and Vit-A (Golden Rice), Plantibody, Plant cell chemical factory, Current global status and limitations of transgenic crops, Ethical and legal issues related to GM crops, Regulation of GM crops in India.

Text Books :

1. H. S. Chawla, Introduction to Plant Biotechnology, 3/e, CRC Press, 2009.
2. A. Slater, N. Scott, M. Fowler, Plant Biotechnology: The Genetic Manipulation of Plants, 2/e, Oxford University Press, India, 2008.
3. Purohit S.D, Introduction to Plant Cell, Tissue and Organ CulturePaperback– 2012.

References:

1. L. Pena, (Editor), Trangenic Plant: Methods and Protocols (Methods in Molecular Biology Series Vol. 286)", HanumanaPressTotowa, New Jersey, USD, 2005.
2. Agnès E Ricroch, Surinder Chopra, Shelby Fleischer. Plant Biotechnology: Experience and Future Prospects. Springer International Publishing, pp.XIII, 291, 2014, 978-3-319-06891-6.
3. Functions and Biotechnology of Plant Secondary Metabolites 2nd ed (2010). Wink, M. Wiley-Blackwell

Course Outcomes:

1. After the completion of the course the student should be able to
2. Apply fundamental knowledge of in vitro plant propagation in laboratory and industry
3. Develop protocols for large scale micropropagation system, germplasm conservation, virus elimination
4. Explain screening and selection of haploids, somatic hybrids, and other variants for biotic and abiotic resistance Improvise secondary metabolites through selection and genetic transformation
5. Calculate the cost of tissue cultured plant and the enterprises

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-453	PLANT TISSUE CULTURE AND PLANT BIOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	**Plant Tissue Culture (BTE-404)**				

COURSE DESCRIPTION:

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner

Experiments Details:

1. Preparation of stock solution for Murashige & Skoog's (1962) (MS) medium.
2. Shoot tip culture
3. Axillary bud culture.
4. Induction and establishment of callus culture.
5. Subculture and multiplication of callus.
6. Cell suspension culture.
7. Haploids from anther culture
8. Zygotic embryo culture and somatic embryogenesis (Demonstration).
9. Artificial seeds production and plantlets regeneration.
10. Isolation and culture of protoplasts.
11. *Agrobacterium* mediated genetic transformation and hairy root culture.
12. In vitro rooting/ germination of somatic embryo and regeneration of complete plant.
13. Soil transfer, hardening and acclimatization of plantlets

Text Books:

Laboratory manual

Course Outcomes:

The students should be able to develop their skills

1. Comprehend the concepts of plant tissue culture techniques.
2. In vitro study of plant secondary metabolites.

3. Understand the technology of plant transformation, conventional and molecular marker breeding techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2	2			3		
CO2	3	3	2	3	3	2	2	3	2	1	1		2		
CO3	3	3	3	3	3	2	2		2	1			2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-405	IMMUNOTECHNOLOGY	L	T	P	C
		3	1	0	4
Pre-requisite	Biology and Biochemistry				

COURSE DESCRIPTION:

The immune system is designed to prevent foreign organisms from causing harm to the body. Immunotechnology utilizes the components of the immune system for therapeutic and analytical applications. This course describes the components of the immune system, the mechanisms of immune response and application of this knowledge for selection of transplants and to produce vaccines.

Course Educational Objectives:

1. Introduce the concepts of immunology
2. Describe the structure and functions of immunoglobulins and complement proteins
3. Introduce various immunological techniques
4. Introduce hypersensitivity reactions and transplantation immunology.
5. Describe models of immune deficiency

UNIT 1

Types of immunity: innate and adaptive. Cells of the immune system, t and b lymphocytes – origin, activation, differentiation, characteristics and functions. Nature of t and b cell surface receptors. Macrophages phagocytosis, primary and secondary lymphoid organs: structure and function. Antigens, immunogen, hapten, adjuvant, epitope. Super antigens. Major histocompatibility complex, human leukocyte antigens (hla), antigen presenting cells, processing and presentation of antigens. Necrosis & apoptosis.

UNIT 2

Structure of immunoglobulin, immunoglobulin classes and biological activities. Isotypes, Allotypes, idiotypes. Immunoglobulin genes and antibody diversity, class switching, humoral and cell-mediated immune responses, cytokines-interleukins, interferons, tnf. The complement, pathways and consequences of complement activation.tumor immunology: definition, tumor antigens, immune response to cancer.

UNIT 3

Antibody affinity and avidity, precipitation reactions –immunodiffusion, radial immunodiffusion, double immunodiffusion, immunoelectrophoretic, rocket immunoelectrophoretic, agglutination reactions-hemagglutination and complement fixation, immunofluorescence, ria, elisa, immunoblotting, flow cytometry and fluorescence, hybridoma technology - production of monoclonal antibodies and their applications. Catalytic antibodies.

UNIT 4

Hypersensitivity: immediate (type i, type ii, type iii) and delayed hypersensitivity reactions, autoimmunity - organ specific (hashimoto's thyroiditis) and systemic (rheumatoid arthritis) diseases. Transplantation immunology- auto, allow, iso and xenograft, bone marrow and kidney transplants, graft rejection (graft versus host rejection and host versus graft rejection mechanisms), co stimulatory pathways, immuno suppressive agents. Immunodeficiencies - scid and aids.

UNIT 5

Types of vaccines, development, production of peptide and DNA vaccines, knockout mice,transgenic mice as models of immune system diseases-nude mice and scid mice.

Text Books :

1. Thomas J. Kindt, Barbara, A. Osbarne, Richard A. Goldsby, Kuby Immunology, 8th Edition, W.H Freeman, 2018.
2. P.M. Lydyard, A. Whelan & M.W Fanger, Instant notes in Immunology, 1st Edition, Viva publishers, 2008.

References:

1. William E. Paul, Fundamentals of Immunology, 7th Edition, Lippincott and Wilkins, 2012.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roit, Roitt's Essential Immunology, 12thedition, Wiley Black well, 2011.

Course Outcomes:

1. After the completion of the course the student should be able to
2. Describe the molecular basis of the immune response
3. Understand the basics of transplantation immunology.
4. Describe immunosuppressive drugs and immunodeficiency disorders
5. Outline the principles of vaccine development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	1	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	2	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	1	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	2	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-452	IMMUNOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-405				

COURSE DESCRIPTION:

Provides an opportunity to experimentally verify the theoretical concepts already studied. it also helps in understanding the theoretical principles in a more explicit and concentrated manner

Experiments details:

1. Different types of antigen –antibody cross reaction
2. Identification of blood group antigens
3. Differential count of White blood cells by haemocytometer
4. Isolation, purification and identification of immunoglobulin from goat blood.
5. Widal test for identification of *Salmonella Typhi*
6. Double diffusion techniques for identification of antigen-antibody samples
7. Agglutination inhibition test to detect pregnancy
8. Immuno-electrophoresis techniques.
9. ELISA (Enzyme linked Immunosorbent Assay)

Demonstration

1. Protein immunoblotting (Western blotting) technique
2. Flow cytometry

Text Books:

1. Immunology, The experimental Series – II by W. Luttmann, K. Bratke, M. Kupper, Myrtek, USA, Elsevier, Academic Press;2006
2. Manual of clinical laboratory Immunology by N. R. Rose, R. G. Hamilton, B. Detrick, 6th edition, ASM Press, 2002.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-553	**ENZYMOLOGY & ENZYME TECHNOLOGY LAB**	**L**	**T**	**P**	**C**
		0	0	2	1
Pre-requisite	**BTE-501**				

COURSE DESCRIPTION:

The course should help the students to understand the basics of enzymes, mechanisms of enzyme action and its application in the various fields. This course facilitates the students to troubleshoot the real time industrial problems with the help of their knowledge acquired on enzyme kinetics and various purification methods

Experiments Details:

1. Isolation of enzyme from different microorganism.
2. Isolation of alpha amylase from plant source.
3. Determination of Enzyme activity.
4. Effect of pH on Enzyme kinetics.
5. Effect of temperature on Enzyme kinetics.
6. Identification of Enzyme by different assay.
7. Fractionation of protein using ammonium sulphate.

Text Books:

1. Laboratory manual
2. Jakoby WB. [23] Crystallization as a purification technique. Methods in Enzymology. 1971 Dec 31; 22:248-52.
3. Bernfeld P. Amylases α and β. Methods in Enzymology Volume I. Elsevier, Science Direct. G; 1955, 149-158 p.

Course Outcomes:

The students should be able to develop their skills

1. Have the ability to assay the enzyme in the unknown sample
2. Acquire knowledge on the kinetics of single andmulti substrate enzymatic reactions.
3. Have the ability to understand the concepts of enzyme inhibition and regulation

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3		3			3	1	1	
CO2	3	3	2	3	3	2	3		3			3	1	1	
CO3	3	2	3	3	3	2	2		3			3	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

HSC-501	REASONING ABILITY – I	L	T	P	C
		2	0	0	2
Pre-requisite	High School Maths, English				

COURSE DESCRIPTION:

The module is designed in a manner to prepare students for various competitive examinations.

Course Educational Objectives:-

1. Interpret the questions of aptitude building objectively and prepare for various competitive examinations/ CRTs
2. Understand the optimized approach of dealing with placement questions

UNIT 1

Quantitative Aptitude:- Number System : Numbers & types; Theory of factors; Divisibility test; Place value and face Value; Base system (subtraction and addition in different bases); Remainder theorem; Digits at the unit places and finding last two digits in a given expression; Calculating number of zeroes, Finding maximum power of any prime number or any composite number in any factorial; Successive Division Fractions : Introduction to various types of fractions; Conversion of terminating and non terminating types of fractions into rational number; Subtraction, addition and multiplication of terminating and non terminating decimals H.C.F and L.C.M : Basic theory, Different methods of finding HCF and LCM for given numbers; various types of questions.

UNIT 2

Quantitative Aptitude:- Percentage: Basic concepts; Conversion from fraction to percentage using addition; Application of percentage in – (a) Expenditure, Cost , Consumption problems; (b) Population increase or decrease problems; (c) Production, Manpower and Working hour problems; (d) In successive increment or decrement; (e) Comparison of salary or numbers; (f) Percentage change in area or volume
Profit and Loss: Introduction; Concept of single, double and triple discount and Marked price; Various types of questions Simple Interest & Compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money; Various Questions

UNIT 3

Quantitative Aptitude:- Ratio, Proportion and Variation: Ratio- Introduction; Types of ratios (Properties and Uses); Comparison of Ratios; Concept of duplicate, triplicate, sub-duplicate and sub-triplicate ratios Proportion and variation – Concept of direct, inverse, continuous and mean proportions; various questions Logical Aptitude (Reasoning):- Coding Decoding, cryptarithmetic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continues pattern series, Alpha -numerical sequence puzzle

UNIT 4

Logical Aptitude (Reasoning):- Classification or odd one out based on several kind of relationship – Relationship based on meaning/ Functional relationship/Even, odd or prime number relationships, divisibility or non- divisibility by a certain number Blood Relation : Indicating form / puzzle form / coding form, Direction Sense based on only direction/ direction & distance, Direction puzzles.

UNIT 5

Logical Aptitude (Reasoning):- Analytical reasoning: Seating Arrangements – Linear / Circular / Distribution / comparison / Floor and box arrangement/Quant based arrangements, Decision making and selection Critical reasoning: Assertion and Reason, Statement and Assumptions, Statement and Arguments, Statement and Course of action, Statement and conclusion, Probably true/false, Statement and Inference, cause and Effects

Text book [TB]:-

Quantitative Aptitude:-

How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8 th edition, 2018

Logical Aptitude (Reasoning):-

A Modern Approach to Logical Reasoning-R.S. Aggarwal (S Chand Publishing; 2 Colour edition (2018))

Reference books [RB]:-

Quantitative Aptitude:-

1. Quantitative Aptitude for Competitive Examinations- R.S. Agarwal (S. Chand Publications
2. Quantitative Aptitude- Saurabh Rawat & Anushree Sah Rawat (Savera Publishing House, 1st edition, 2016)

Logical Aptitude (Reasoning):-

1. Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha; (Pearson India; 5th edition (2016))
2. Wiley's Verbal Ability and Reasoning - P A ANAND (Wiley (2016))

Course Outcomes:-

By the end of this semester, students will be able to

1. Perceive and analyze the requirements of placement trends (in campus and off campus) and the question types asked in various government exams like SSC, Bank PO. IBPS etc.
2. Able to solving the Critical reasoning: Assertion and Reason, Statement and Assumptions

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2	3	3									1	
CO2			2	3	3									1	

		L	T	P	C
BTE-503	BIOINFORMATICS -1	3	0	0	3
Pre-requisite	Computer Knowledge				

COURSE DESCRIPTION:

The first aim of bioinformatics is to store the biological data organized in form of a database. These allow the researchers an easy access to existing information and submit new entries. These data must be annonated to give a suitable meaning or to assign its functional characteristics. The databases must also be able to correlate between different hierarchies of information.

Course Educational Objectives:

1. Describe nature and type of information available in biological databases
2. Explain the principles of sequence alignment
3. Analyze the algorithms for phylogenetic analysis
4. Explain the principles of protein structure prediction
5. Explain the principles of structural and functional genomics

UNIT -1

Introduction to Bioinformatics: History of Bioinformatics; Objectives and areas of Bioinformatics; Applications of Bioinformatics in Biotechnology, Central Dogma, Genome sequencing projects; Human Genome Project -History, Techniques and insights

UNIT-2

Introduction to Biological Database: Overview, Types of biological databases, Nucleic acid and protein databases- GenBank, EMBL, DDBJ, SWISS PROT. Structural databases - PDB, etc; Motifs and Pattern Databases - PROSITE, Pfam, etc. Database Retrieval systems - SRS, Entrez, Bankit, Seqin.etc., Protein Databases, Literature Databases- PUBMED, MEDLINE Composite Databases, Sample Sequence Data File, Representation of sequence, Data submission & Data retrieval system.

UNIT -3

Sequence Analysis & Alignment: Statistical significance of alignment; Sequence assembly Analysis;

Global & Local Alignment and their algorithms, Pair-wise and Multiple sequence alignment: Methods for sequence alignment. Dot plots, Dynamic programming algorithms, Heuristics - FASTA, BLAST, Gaps & gap penalties.

UNIT- 4

Evolutionary analysis- Concept of phylogeny and trees, Phylogenetic prediction, evolutionary tree construction, tree building methods, rooted & unroofed trees, evolution tree & data phylogenetic software like PHYLIP, phylogenies from pairwise distance matrices (UPGMA and NJ algorithms) CLUSTAL W, T-cofee, Phylogenetics on the web, Sequence Homology, COGS (Cluster of Orthologous genes).

UNIT -5

Predictive methods using nucleotide sequence: Annotation of DNA and protein sequences, Database searches for homologous sequences- FASTA, BLAST, PSI-BLAST and PHI-BLAST, Scoring matrices - PAM, BLOSUM.

Text Books/ Reference Books:

1. Mount D. W. (2004). Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press. C. Braden and C. Tooze (1991). Introduction to Protein Structure" Garland Publishing Inc., New York.
2. S.C.Rastogi, N.Mendiratla and P.Rastogi (2004)., Bioinformatics methods and applications- Genomics, Proteomics and Drug Discovery, Prentice Hall (India).,
3. T.B.Kitano (2003), Handbook of Comparative Genomics: Principles and Methodology, Graziano Pesole.
4. Dov Stekal (2003) Microarray Bioinformatics, Cambridge University Press, Cambridge.
5. Brown TA. (2002) Genomes. John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
6. P.Clate & R.Backofen (1998), Computational Molecular Biology, Willy Publication,
7. T.K.Atwood and D.J. Parry Smith, Introduction to Bioinformatics.

Course Outcomes:

1. Knowledge and awareness of the basic principles and concepts of biological database.
2. Problem-solving skills, including the ability to develop new algorithms and analysis methods
3. An understanding of protein structure prediction and analysis
4. Knowledge of algorithms for phylogenetic analysis
5. An understanding of the intersection of life and information sciences, , information theory, gene expression, and database queries.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-554	BIOINFORMATICS -1 LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-503, Computer Knowledge				

COURSE DESCRIPTION:

This course designed to understanding of use of NCBI and EBI data base for biotechnological use.

Course Educational Objectives:

Describe how bioinformatics data is stored and organized. Describe the different types of data found at the NCBI and EBI resources. Explain how to locate and extract data from key bioinformatics databases and resources.

List of Experiments:

1. Explore NCBI.
2. Analysis of sequence alignment of any given protein sequence.
3. Analysis of sequence alignment of any given gene sequence.
4. Analysis of Multiple sequence alignment of given protein sequences.
5. Phylogenetic analysis of given protein sequences.
6. Annotation of any nucleotide sequence.

Text Books/References:

1. D.W. Mount Bioinformatics: Genome and Sequence Analysis: (2001) Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
2. Ian Korf, Mark &Josaph: BLAST, Oreilly Publisher, 2003
3. R. Durbin, S. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.
4. A.D. Baxevanis& B.F.F. OuletteBioinformatics – A practical guide to the Analysis of Genes and Proteins,2002, Willey International publishers.
5. M.J. Bishop and C.J. Rawlings (editors), DNA and Protein Sequence Analysis---A Practical Approach IRL Press at Oxford University Press, ISBN 0 19 963464 7 (Pbk)
6. J. Pevsner (2002) Bioinformatics and Functional Genomics; Cold Spring Harbor Laboratory Press,

Cold Spring Harbor, New York

Course Outcomes-

1. Understand the use of databases at the NCBI and EBI resources
2. Understand the difference between databases, tools, repositories and be able to use each one to extract specific information.
3. Understand how to extract data from specific databases using accessions numbers, gene names etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3									1	
CO2	3	3	3	1	3									1	
CO3	3	3	3	2	3									1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-504	FERMENTATION TECHNOLOGY	L	T	P	C
		3	1	0	4
Pre-requisite	Microbiology, Enzymology				

COURSE DESCRIPTION:

Fermentation is the process that started the era of industrial biotechnology. This technology can be utilized to produce biochemicals, fuel and medicines. This course introduces the procedures involved in fermentation.

Course Educational Objectives:

1. Introduce the concepts of screening, isolation and maintenance of industrially important microorganisms.
2. Describe the production of organic acids and fermented beverages
3. Describe the applications of secondary metabolites, antibiotics and enzymes.
4. Introduce the commercial aspects of fermented foods.
5. Describe the application of recombinant DNA technology for production of therapeutics

UNIT-1

Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Introduction to submerged and solid state fermentation, Microbial culture selection for fermentation processes. Primary and Secondary metabolites.

UNIT-2

Raw material availability, quality, processes and pretreatment of raw materials. Major alcoholic raw materials. Applications of the nonconventional raw materials (cellulosic material and hydrocarbons).

UNIT-3

Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression

UNIT-4

Creation/procedures for developing mutants of the desired microbes with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept for overproduction of metabolites.

UNIT-5

Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β- lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)- Microbial Transformations, Microbial leaching.

Text Books/ Reference Books:

1. Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latested.
2. Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, OriffinPublication
3. Industrial Fermentations- Leland, N. Y. ChemicalPublishers.
4. Prescott and Dunn's- Industrial Microbiology, 4 th,ed.
5. Biotechnology Series, Rehm, Reed & Weinheim,Verlag-Chemie.
6. Biochemical Engg., Aiba, Humphrey & Miller, AcademicPress.

Course Outcomes:

Students will be able to stands

CO1: Able to understand the process knowledge required for fermentation, controlling parameters in fermentation.

CO2: Comprehend principles of fermenter design, fermenter inoculation and operation.

CO3: Get acquainted with the industrial aspect of the fermentation process.

CO4: Develop an understanding of process control, upstream and downstream process.

CO5: Learn microbial growth kinetics of and product formation in industrial fermentation processes.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	3	3									1	
CO2	3	1	3	3	3									1	
CO3	3	1	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	1	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 – High Correlation

BTE-551	FERMENTATION TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-504				

COURSE DESCRIPTION:

To develop their practical skills in microbial fermentation techniques.

Experiments Details:

1. Fermentative production of Penicillin Antibiotics using *Penicilium chrysogenum*.
2. To study the induction effect of β-galactosidase enzyme in E.coli.
3. Citric acid production by (a) solid state and (b) submerged fermentation.
4. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
5. Fermentative production of Ethanol using *Saccharomyces cerevisiae*.
6. Wine Fermentation.
7. Microbial production of Biosurfactant using suitable strain.
8. Microbial production of Biopolymer using suitable Strain..

Text Books:

Laboratory manual

Course Outcomes:

The students should be able to develop their skills

1. Enables the student to develop their skills in the field of microbial fermentation technology from upstream to downstream process.
2. To enable understanding of beneficial role of microbes in industry and mankind.
3. Hands on experience for boosting confidence among students.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3		3			3		1	
CO2	3	3	2	1	3	2	3		3			3		1	
CO3	3	2	3	3	3	2	2		3			3		1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-502	**RECOMBINANT DNA TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	0	0	3
Pre-requisite	**Molecular Biology**				

COURSE DESCRIPTION-

This course is designed to understanding of genetic engineering in plant and animal system for development of therapeutic products.

Course Educational Objectives

1. Introduce the tools of techniques of molecular biotechnology
2. Discuss the risks and benefits of biotechnology
3. Describe the principles of medical biotechnology.
4. Discuss concepts and implications of personalized medicine.
5. Describe the relevance of biotechnology for agriculture and medicine

UNIT-1

Recombinant DNA and Gene Cloning: Introduction to various vectors, properties of ideal vector and host, development of high capacity vectors. Plasmids: types of plasmids. Construction of Genomic and cDNA libraries, their strategies and advantages. Restriction Enzymes, DNA finger printing and DNA labeling Enzymes used in cloning – polymerases, ligases, restriction endonuclease. Types and nomenclature of restriction enzymes. Different blotting techniques: southern, northern, western and hybridization.

UNIT-2

Gene amplification through Polymerase Chain Reaction: Principle of PCR, design of primers, PCR methodology: RT-PCR, multiplex PCR, anchored PCR, inverse PCR, site directed mutagenesis, gene sequencing.

UNIT-3

Molecular Markers, Micro array and gene silencing Type of molecular markers, use of RFLP, RAPD, AFLP, STMS, DNA chips, SNPs and microarray, 16s r-ANA typing, gene chip and micro array; applications in disease profiling, RNA silencing.

UNIT-4

Expression and purification of recombinant proteins: Strategies of protein expression in bacteria, insects, transgenic plant and animal, purification of recombinant proteins.

UNIT-5

Applications of Genetic Engineering: Gene cloning in medicine, agriculture, transgenic animals and plants, molecular farming. Trait modification by genetic engineering – over expression or under expression of heterologous genes

Text Books :

1. T.A. Brown, Gene cloning and DNA analysis: an introduction, 6/e, Wiley- Blackwell, 2010.
2. D. S.T. Nicholl, An introduction to genetic engineering, 3/e, Cambridge University press, 2008.

References:

1. J.D. Watson, R.M. Meyers, A.A. Caudy and J.A. Witkowski, Recombinant DNA: genes and genomes - A short course, 3/e, W.H. Freeman and Co, 2007.
2. S.B. Primrose, R. Twyman, B. Old, Principles of gene manipulation, 6/e, Wiley-Blackwell, 2001.

Course Outcomes:

After the completion of the course the student should be able to

1. Summarize the common methods of isolation of nucleic acids and enzymes used in molecular biology.
2. Explain the applications of genome sequencing methods.
3. Select best biological hosts for optimum production of a recombinant protein.
4. Explain the principles of modern gene therapy.
5. Describe the applications of rDNA technology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	2	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	2	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-552	RECOMBINANT DNA TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-502				

COURSE DESCRIPTION:

The practical deals with creating recombinant DNA molecules, To give hands-on training in creating recombinant DNA molecules. Molecular analysis indirectly by restriction digestion and PCR as well as directly by DNA sequencing. To give hands-on training Ligation and transformation

Experiments Details:

1. Isolation of plasmid DNA from E.coli culture
2. Separation of plasmid DNA on agarose gel electrophoresis
3. Restriction digestion of phage DNA
4. Ligation of the DNA digested by restriction endonucleases
5. Preparation of competent E.coli cells
6. Transformation of competent E.coli cells with ligated plasmid and selection of positive colonies through Blue-white screening method
7. Studying the expression of cloned genes (GFP).
8. PCR amplification of DNA using gene specific primers
9. DNA finger printing through RFLP and RAPD

Text Books:

1. Laboratory manual by Sambrook and Russel
2. T.A. Brown, Gene cloning and DNA analysis: an introduction, 6/e, Wiley- Blackwell, 2010.
3. D. S.T. Nicholl, An introduction to genetic engineering, 3/e, Cambridge University press, 2008.

Course Outcomes:

The students should be able to develop their skills

1. The student can able to isolate plasmid DNA
2. The student can able to do molecular digestion and gel elution of vector and inserts and Ligation and transformation.
3. The student can able to do plasmid isolation from PCR positive colonies and perform confirmation of cloning by restriction digestion.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3		3			3	1	1	
CO2	3	3	2	2	3	2	3		3			3	1	1	
CO3	3	2	3	3	3	2	2		3			3	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-601	**BIOINFORMATICS -II**	3	0	0	3
Pre-requisite	**BTE-503**				

COURSE DESCRIPTION:

The first aim of bioinformatics is to store the biological data organized in form of a database. These allow the researchers an easy access to existing information and submit new entries. These data must be annonated to give a suitable meaning or to assign its functional characteristics. The databases must also be able to correlate between different hierarchies of information.

Course Educational Objectives:

1. The first aim of bioinformatics is to store the biological data organized in form of a database.
2. These allow the researchers an easy access to existing information and submit new entries.
3. These data must be annoted to give a suitable meaning or to assign its functional characteristics.
4. The databases must also be able to correlate between different hierarchies of information

UNIT -1

Gene prediction: Gene prediction in prokaryotes & eukaryotes, Basis of Gene Prediction, Pattern Recognition, Gene Prediction methods, Gene Prediction Tools, Gene expression informatics. Primer Design, ORF Finder

UNIT-2

Protein structure prediction: Protein Identification and Characterization, Motif, Profiles, Patterns, Primary Structure Analysis and Prediction, Secondary Structure Analysis and Prediction, 3D proteins structure file formats: PDB, CIF, MMDB; Tertiary structure predictions: Homology modeling, Threading, ab initio.

UNIT -3

Molecular modeling, Introduction to the concepts of molecular modeling, Conformational analysis, Use of molecular graphics packages (Rasmol, MOLMOL, Pymol etc.).

UNIT -4

Computer Aided drug design, Drug discovery process, Drug Design Approaches; Ligand Based Approaches, Target Based Approaches, Lipanski rule of Five, ADMET Property Prediction, Role of Bioinformatics in drug and Vaccine designing and development

UNIT -5

Genomics, Proteomics, Comparative Genomics & Proteomics, Tools and Techniques in Genomics, Tools and Techniques in Proteomics, Protein-Protein Interaction, Post-translational Modifications.

Text Books/ Reference Books:

1. Mount D. W. (2004). Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press.
2. C. Braden and C. Tooze (1991). Introduction to Protein Structure" Garland Publishing Inc., New York.
3. S.C.Rastogi, N.Mendiratla and P.Rastogi (2004)., Bioinformatics methods and applications-Genomics, Proteomics and Drug Discovery, Prentice Hall (India).,
4. T.B.Kitano (2003), Handbook of Comparative Genomics: Principles and Methodology, Graziano Pesole.
5. Dov Stekal (2003) Microarray Bioinformatics, Cambridge University Press, Cambridge.
6. Brown TA. (2002) Genomes. John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
7. P.Clate & R.Backofen (1998), Computational Molecular Biology, Willy Publication,
8. T.K.Atwood and D.J. Parry Smith, Introduction to Bioinformatics.

Course Outcomes:

1. Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
2. Problem-solving skills, including the ability to develop new algorithms and analysis methods
3. An understanding of the intersection of life and information sciences
4. Data must be annoted to give a suitable meaning or to assign its functional characteristics
5. An understanding of the intersection of life and information sciences, information theory, gene expression, and database queries.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-652	BIOINFORMATICS –II LAB	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-503, BTE-554, BTE-601				

COURSE DISCRIPTION:

This course designed to familiar with the retrieval of information from different databases.

Course Educational Objectives: Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

Experiments Details:

1. Gene Prediction of any nucleotide sequence.
2. ORF prediction of any nucleotide sequence.
3. Secondary Structure prediction of any amino acid sequence.
4. Draw any drug molecule by chemsketch tool.
5. Visualize any protein molecule.
6. Homology modeling of any given protein sequence.

Text/Reference Books:

Sambrook et al, "Molecular Cloning-A laboratory Manual"

Course Outcomes:

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

1. Familiar with the retrieval of information from different databases
2. Understand the genomic comparison and its analysis
3. Compare predicted vs experimental pose

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

		L	T	P	C
BTE-602	BIOPROCESS ENGINEERING	3	1	0	4
Pre-requisite	Biology and Biochemistry				

COURSE DESCRIPTION:

Industrial scale production of bioproducts involves optimization of media, operational conditions, selection of bioreactor type and method for control of operational parameters at the optimum values. Models of microbial growth are utilized to estimate the time requirements and process efficiency. This course describes the methods for optimization of media, aeration rate, process parameters and bioreactor type.

Course Educational Objectives:

1. Identify differences between chemical processes and bioprocesses
2. Explain principles of media design and optimization
3. Explain principles of microbial growth kinetics
4. Describe selection and operation of bioreactors
5. Describe fermenter design

UNIT 1

Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in Batch and continuous bioreactors, chemostat with recycle, multistage chemostat, fed-batch growth. Microbial growth parameters, and Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

UNIT 2

Sterilization: concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods &Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand.

UNIT 3

Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors

UNIT 4

Role of diffusion in Bioprocessing, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

UNIT 5

Design of a fermented Basic functions of a fermenter for microbial or animal cell culture. Bioreactor control mechanism, Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in applications.

Text Books :

1. M. L. Shuler, F. Kargi, Bioprocess Engineering Basic Concepts, 2/e, Prentice Hall, 2002

References:

1. Pauline M Doran, Bioprocess Engineering Principles, Elsevier, 2005.
2. P.F.A. Stanbury, A. Whitaker, S.J. Hall, Principles of Fermentation Technology, 2/e, Pergamon,1995.

Course Outcomes:

1. After the completion of the course the student should be able to
2. Explain requirements for design of a bioreactor
3. Calculate power requirements of a bioreactor
4. Explain kinetics of microbial growth
5. Explain control of operating conditions in a fermenter and describe regulatory constraints

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-651	**BIOPROCESS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	0	2	1
Pre-requisite	**BTE-602**				

COURSE DISCRIPTION:

The course provides the student with the basics of bioreactor technology. It specifically focuses on bioreactor performance and operation and on the kinetics related to microbial growth, product formation, function of enzymes and transfer phenomena.

Experiments Details:

1. Determine the growth patterns and specific growth rate of *E.coli*
2. Determine the effect of peptone concentration on *E.coli*. growth
3. Determination of specific thermal death rate constant (kd) for E.Coli
4. Determine the effects of temperature & pH on *Pseodomonas putida*
5. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
6. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillus niger*
7. Upstream and Downstream of bioprocess for the production of α-amylase by *Aspergillus nudulans*
8. Estimation of volumetric liquid mass transfer coefficient (KLa) using sodium sulphite method.
9. Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
10. Computational Design of Fermentative Process for l-Lysine production

Text Books:

Laboratory manual

Course Outcomes:

The students should be able to develop their skills

1. Find the effect of pH and temperature on enzyme activity
2. Estimate the monod parameters in batch, fed-batch and continuous cultures.
3. Estimate residence time distributions in batch and continuous bioreactors

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3		3			3		1	
CO2	3	3	2	1	3	2	3		3			3		1	
CO3	3	2	3	3	3	2	2		3			3		1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

HSC-601	REASONING ABILITY – II	L	T	P	C
		2	0	0	2
Pre-requisite	Basic knowledge of Mathematics and must have studied HSC 501				

COURSE DISCRIPTION:

This course designed to preparation of the competitive and skill examination test.

Course Educational Objectives: The course is placement specific and final step to help students focuses to:

1. Align themselves with the placement requirements and its needs.
2. Solve the questions using short tricks in less time

UNIT- 1

Partnership, Speed Distance & Time, Time, Work & Wages: Partnership: Introduction; Various types of partnerships and various questions; Speed, Distance and Time: Concept of Average Velocity; Concept of Race tracks - Straight and Circular; Concept of trains; Boats and Streams; Time, Work and Wages: Basic concepts (relationship between men, days and work); Understanding concept of group efficiency; Alternate work concept; Negative work; Concept of Wages; Pipes and Cisterns

UNIT- 2

Permutations Combinations & Probability: Permutations and Combinations: Basic Principles of Counting (Addition and Multiplication); Arrangements around- Circular, Square and Rectangular tables and in straight lines; Different question types, Probability: Introduction, various types of events; Classical definition of probability; Random and Discrete variables; Bayes' Theorem and question types;

UNIT 3

Data Interpretation & Deductive Logic: Data Interpretation: Introduction; Different ways of representing data- Narration based, pictorial, pie chart, Bar graph, line charts; various questions based upon them, Deductive Logic: Premises and conclusion structure, Quality of deductive argument, Categorical arguments, Syllogism, Conditional Arguments- If..then, only if..then, If and only if , Either or.

UNIT- 4

Puzzles, Set Theory, Critical Reasoning Set- Puzzles: Grouping and selection, Double line up, Binary logic- truth teller-lie teller, Team formation and miscellaneous puzzles. Set theory and Venn diagram: Union of sets, Intersection of sets, Use of venn diagrams in problem solving with two, three, four set, concept of maxima-minima through Venn diagram. Critical reasoning problem sets: Identify the assumption, Draw the Inference, Draw the conclusion, Strengthen or Weaken the argument.

UNIT- 5

Non-verbals Reasoning & Data Sufficiency- Non-Verbal reasoning: Mirror-image, Water-image, Spotting out the embedded figures, Completion of incomplete pattern, Figure matrix, Paper folding, Paper cutting, Grouping of identical figures, Counting figures, Non verbal series / analogies / OMO. Data Sufficiency based on logical reasoning field like Coding-Decoding / Puzzle Test / Blood Relations / Mathematical calculations / clock / calendar / etc.

Text book [TB]:-

Quantitative Aptitude:-

How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8 th edition, 2018

Logical Aptitude (Reasoning):- A Modern Approach to Logical Reasoning-R.S. Aggarwal (S Chand Publishing; 2 Colour edition (2018))

Reference books [RB]:-

Quantitative Aptitude:-

1. Quantitative Aptitude for Competitive Examinations- R.S. Agarwal (S. Chand Publications

2. Quantitative Aptitude- Saurabh Rawat & Anushree Sah Rawat (Savera Publishing House, 1st edition, 2016)

Logical Aptitude (Reasoning):-

1. Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha; (Pearson India; 5th edition (2016)) 2. Wiley's Verbal Ability and Reasoning - P A ANAND (Wiley (2016))

Course Outcomes:

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

1. Clear himself with the understanding of time & work, time speed distance and partnership and will be able to solve the questions from basic to advanced level.
2. Solve the questions of probability and permutation combinations efficiently.

3. Understand various types of data interpretation sets, also he/she will be able to solve argument-based reasoning sets .
4. Solve puzzle-based problems from various domains/topics.
5. Solve the questions from non-verbal reasoning. By the end of this semester, students will be prepared for the upcoming placements and they will also be ready for other competitive exams.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3		2	3	2		2						2			
CO4		3	2	2		2						2			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-601	NANOBIOTECHNOLOGY & BIOSENSORS	L	T	P	C
		3	0	0	3
Pre-requisite	Biology				

COURSE DESCRIPTION:

Nanomaterials are materials that are restricted to nanoscale size in at least one dimension. Nanoscience is the study of nanomaterials that have unique physical, chemical or biological properties due to their size. Nanobiotechnology utilizes the unique properties of nanomaterials for applications in medicine, agriculture and industry. This course is an introduction to the fabrication, characterization and biological applications of nanomaterials.

Course Educational Objectives:

1. The objective of course is to familiarize the students with advanced research area and basic concept in Nanobiotechnology and Biosensors
2. Describe the methods for synthesis and fabrication of nanomaterials
3. Describe the methods for characterization of nanomaterials
4. Create awareness of applications of nanotechnology
5. Describe the application of nanomaterials in novel biomedical devices and components

UNIT 1

Nanotechnology and Nanobiotechnology in today's World: Significance of Nanoscale materials, Structure and properties of carbon nanotubes and graphene, Size dependent properties: Size dependence of sedimentation rate, adsorption effects, scattering of light, absorption of electromagnetic radiation, magnetic and electrical properties. Cooperative transitions in biological systems: Zimm-Bragg theory for helix-coil transition in polypeptides

UNIT 2

Production of nanomaterials and characterizations: Top down &bottom up strategies. Green synthesis of Nanoparticles (plants). Microbial synthesis of Nanobiotechnology (bacteria, fungi, yeast, Algae) Self-assembly: Langmuir-Blodgett films. DNA origami. Bionanomaterial characterization:

Electron microscopy. Scanning probe microscopy (Atomic Force Microscopy). Light Scattering. Optical tweezers. Surface plasmon resonance. Light scattering. X-ray diffraction.

UNIT 3

Application of Nanomaterials in medicine: Drug delivery, Drug encapsulation, Tissue repair and implantation, Nanocoatings, Miniaturized devices/ Lab on a chip, Toxic effects of nanomaterials , Vectors for drug delivery: Liposomes, Micelles and viral capsids. Nanomaterials for Biomedical imaging: Quantum dots, SPIONs Theragnostic.

UNIT 4

Diagnostics and Prognostics: Principles and applications of Nanoarrays and Nanofluidic. Nanopore sequencing of DNA. BioNanomechanics: NanoBiomotors. Mechanics of cilia and flagella. Nanobioelectronic: Nanowires based on DNA. Molecular transistors. Voltage gated ion channels.

UNIT- 5

Biosensors: Introduction to biosensors, Components of a typical biosensor, Types of biosensors (Calorimetric, Potentiometric, amperometric, optical, Piezo-electric, Immuno based sensors), Applications related to healthcare, bio-defense, food and water safety, agriculture and environment, Multidisciplinary interactions for biosensor development.

Text Books :

1. C. M. Niemeyer and C. A. Mirkin. Nanobiotechnology: Concepts, applications and perspectives. Wiley, 2006.
2. C. A. Mirkin and C. M. Niemeyer, Nanobiotechnology II: More concepts and applications, Wiley-VCH, 2007

References:

1. T.Vo-Dinh, Nanobiotechnology in biology and medicine: methods, devices and applications, CRC, 2007.
2. Y Xie, The nanobiotechnology handbook, CRC, 2012
3. https://nptel.ac.in/courses/118107015

Course Outcomes:

After completing this unit, the student will be able to:

1. Understand and explain the unique properties of nanomaterials
2. Compare the methods for fabrication of nanomaterials
3. Select optimum methods for nanomaterial characterization
4. Compare drug delivery vectors
5. Describe the applications of nanobioelectronic.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	1									1	
CO3	3	3	3	3	1									1	
CO4	3	3	3	3	1									1	
CO5	3	3	3	3	1									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-602	MOLECULAR DIAGNOSTICS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3
Pre-requisite	Molecular Biology				

COURSE DESCRIPTION:

Molecular diagnostics is a dynamic and transformative area of diagnostics, leading to insights in research and treatment in many disease states that are revolutionizing healthcare. This course describes the methods to detect and measure the presence of genetic material or proteins associated with a specific health condition or disease, helping to uncover the underlying mechanisms of disease. Students aspiring to continue higher education and research in medical biotechnology will have a solid footing in this course

Course Educational Objectives:

1. To learn methods for isolation and sequencing of nucleic acids
2. To learn molecular techniques useful for molecular diagnosis and prognosis
3. To learn methods for molecular diagnosis of common genetic disorders
4. To learn methods for molecular diagnosis of cancer and infectious diseases
5. To learn quality control and quality assurance for molecular diagnosis

UNIT 1

Isolation of DNA from Buccal swabs, Blood, Urine and Hair. Methods for DNA and cDNA amplification. Next generation DNA sequencing technology. Lab-on-a-chip approach to molecular diagnostics.

UNIT 2

Biomarkers. Primer design and primer selection for selected diseases. PCR-RFLP, Real time PCR, Reverse Transcription-PCR, multiplex-PCR, SSCP, CSGE, DGGE.

UNIT 3

Genetic Disorders and classification of genetic disorders, single gene disorders (Cystic Fibrosis,

Marfan's syndrome), multifactorial disorders (Diabetes, Atherosclerosis, Schizophrenia). Tumor profiling. Molecular diagnosis for cervical cancer. Molecular diagnostics for hematopoietic disorders (sickle cell anaemia, thalassemia).

UNIT 4

Disease identification and genetic tests for following disorders., Thrombofilia, cystic fibrosis, Huntington disease, fragile-X syndrome, thalassemia, sickle cell anemia, Alzheimer's disease, Huntington's disease, hepatitis C virus, cytomegalovirus. Molecular diagnostics for streptococcus and tuberculosis. Molecular diagnosis for HLA typing.

UNIT 5

Quality control and quality assurance identification and standards for molecular diagnosis, Regulatory issues in molecular diagnostics. Ethical considerations in molecular diagnostics.

Text Books:

1. C.A. Burtis, D.E. Bruns Tietz, Fundamentals of clinical chemistry and molecular diagnostics, 7/e, Saunders, 2014.
2. L. Buckingham, Molecular Diagnostics: fundamentals, methods and clinical applications, F.A. Davis Company, 2011.

References:

1. G.P. Patrinos, W.J. Ansorge, Molecular Diagnostics, 2/e, Elsevier publications,2010.
2. W.W. Grody, R.M. Nakamura, F.L. Kiechle, C. Storm, Molecular diagnostics: techniques and applications for the clinical laboratory, 1/e, Academic press,2009.
3. D.E. Bruns, E.R. Ashwood, C.A. Burtis, Fundamentals of molecular diagnostics, Elsevier-Saunders.2007.
4. C.A.Burtis,D.E.Bruns,eds.TietzFundamentalof clinicalchemistryand molecular diagnostics, 7/e, Saunders-Elsevier,2015.

Course Outcomes:

1. Describe techniques useful for molecular diagnostics
2. Describe the molecular basis for genetic disorders
3. Describe molecular methods for testing of genetic diseases
4. Describe molecular methods for diagnosis of infectious diseases
5. Describe molecular methods to assist diagnosis of cancer, diabetes and cardiovascular disorders.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-603	FOOD SAFETY AND QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Food Science				

COURSE DESCRIPTION:

In our healthy life, selection of types of foods or its products play important role with awareness of types of foods. And modern era, our customers are more sincere about selection of foods which could be safe, nutritious and least processed in nature. Most of our food processing industries are developing the more variety of foods for our people. But they are sensitive about processing conditions with maintenance of food standards as well ensuring of food safety for their products. A lot of international or national food safety guideline has been provided to maintain our products in safety nature.

Course Educational Objectives:

1. To understand the values of hygienic conditions for our food products
2. To understand the guidelines for food safety issues to be maintained
3. To understand the food borne disease from food safety failure
4. To understand the food processing condition changes during transformation of foods
5. To optimize processing conditions for more safe food products

UNIT-1

Characterization of food safety: Food Safety definition and principles, characterization of food hazards, risk analysis for chemical and microbial hazards, exposure assessment of microbial food hazards, chemical risk assessment in foods

UNIT-2

Food hazards from biological agents, prevalence of food-borne pathogens, physiology and Survival of food-borne pathogens in various food systems, characteristics of biological hazards in foods

UNIT-3

Chemical and physical nature of food hazards, hazards from natural origins, chemical and physical hazards produced during food processing, storage, and preparation, hazards associated with nutrient

fortification, monitoring chemical hazards: regulatory information

UNIT-4

Food quality and food standard, Codex Alimentarius as FAO/WHO food standards program Implementation of FSLS regulatory programs for pathogen reduction, advances in food sanitation: use of intervention strategies, use of surveillance networks, hazard analysis critical control point (HACCP)

UNIT-5

Food plant sanitation, food safety control systems in food processing, food safety and innovative food packaging, safe handling of fresh-cut produce and salads, good manufacturing practices, prerequisites for food safety, the principles of modern food hygiene.

Textbooks:

1. Ronald H. Schmidt and Gary E. Rodrick, 2003, Food Safety Handbook. A John Wiley & Sons Publication

References:

1. K. Singh P. N. Raju & A. Jana. Food Technology-I, www.agrimoon.com
2. R. Paul Singh and Dennis R. Heldman. 2009. Introduction to Food Engineering Fourth Edition, Academic Press is an imprint of Elsevier

Course Outcomes:

After the completion of the course the student should be able to

1. People can purchase of more variety of food via ensuring the food safety issues
2. Processed foods can create more marketing opportunity for different food once consumer will secure about food safety issue and quality or food standards
3. Safe food can enhance the shelf-life of many foods
4. Processed foods can help to gain more opportunity for investment with foreign currency gain with proving of food safety and hygienic processing conditions
5. Processed foods can maintain the sensory quality and nutrient contents for customers for long periods

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

	MARINE BIOTECHNOLOGY	L	T	P	C
TBT-604		3	0	0	3
Pre-requisite	Marine Science				

COURSE DESCRIPTION:

Marine ecosystems are a major source of food, oxygen and play a vital role in biogeochemical cycles. This course describes the natural products obtainable from marine resources and the application of biotechnology for diagnosis of diseases prevalent in commercially important marine organisms such as fish.

Course Educational Objectives:

1. Provide the basis for evaluation and conservation of marine biodiversity.
2. Describe the resources from marine environment.
3. Introduce the different aspects of aquaculture.
4. Describe the applications of marine biotechnology

UNIT -1

Overview of the present status of marine biotechnology, Marine ecosystems – intertidal zone, inhabitants and ecology of estuaries, salt marshes, mangrove swamps, coral reefs and the deep sea, Plankton, nekton and benthos.

UNIT-2

Introduction to tides and waves. Water currents and winds. Major and minor elements in the sea water and their importance, dissolved oxygen. Biogeochemical cycles (Carbon, Nitrogen, Sulphur and Phosphorus) in the ocean. Global climatic change and potential effects on coral bleaching, eutrophication.

UNIT-3

Applications from both the biology and policy perspectives (e.g. endangered species, captive breeding, habitat fragmentation, ecosystem restoration, rehabilitation. Marine food web dynamics - primary, secondary and tertiary production.

UNIT-4

Marine natural products, aquaculture, valuable chemicals, bioactive compounds from micro-algae, macro-algae and other marine organisms. Important enzymes from marine microorganisms and their applications: Xylanases, proteases, chitinases.

UNIT-5

Marine biotechnology for economic development and environmental problem solving. Aquaculture- fish, shrimp and pearl oyster culture. Transgenic marine organisms. Biofouling and prevention Bioremediation. Probiotic bacteria and their importance in aquaculture. PCR, molecular and immunological techniques for determination and identification of bacterial and viral pathogens in aquaculture. Vaccines for aquaculture.

Text Books :

1. Text book of Marine Ecology. (1989). Nair N.B. &Thampy, D.M.
2. Recent Advances in Marine Biotechnology. Vol.2 (1998) Fingerman, M., Nagabushanam, R., Thompson, M.

References:

1. Biological Oceanography. (1999). Lilly, C.M.
2. Ecology of Coastal water. (1988). Mann, K.H.
3. An introduction to Marine Sciences. (1988). Meadows, P.S. & Campbell J.J.
4. General Oceanography–An introduction (1980).Dietrich,G.,Kalle,K, Krauss,W&Siedler, G.
5. Biotechnology in the marine sciences: Proceedings of the first annual MIT Sea grant lecture & seminar. (1984). Colwell, R.D.(Ed)

Course Outcomes:

After the completion of the course the student should be able to

1. Explain physicochemical aspects of marine environment
2. Summarize applications of marine natural products
3. Apply biotechnological interventions to economic and environmental issues
4. Appreciate the importance of marine biotechnology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-611	AGRO BIOTECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Plant Physiology, Plant Tissue culture and Molecular Biology.				

COURSE DISCRIPTION:

This course designed to importance of biotechnology in agriculture as well as industrial purpose

Course Educational Objectives:

1. To Familiarize the students with basic concepts of Agriculture Biotechnology
2. To clarify major scientific, ecological and sociological aspects of biotechnology in agriculture and food production.
3. To familiarize advanced molecular biology applications in Agriculture Biotechnology.

UNIT-1

Introduction: Agriculture and Agricultural Biotechnology, In vitro Germplasm Conservation Micro propagation, In vitro production of pathogen and/or disease-free plants

UNIT-2

Biotechnology- Methods of Crop Improvement, Genetic Engineering for Crop Plants Improvement. Methods of gene transfer in plants, Transgenic Plants for biotic and abiotic, stress resistance, In vitro induced mutagenesis, Role of antisense and RNAi in crop improvement, Regulated and tissue specific expression of transgenes for crop improvement, Terminator gene technology

UNIT-3

Recent advances – Non gel based techniques for plant, genotyping – Homogenous assays – Qualitative/Real Time assays; DNA Chip and its technology. Molecular breeding (MAS) Transgenic Plants, Molecular Markers, QTL.

UNIT-4

Mapping In vitro Production of Secondary Metabolites Production of foreign compounds in transgenic plants Molecular Pharming, Production of Edible vaccines and other therapeutics, Biotransformation

UNIT -5

Biofertilizers and Phyto-remediation Biopesticides, Agricultural antibiotics Biotechnology in Agriculture, Hydroponics, Biosafety regulations, Ethical Aspects and Public Acceptance.

Course Outcomes:

1. The students will acquire knowledge about the range of approaches to manipulate and improve the plants, crop production and sustainable agriculture.
2. They are able to demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation.
3. Students will have sufficient scientific understanding of different biotechnological methods to improve the crop production and for sustainable agriculture.
4. Students will understand the relationship between society and science and the justification for biotechnological manipulation in agriculture practices.

Books recommended:

1. Molecular Plant Breeding By B.D. Singh, N.S. Shekhawat, Scientific Publishers, 2017
2. Agricultural Biotechnology by H. D. Kumar, Daya Publishing House, 2005.
3. Agrobacterium Protocols, Volume 1- Editor- Kan wang, Humana Press, 2010.
4. Agrobacterium Biology- From Basic Science to Biotechnology. Ed. Stanton B. Gelvin, Springer International Publishing, 2018.
5. Plant Biotechnology and Agriculture Prospects for the 21st Century, Arie Altman, Paul Michael Hasegawa, Elsevier Science, 2012.
6. Biotechnology By B. D. Singh, Kalyani Publishers, 2010.
7. Omics Technologies and Crop Improvement by Noureddine Benkeblia, CRC Press,2014.
8. Agricultural Biotechnology by Geetha , Jebaraj S, Pandiyarajan P, Agro-Bios, 2008, Reprint 2012
9. The Role of Biotechnology in Improvement of Livestock: Animal Health and Biotechnology by Muhammad Abubakar, Ali Saeed, Oguz Kul, Springer, 2015.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-612	SYNTHETIC BIOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite					

Course Description:

Synthetic Biology is the design and production of novel sub-systems or entire organisms from biological or bioengineered components. It may involve metabolic engineering or genetic engineering to optimize existing biological systems. Or novel biological systems may be designed and created.

Course Educational Objectives:

1. Describe the genetic code and its variations
2. Describe model systems for Synthetic Biology
3. Explain the principles of genome design
4. Explain the strategies for genome synthesis
5. Describe the potential applications of Synthetic Biology

UNIT-1

Introduction to Synthetic Biology, Basic concepts of synthetic biology. Self-replicating systems. RNA dependent RNA polymerase. Synthetic genetic code. Minimal genetic code. Extended genetic code. Non-native nucleic bases. Non-native backbone.

UNIT- 2

Minimal nucleic acid polymerases. Minimal ribosome. Minimal genome. Minimal cell. Minimal microbes (specific example E.coli and Mycobacteria). Targeted deletion methods. Semi-synthetic systems. Semi-synthetic microbes.

UNIT-3

Genome design. Building blocks and structures. Temporal and spatial engineering. Design tools for synthetic biology. OPEN and CoDA selection systems.

UNIT-4

Genome synthesis strategies. Genome editing tools - Zinc finger nucleases, TALENs, CRISPR- Cas9. Genome assembly methods. Genome sequencing. Measurement of genetic output.

UNIT 5

Microbial cell factories. Potential applications of synthetic biology for production of biomaterials, biofuels and drugs. Potential applications of synthetic biology in medicine, food production and bioremediation. Regulation of synthetic biology for safety. Intellectual property rights for synthetic organisms.

Text Books :

1. C. Smolke, S.Y.Lee, J.Nielsen, G. Stephanopoulos. Synthetic Biology: Parts, Devices and Applications. (2018). Wiley-VCH.
2. D.N.Nesbeth. Synthetic biology handbook. (2016). CRC Press.
3. Church, G and Regis, E. (2012). Regenesis: How Synthetic Biology will Reinvent Nature and Ourselves. Basic Books.
4. Pier Luigi Luisi, Cristiano Chiarabelli. Chemical Synthetic Biology. (2011) Wiley & Sons.
5. Gibson, D.G., 2014. Programming biological operating systems: genome design, assembly and activation. Nature methods, 11(5), pp.521-526.

Course Outcomes:

After completion of the course, the student should be able to:

1. Describe the genetic code and its variations
2. Explain the importance of model systems for Synthetic Biology
3. Understand the principles of genome design
4. Describe the strategies for genome synthesis
5. Describe the potential applications of Synthetic Biology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	3	3									1	
CO2	3	1	3	3	3									1	
CO3	3	1	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	1	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-613	BIOTECHNOLOGY FOR SOCIETY	L	T	P	C
		3	0	0	3
Pre-requisite	Biotechnology, Genetics,				

COURSE DISCRIPTION:

This course is designed to understand the importance of biotechnology and their risk for society.

Course Educational Objectives:

1. Introduce the tools of techniques of molecular biotechnology
2. Discuss the risks and benefits of biotechnology
3. Describe the principles of medical biotechnology.
4. Discuss concepts and implications of personalized medicine
5. Describe the relevance of biotechnology for agriculture and medicine

UNIT- 1

History of Biotechnology, Genes (basic concepts) Genetic Engineering Invention, Genetic engineering, Tools for manipulation of genes (introduction to recombinant DNA technology) Vectors and expression systems (introduction).

UNIT- 2

Intellectual property rights (concepts related to drugs, genes and genomes) Recombinant DNA Debates, Biotechnology and Business, Patenting Life, Genetically Modified Foods: Risk and Regulation

UNIT-3

Freezing, Banking, Crossing, Eugenics, The Human Genome Project, Genetic Testing, Disability, and Discrimination, Bioethics and Medicine, From the Pill to IVF, Cloning, Stem Cells, Designer Babies.

UNIT-4

Biotechnology and Diversity, Personal Genomics, Biotechnology and Race, Drugs and designer bodies. Bioprospecting and Bio colonialism

UNIT-5

Vaccines, Gene therapy, Clinical trials, Synthetic Biology and Bioterrorism, Use of biofertilizers and biopesticides for organic forming

Text Books :

1. Biotechnology and Society: An introduction. Hallam Stevens. University of Chicago Press. 2016. ISBN 022604615X, 9780226046150

References:

1. W. Godbey, An Introduction to Biotechnology, The Science, Technology and Medical Applications, 1/e, Woodhead Publishing, 2014.
2. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society of chemistry, 2009.
3. B.R. Glick, J.J.Pasternak, C.L.Patten. Molecular Biotechnology.ASM Press. 2009. ISBN-10: 1555814980, ISBN-13: 978-1555814984

Course Outcomes:

After studying the course, the student will be able to:

1. Summarize the principles and tools of biotechnology.
2. Assess the risks and benefits of biotechnology
3. Identify techniques used in biotechnology
4. Understand the potential of biotechnology for exploration.
5. Appreciate the potential of recombinant DNA technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	1	1	1	1	3	2	1
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	2
CO4	3	2	2	3	3	1	3	2	2	1	1	1	3	3	1
CO5	3	3	3	3	3	1	3	1	3	1	2	1	3	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-614	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite					

COURSE DESCRIPTION:

Biomedical Engineering is the application of engineering principles, practices, and technologies to the field of medicine. Models of physiological systems assist in obtaining insights regarding their function and provide information for potential remedial action. A wide variety of instruments assist the medical practitioners in the acquisition of the data required for diagnosis. Methods developed in Information Technology and Computer Science are being adopted for development of Clinical Decision Support systems.

Course Educational Objectives:

1. Describe the physical and engineering properties of materials relevant for biocompatibility
2. Explain the concepts of stress and strain required for understanding the musculoskeletal system
3. Describe the rheological properties of the cardiovascular system
4. Introduce the principles of biomedical sensors and signal processing
5. Describe Data types and Databases for clinical decision support systems

UNIT -1

Biomaterials

Tissue-implant interactions for ceramics, metals and polymers. Biodegradable materials. Smart biomaterials. Tissue engineering: Transformed human cell lines and their applications. Embryonic stem cells and adult stem cells; therapeutic applications of stem cells. Organ culture of skin.

UNIT-2

Biomechanics

Relationship between stress and strain. Local balance of mass, momentum and energy. One Dimensional model of a skeletal muscle. Viscoelastic properties of muscles.

UNIT-3

Biologic unit transport phenomen.

Rheology of blood and the Casson equation. The Fahraeus effect. Molecular and macroscopic level control of blood oxygenation level: Hill equation, Oxygen transport in the Krogh tissue cylinder. Single compartment model of urea hemodialysis. Two compartment model for drug absorption.

UNIT 4

Biomedical Instrumentation

Biomedical sensors – physical measurements, biopotential measurements, blood gas sensors. Introduction to Bioinstrumentation design. Time varying signals. Active Analog filters. Biomedical signal processing. Biomedical Imaging.

UNIT 5

Biomedical Informatics

Data types used in computer aided diagnosis: physical examination, historical, in-vitro diagnostic, histopathological, genetic, nucleotide sequence and image data. Medical image databases and PACS. SNP and genomic databases. Genomic and SNP data for prognosis. Clinical decision support systems.

Text Books :

1. M. Saltzmann. Biomedical Engineering. 2ndEdition. Cambridge University Press. 2015. ISBN-978-1107037199
2. J.Enderle, J. Bronzino. Introduction to Biomedical Engineering. 3rdEdition. Academic Press. 2011. ISBN-978-0123749796

References:

1. C. Oomens, M. Berkelmans, S. Loerakker, F. Baaijens. Biomechanics. 2nd Edition. Cambridge University Press. 2018
2. R. L. Fourneir. Basic Transport Phenomena in Biomedical Engineering. CRC Press. 2018
3. Medical Informatics: Knowledge Management and Data Mining in Biomedicine. Volume 8 of Integrated Series in Information Systems. Ed. Hsinchun Chen, Sherrilynne S. Fuller, Carol Friedman, William Hersh. Springer Science & Business Media, 2006
4. Medical Informatics: Computer Applications in Health Care and Biomedicine. Ed. Edward
5. H. Shortliffe, Leslie E. Perreault. 2nd Edition. Springer Science & Business Media, 2013

Course Outcomes:

1. Compare the physical and engineering properties of materials relevant for biocompatibility
2. Explain the rheological properties of the cardiovascular system
3. Analyze stress and strain relationships in the musculoskeletal system
4. Describe the properties of biomedical sensors
5. List Datatypes and Databases for clinical decision support systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	3									1	
CO3	3	3	3	3	3									1	
CO4	3	3	3	3	3									1	
CO5	3	3	3	3	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

ESC-701	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3
Pre-requisite					

COURSE DESCRIPTION:

Many industrial processes in biotechnology involve heating and cooling. Although thermodynamics determines the direction of heat flow, knowledge of the modes of heat transfer enables us to estimate the time required for achieving the target temperature. The orientation of this course is to deal with certain unit operations. This course is a prerequisite for Fluid Mechanics, Stoichiometry, and Process Calculations.

Course Educational Objectives:

1. To understand the fundamental concepts of conduction.
2. To understand the principles of Convection.
3. To understand the basic fundamental concepts of molecular diffusion.
4. To understand the basic principles and equipment of distillation.
5. To understand principles and equipment for liquid-liquid extraction.

UNIT 1

Heat transfer versus Thermodynamics, Modes of heat transfer, basic laws of heat transfer. Conduction: The Fourier heat conduction equation. One dimensional Steady state heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Heat transfer from extended surfaces.

UNIT 2

Convection-The convective heat transfer coefficient. Dimensionless numbers in heat transfer and their significance. Application of Dimensional Analysis to heat transfer by convection. Empirical equations for calculation of heat transfer coefficients in laminar, turbulent and transition region in forced convection. Flow arrangements in heat exchangers, plate and frame heat exchanger, shell and tube heat exchanger.

UNIT 3

Mass transfer operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, Molecular Diffusion in Gases, Stefan's diffusion, estimation of diffusivity of gases and liquids, theories of mass transfer. Interphase mass transfer: concept of equilibrium, diffusion between phases, material balances in steady state co-current and counter-current stage processes.

UNIT 4

Distillation-Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, nenthalpy concentration diagrams, flash vaporization, differential distillation (Rayleigh equation), steam distillation, continuous distillation, McCabe-Thiele method.

UNIT 5

Liquid-liquid Extraction- Liquid-liquid equilibria, choice of solvent for extraction, analytical and graphical solutions for single and multistage operations, continuous counter current operation. Equipment: Mixer settler cascades, Rotating disc contactor, Scheibel extractor, Pulsed column, Centrifugal extractor.

Text Books :

1. B.K. Dutta, Heat Transfer: Principles and Applications, Prentice Hall of India, 2000.
2. R.E. Treybal, Mass Transfer Operations, 3/e, McGraw Hill International Editions, 1981.

References:

1. Warren L. McCabe, Julian C.Smith and Peter Harriott, Unit Operations of Chemical Engineering, 7/e, McGraw Hill, 2005.
2. B.K. Dutta, Principles of Mass Transfer and Separation Processes, Prentice Hall of India, 2007.

Course Outcomes:

After the completion of the course the student should be able to

1. Understand modes of heat transfer, basic laws of heat transfer and steady state heat transfer
2. Understand heat transfer by forced and free convection
3. Analyze mass transfer operations, molecular diffusion in fluids and interphase mass transfer.

4. Analyze continuous steady state distillation processes
5. Understand the concept about single and multistage operations and different types of equipments used in extraction

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	1	1	1	2	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	2	3	3	3
CO5	3	3	3	3	3	1	3	1	1	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-701	BIO SEPARATION TECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Modern Techniques in Instrumentation (BTE-302)				

COURSE DESCRIPTION:

Products of interest have to be separated from biomass and remaining constituents of the media at the end of fermentation. The separation of the desired products is a challenging task that often accounts for a major part of the cost of an industrial bioprocess. This course describes the techniques and processes used for separation and purification of bioproducts.

Course Educational Objectives:

1. Introduce the methods for the separation of bioproducts
2. Describe the various methods for the purification of recombinant proteins.
3. Explain the mechanism of membrane fouling.
4. Create process flow sheet using the unit procedure concept.
5. Explain nucleation and growth of crystals

UNIT-1

DOWNSTREAM PROCESSING

Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT-2

PHYSICAL METHODS OF SEPERATION

Unit operations for solid-liquid separation - filtration and centrifugation

UNIT 3

ISOLATION OF PRODUCTS

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation– ultrafiltration

and reverse osmosis, dialysis, precipitation of proteins by different methods

UNIT 4

PRODUCT PURIFICATION

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

UNIT 5

FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization, drying and lyophilization in final product formulation.

Text Books :

P.A. Belter, E.L. Cussler & Wei-Shou Hu, Bioseparations: Downstream Processing for Biotechnology, Wiley-Interscience. 2012.

References:

1. R.G. Harrison, P. Todd & S.R. Rudge, Bioseparation Science and Engineering, Oxford University Press, 2006.
2. McCabe, Smith & Harriot, Unit Operations of Chemical Engineering, 7th edition McGraw Hill book company, 2014.
3. J.A. Asenjo. Separation Processes in Biotechnology, CRC Press, 1990.

Course Outcomes:

After the completion of the course the student should be able to

1. Describe the various methods for the purification of recombinant proteins.
2. List unit operations for biochemical product recovery.
3. Design equipment for the separation and purification of bioproducts
4. Create process flow sheet
5. Estimate the cost requirements of downstream processing

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-751	BIO SEPARATION TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Pre-requisite	BTE-701				

COURSE DISCRIPTION:

The course provides the student with the basics of bioreactor technology. It specifically focuses on bioreactor performance and operation and on the kinetics related to microbial growth, product formation, function of enzymes and transfer phenomena.

Experiments Details:

1. Cell disruption by chemical method.(Demonstration/Lab)
2. Cell disruption by mechanical method. (Demonstration/Lab)
3. Product recovery by membrane filtration. (Demonstration/Lab)
4. Separation of product using rotary vacuum Evaporation(Demonstration/Lab)
5. Separation of bioproduct using adsorption. (Demonstration/Lab)
6. Biomass removal by flocculation / Centrifugation method. (Demonstration/Lab)
7. Purification of ethanol using distillation method. (Lab)
8. Purification of antibiotic using liquid-liquid extraction. (Demonstration/Lab)
9. Enzyme Purification using Dialysis method / Salting out method. (Demonstration/Lab)

Text Books:

1. Laboratory manual
2. P.A. Belter, E.L. Cussler & Wei-Shou Hu, Bioseparations: Downstream Processing for Biotechnology, Wiley-Interscience. 2012.

Course Outcome:

After the completion of the course the student should be able to

1. Describe the various methods for the purification of recombinant proteins.
2. List unit operations for biochemical product recovery.
3. Design equipment for the separation and purification of bioproducts
4. Create process flow sheet
5. Estimate the cost requirements of downstream processing

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-701	GENOMICS AND GENOME ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Molecular Biology and Bioinformatics				

COURSE DESCRIPTION:

Genomic studies are used to characterize the nucleotide sequences that encode the genetic information of an organism. Comparative genomic studies are useful for identification of biomarkers for diagnostic applications, for elucidation of the function of genes and to identify targets for drug design. This course introduces the methods for characterization of the genome and the methods and applications of genome engineering.

Course Educational Objectives:

1. To learn the concepts related to genome organization, epigenomics and comparative genomics
2. To learn the genomic organization and sequencing strategies of model organisms
3. To learn techniques for genome editing
4. To learn methods for molecular cell imaging and transcriptomics
5. To understand the concepts of metabolomics
6.

UNIT1

Organization of genomes. Genome maps. Data mining and sequence acquisition. Polymorphism and structural variations. Genome wide association studies (GWAS). Epigenomics and comparative genomics. Genome dynamics and cytogenomics.

UNIT 2

Genome sequence determination and genome analysis of E. coli, Saccharomyces cerevisiae, C. elegans, Drosophila melanogaster, Arabidopsis thaliana and Homo sapiens. Applications of genomics in predictive medicine and forensics.

UNIT 3

Introduction to Genome Editing, DNA repair mechanisms, Methods used in genome editing technology ZFNs, TALENs, Introduction to CRISPR/ CAS technology and its applications, Transfection

optimization for efficient gene editing

UNIT 4

Fluorescent tagging of fixed and live cells, CRISPR-based DNA tagging, Quantitative and high-throughput single-cell image analysis, Chip-seq, RNA-seq, single-cell transcriptomics, guide RNA.

UNIT 5

Applications of genome engineering in therapy, synthetic, developmental biology, human genetics and disease phenotyping, Ethical aspects and safety of genome engineering technology.

Text Books :

S.B. Primrose and R.M. Twyman, Principles of gene manipulations and genomics,7/e, Blackwell publishing, Oxford, U.K. 2006.

References:

T.A. Brown, Genomes, 3/e, Garland Science, 2006.

A.M. Campbell and L.J. Heyer, Discovering Genomic, Proteomics and Bioinformatics, 2/e, Benjamin Cummings, 2006.

Course Outcomes:

1. After the completion of the course the student should be able to
2. Be familiar with concepts of genomics and genomic engineering
3. Be familiar with the techniques that are available for the genome engineering
4. Design CRISPR based editing tools for the target gene of interest

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	1	3									1	
CO3	3	3	3	1	3									1	
CO4	3	3	3	1	3									1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-702	FOOD PACKAGING & STORAGE	L	T	P	C
		3	0	0	3
Pre-requisite	Food Biotechnology				

COURSE DESCRIPTION:

In our healthy life, selection of types of foods or its products play important role with awareness of types of foods. And modern era, our customers are more sincere about selection of foods which could be safe, nutritious and least processed in nature. Most of our food processing industries are developing the more variety of foods for our people. But they are sensitive about processing conditions with maintenance of food standards as well ensuring of food safety for their products.

Course Educational Objectives:

1. Acquire knowledge of various type of material handling and the type of equipment utilized
2. Understand to designing food packaging materials depends the variety of food products
3. Select the packaging materials and types depending upon the properties and sources of food.
4. Ensure the self-life of the packaged food product and adapt appropriate storage condition
5. Describe the national and international acts and rules about food packaging

UNIT 1

Material Handling: Solids and granular materials handling: elevators, conveyors; Pumps: centrifugal and positive displacement; Liquid filling machines: open vent, closed vent and piston fillers.

UNIT 2

Packaging Materials Polymer films, metal containers, flexible packages, special packing.

UNIT 3

Requirements for cereals, meat, poultry, fish, milk, vegetables, fruits, plantation crop-based products and carbonated beverages.

UNIT 4

Storage Principle and Practice: Storage losses and their estimation: Modified and control Atmosphere storage: Binandsilo storage force reals and pulses.

UNIT 5

Loss in cereal quality-insect and pest control. Design of storage structures and facilities including cold storage.

Textbooks:

M.J. Kirwan, McDowell, R.Coles, Food packaging technology. Wiley- Blackwell,2010.

References:

1. S. Stanley, C.G. Roger, Food Packaging, AVI Publications, 1970.
2. S. Sacharow, R.C. Griffin, Principles of Food Packaging, AVI Publication, 1980.
3. F.A. Painy, A handbook of Food Packaging, App. Sci. Publishers, 1980.

Course Outcomes:

After the completion of the course the student should be able to

1. Designing various food packaging materials and the equipment's used in processing of materials
2. Select the packaging materials based on their properties and usage.
3. Apply principles of food processing for efficient packaging with enhanced self-life with implementation of various acts and rules
4. Specialized and sustainable (environmentally) packaging for end user satisfaction.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-703	CANCER BIOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Molecular Biology, Cell biology				

COURSE DESCRIPTION:

This Cancer Biology course provides you with an understanding of the disease processes involved in malignancy and the scientific rationale for therapeutic options. You will be trained in scientific research methods and learn the techniques used in cell and molecular biology and pathology.

Course Educational Objectives:

1. The objective of the course is to develop understanding of the biology of cancer.
2. The course will elaborate understanding of tumor hallmarks, carcinogens, diagnostic and Therapeutic options to cancer patients.

UNIT- 1

Introduction to cancer- Cancer statistics and problems at National and International perspectives. Origin of cancer cell, Genetic, molecular and epigenetic changes in cancer cells, Tumor hallmarks, Tumor microenvironment. Cancer progression Basis of tumour progression, Steps in tumor progression, Cancer stem cell theory for origin of cancer, Classifications, stages and grades of tumor

UNIT- 2

Causes of cancer Chemical carcinogenesis Endogenous & exogenous mutagens, Identification of carcinogens, Tumour initiators & tumour promoters, Molecular basis of cancer- Aberrant signaling in cancer, Cellular and viral oncogenes (Gain of Function), Deregulated apoptotic genes (Loss of functions), Genomic landscape of cancers, DNA repair response in cancer, Dysregulation of cell cycle and cell growth, mutation in apoptosis genes, The role of viral genes in cancer progression (DNA tumour virus (SV 40) and human papilloma virus (E6 and E7).

UNIT- 3

Introduction to Oncogenes families Cell transforming ability of oncogene, Retrovirus as a source of cancer, Oncogenes: Ras, Myc, Src, Jun and Fos, Controlling factors of oncogene expressions Tumour suppressor genes Molecular basis of tumor suppressor genes including Retinoblastoma (Rb), p53,

Adenomatous polyposis coli (APC) in the development and progression of tumor. Metastasis Molecular basis of metastasis, steps in cell invasion, intravasation, transport, colonization, angiogenesis.

UNIT- 4

Cancer biomarkers and diagnostic options, Expanded diagnostic technique, Tumour markers, Nucleic acid based markers and mitochondrial DNA mutation markers, Epigenetic markers including DNA methylation pattern and chromatin remodeling, mitochondrial DNA,

UNIT-5

Cancer therapy Contemporary chemotherapy, radiotherapy Emerging therapies (Targeted delivery & Synthetic lethal approaches) Inhibitors of oncogenic protein, tumour blood vessels as target for cancer therapy Tumor immunology and cancer immunotherapies

Recommended books

1. The Biology of Cancer, 2nd Edition; Author(s): Robert A. Weinberg; Garland Science; 2nd edition (14 May 2013). ISBN: 9780815342205.
2. Molecular biology of the cell, Garland Science; 5th edition (November 16, 2007), By Bruce Alberts (Author), Alexander Johnson (Author), Julian Lewis (Author), Martin Raff (Author),
3. Keith Roberts. ISBN-10: 0815341059, ISBN-13: 978-0815341055.
4. Cancer Biology, 4 edition (10 May 2007) By Raymond W. Ruddon, Oxford University press, ISBN-10: 0195096908.

Course outcomes:

At the end of course, students will be able:

1. To understand the origin and development of cancer.
2. To explain the molecular basis of tumor pathologies.
3. To familiarize with knowledge on current diagnostic and therapeutic avenues for cancer patients.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	1	3									1	
CO3	3	3	3	1	3									1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

TBT-704	MEDICAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Molecular Biology, Microbiology				

COURSE DESCRIPTION:

Medical Biotechnology is the study of living cells and organisms to research, develop and produce pharmaceutical and diagnostic products that are used to treat and cure human diseases. In medical science and technology, this is a very vast field with a lot of career options to choose from.

Course Educational Objective:-

The objective of the course is to familiarize the students with the basic concepts of medical terms utilized in biotechnology.

UNIT-1

Therapeutic Aspects of Bio-macromolecules: Introduction, Endogenous peptides and proteins, Modification of endogenous peptides and proteins. Immune System: Overview, Antibody-mediated response, Vaccines, Cell-mediated immune response, Cancer immunotherapy.

UNIT-2

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozymes. Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer vaccines.

UNIT-3

Radiological Agents: Radiosensitizers and Radioprotective agents. Cardiovascular Drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, anthrombotics and hemostatics.

UNIT-4

Chemotherapeutic Agents: Synthetic antibacterial agents, Lactam antibiotics, Anthelminitic agents, Anthelmintic agents, Antiamebic agents, Antiviral agents. Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response.

UNIT-5

Drug Targeting Organ-Specific Strategies: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery.

Recommended Text/Books

1. Christine M. Bladon ,Pharmaceutical Chemistry, John Wiley & Sons, Ltd. (2002).
2. Manfred E. Wolff.A Burger's Medicinal Chemistry and Drug Discovery (5th edition) , Wiley & Sons, Inc. (2000).
3. Grietje Molema and Dirk K. F. Meijer Drug Targeting Organ-Specific Strategies,Wiley-VCH. (2002).

Course Outcomes:-

Upon completion of the subject, students will be able to:-

1. Therapeutic aspects of bio-macromolecules, endogenous peptides and proteins.
2. To understand about gene therapy and carbohydrate-based cancer vaccines
3. To understand the antibody-mediated response, vaccines, cell-mediated immune response
4. Knowledge of anticoagulants, anthrombotics and hemostatics
5. Drug targeting organ-specific strategies.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	1	3									1	
CO3	3	3	3	1	3									1	
CO4	3	3	3	1	3									1	
CO5	3	3	3	1	3									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-711	APPLICATION OF NATURAL PRODUCTS	L	T	P	C
		3	0	0	3
Pre-requisite	Basic knowledge in plant biotechnology and industrial biotechnology is essential.				

COURSE DESCRIPTION:

Application of Natural Products is combines courses in pharmaceutics, chemistry, and natural products. The curriculum includes in pharmaceutics, biopharmaceutics, and pharmacology. The program is taught in a small campus environment, which makes it ideal for working professionals.

Course Educational Objectives:

The objective is critical understanding of the uses of plants for human health and medicine. This degree is intended for individuals who are interested in the role of phytotherapy in modern medicine, as well as those who are interested in plant-based medicines.

UNIT-I

Sources of crude drug: Biological, marine, Mineral and plant tissue culture as source of natural products. Various methods of extraction and isolation of phytopharmaceuticals namely infusion, decoction, maceration, percolation, hot continuous extraction, successive solvent extraction, supercritical fluid extraction, steam distillation, Counter-current Extraction, Ultrasound Extraction (Sonication). Parameters for selection of suitable extraction process.

UNIT-2

Phytochemical Screening: Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, manthraquinones, cynogenetic glycosides, amino acids in plant extracts. Important therapeutic classes: antimicrobial, antidiabetics, hepatoprotectives, immmunomodulators, anti-cancer.

UNIT-3

Herbal cosmetics: Importance of herbals as shampoos (soapnut), conditioners and hair darkeners, (amla, henna, hibiscus, tea), skin care (aloe, turmeric, lemon peel, vetiver); Colouring and Flavouring agents

from plants; Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil

UNIT-4

Nutraceuticals and Health Foods: Classification of Nutraceuticals, Health foods: Source, Chemical constituents, uses, actions and commercial preparations of, following health foods, Alfalfa, Bran, Angelica, Chamomile, Corn oil, Fenugreek, Ferverfew, Garlic, Ginseng, Ginkgo, Honey, Hops, Safflower oil, Soyabean Oil,Turmeric. Concept and examples of Adaptogens .

UNIT-5

Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines-Extractive values, ash values. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations.

Text / Reference Books:

1. Manual K. Lindsey, Plant Tissue Culture, Springer U.K. Wagner.
2. Wagner and Bladt, Plant Drug analysis, Springer U.K.
3. A.R.Kashi, Industrial Pharmacognosy, Universities press
4. S.S.Agrawal, Herbal drug technology, Universities press
5. Quality Standards of Indian Medicinal Plants, Vol 10, (ICMR), New Delhi, 2012.
6. Indian Herbal Pharmacopoiea, K. M. Varghese Co.Bombay.
7. Craker L., Herbs, Spices And Medicinal Plants, CBS Publishers

Course Outcomes:

Upon completion of the subject, students will be able to:-

1. Provide an overview of the field of natural product chemistry.
2. Identify different types of natural products, their occurrence, structure, biosynthesis and properties.
3. Discuss the use of natural products as starting materials for medicines.
4. Carry out independent investigations of plant materials and natural products.
5. Quality control of herbal drugs

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-712	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Biochemistry, Human physiology, Chemistry, Upstream, downstream processing and bioinformatics,				

COURSE DESCRIPTION:

The science of pharmaceutical biotechnology is a dynamic science aimed at focusing the attention of students on the manufacture and recovery of biopharmaceuticals and other biological products, basic knowledge about biological techniques used in production of some biological drugs and some basic principles and definitions related to pharmaceutical biotechnology. Dosage forms, pharmacokinetics, dynamics and Clinical Trials, case studies on biopharmaceutical product development which would broaden the knowledgebase of the students.

Course Educational Objectives:

1. Introduce the drug discovery, development, regulatory aspects of drugs and cosmetics act.
2. Impart knowledge of drug dosage forms Pharmacokinetics and dynamics.
3. Summarize bulk drug production and a case study.
4. Explain pharmacology principles, classification of drugs and mechanisms.
5. Discuss case studies on biopharmaceutical product development

UNIT-1

Introduction History of pharmaceutical industry, drug discovery and development phases; Introduction to pharmacokinetics and pharmacodynamics (factors affecting drug metabolism (ADME)), Dose effect relationship, adverse drug reactions (ADR), the role of patents in the drug industry.

UNIT-2

Dosage form, Drug screening principles; definition of dosage forms, classification of dosage forms (solid unit dosages – Tablets, capsules; liquids – solutions, lotions, suspension etc; semi-solid – ointments; Parenteral)

UNIT 3

Bulk drug manufacturing: Types of reactions in bulk manufacture and processing. Special Requirements for bulk drug manufacture. Case study: Unit process and unit operations of inulin production, purification, formulation, and packaging.

UNIT 4

Generics and its advantages; bio-generics and biosimilar, protein-based Biopharmaceuticals; Marine natural products, bioactive compounds from micro-algae, macro-algae, and other marine organisms.

UNIT 5

GMP, GLP, Purity determination as per ICH guidelines, FSSA guidelines, use of biochemical and molecular techniques in quality evaluation. Drugs and Cosmetics Act and regulatory aspects.

Textbooks:

1. D.M. Brahmankar and Sunil B. Jaiswal 2019 Biopharmacuitics and pharmacokinetics - A Treatise 3/e Vallabhaprakashan new edition. 9788185731933.
2. Ghangas Jyoti, A. N. Nagappa, A. Kaushik, G. Agarwal 2022 Biopharmaceutics and Pharmacokinetics, 1/e, CBS Publishers & Distributors
3. Fingerman, M., Nagabushanam, R., Thompson, M. 1998. Recent Advances in Marine Biotechnology. Vol.2

References:

1. R.K. Khar, S. P. Vyas, F J Ahmad G.K. Jain 2020. Lachman/Lieberman's, The Theory And Practice Of Industrial Pharmacy, CBS publishers and Distributors 4/e.
2. Biotechnology in the marine sciences: Proceedings of the first annual MIT Sea grant lecture & seminar (1984), Colwell, R.D. (Ed)

Course Outcomes:

After the completion of the course the student should be able to

1. Explain drug development, pharmacokinetics and pharmacodynamics
2. Explain the various process involved in bulk production with a case study
3. Summarize drug screening method and applications of marine natural products
4. Apply GMP and ICH guidelines in purification of drug
5. Appreciate the importance of regulatory aspects of drug production

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-713	BIOPHARMACEUTICALS	L	T	P	C
		3	0	0	3
Pre-requisite	Biochemistry, Chemistry, Pharmaceutical Biotechnology				

COURSE DESCRIPTION:

The biopharmaceutics course is often concerned with advanced biotechnological research outcomes. It is the study of optimization of the pharmacological and therapeutic activities of drugs in living organisms and involves identification of the factors influencing their bioavailability.

Course Educational Objective:

To create general understanding regarding basic knowledge of Biopharmaceuticals to familiarize the student with the production techniques, mode of action and therapeutic uses of Biopharmaceuticals.

UNIT-1

Introduction and current status of Biopharmaceuticals in the pharmaceutical industry. How are Biopharmaceuticals different from Pharmaceutical Products

UNIT-2

Good Manufacturing Practices: Clean room, cleaning, documentation and sanitation (CDS), preparation of purified water and water for injection for the biopharmaceutical processing, Source of Biopharmaceuticals: E.coli as a source of recombinant, transgenic animals, and transgenic plants Analysis of final biopharmaceutical products: Detection of protein based product impurities, pyrogen detection, endotoxin assay, and immunological approaches

UNIT-3

Insulin, Insulin receptors, production of human insulin by rDNA technology, insulin formulation, and Glucagon

UNIT-4

Anticoagulants: Hirudin, Vitamin K, and Antimetabolites, Oxygen carrying blood substitutes: Albumin, Dextran, and Gelatin, Insulin growth factor (IGF), Epidermal growth factor (EGF), and Platelet derived growth factor (PDGF), Wound healing process

UNIT-5

Vaccines: Types of vaccines, peptide vaccine, and vaccine vectors Basic approach to gene therapy: Types of gene therapy vectors Antisense technology: Uses, advantages, and limitations

Recommended Books:

1. D.M. Brahmankar and Sunil B. Jaiswal 2019 Biopharmacuitics and pharmacokinetics - A Treatise 3/e Vallabhaprakashan new edition. 9788185731933.
2. Ghangas Jyoti, A. N. Nagappa, A. Kaushik, G. Agarwal 2022 Biopharmaceutics and Pharmacokinetics, 1/e, CBS Publishers & Distributors

Course Outcomes:

At the end of the course, the students will have:

1. Sufficient understanding of the current status of biopharmaceuticals in the pharma industry
2. Knowledge on biopharmaceutical formulation techniques.
3. Ability to demonstrate the significance of therapeutic agents like hormones, blood products and enzymes in pharmaceuticals
4. Understanding of the biological effects and production of monoclonal antibodies, vaccines and biosimilars
5. Knowledge on vaccines, peptide vaccine, and vaccine vectors advantages, and limitations.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-714	BIOENTERPRENEURSHIP	L	T	P	C
		3	0	0	3
Pre-requisite	Animal Biotech, Plant Biotech, Agro Biotech, Upstream, Downstream processing, Pharmaceutical Biotechnology and Bioinformatics, Business management, Operations				

COURSE DESCRIPTION:

This course explores all aspects of the creation of a new venture from idea through startup, growth, and beyond. Students will learn how to evaluate opportunities, develop strategies, create a business plan and acquire financing for a new venture.

Course Educational Objectives-

The overall aim of the course is to give the participants an insight into field of bioentrepreneurship, i.e. business within the life sciences. After finalizing the course, the student will be able to:

1. Describe the processes of product and service development in the life science sector as well as their similarities and differences •
2. Demonstrate a general understanding of the central role that business development plays for the biomedical industry
3. Assess and compare different forms of IP and perform basic IP analysis •
4. Apply idea creation tools, Write, and critically review a business plan •
5. Perform a basic market analysis in the life science sector Regarding judgment and approach Analyse and critically asses a case study

UNIT-I

Introduction: Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, pillars of bio-entrepreneurship and major start-ups in Biotechnology, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (eg. Biotech Consortium India Limited)

UNIT-2

Project management: Search for a business idea, concept of project and classification, project

identification, project formulation, project design and network analysis, project report, project appraisal.

UNIT-3

Financial analysis: Ratio analysis, Investment process, Break even analysis, Profitability analysis, Budget and planning process.

UNIT-4

Funding of biotech business (Financing alternatives, Venture Capital funding, funding for biotech in India, Exit strategy, licensing strategies, valuation), support mechanisms for entrepreneurship (Bio-entrepreneurship efforts in India, difficulties in India experienced, organizations supporting biotech growth, areas of scope, funding agencies in India, biotech policy initiatives)

UNIT-5

Biotech enterprises: Desirables in start-up, Setting up Small, Medium & Large scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities

Recommended Books:

1. The Business of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 1991.
2. Entrepreneurship in Biotechnology: Managing for growth from start-up By Martin Gross Mann, 2003
3. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006
4. Dynamics of Entrepreneurial Development and Management by Vasant Desai, Himalaya Publishing House, 2005.
5. Projects Planning Analysis, Selection, Implementation & Review by Prasannan.
6. Best Practices in Biotechnology Education: By Yali Friedman, Published by Logos Press, 2008.

Course Outcomes

Students will be able to learn

1. Describe biotechnology and bioentrepreneurship, their components and forms
2. Identify business opportunities in the life science sector
3. Develop and explain a business idea
4. Develop and write a complete business plan based on a new idea
5. Describe the process of launching a venture, its context and common bottlenecks

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	1	3	1	1
CO2	3	1	3	3	2	2	3	2	2	1	1	1	3	2	1
CO3	3	1	1	2	3	1	3	2	1	1	2	1	3	3	1
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	2
CO5	3	3	3	3	3	2	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

LBT-701	CAPSTONE PROJECT PHASE - I	L	T	P	C
		0	0	4	2
Pre-requisite					

Students should devote themselves to prepare something tangible, which could be a working model of their thoughts based on their subject of choice. The project shall be finalized by the students based on the VII semester project work report and shall be completed and submitted at least one month before the last teaching day of the VII semester, date of which shall be notified in the academic calendar. The assessment of performance of students should be made at least twice in each semester i.e. VII and VIII. In this semester student shall present the final project live as also using overheads project or power point presentation on LCD to the internal committee as also the external examiner. The evaluation committee shall consist of faculty members constituted by the college which would comprise of at-least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the Director. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Principal.

LBT-702	PRESENTATION ON INDUSTRIAL TRAINING	L	T	P	C
		0	0	2	1
Pre-requisite					

Students will attend Industrial training of six weeks in any industry or reputed organization after the VI semester examination in summer vacation. The evaluation of this training shall be included in the VII semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty would be identified before the end of the VI semester and shall be the nodal officer for coordination of the training. Students will also be required to prepare an exhaustive technical report of the training undertaken during the VI semester which will be duly signed by the officer under whom training was taken in the industry/ organization. The covering format shall be signed by the concerned office in-charge of the training in the industry. The officer-in-charge of the trainee would also give his rating of the student in the standard University format in a sealed envelope to the Principal of the college. The student at the end of the VII semester will present his report about the training before a committee constituted by the Director of the College which would be comprised of at least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the Director. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Director. The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial training/ project submission

BTE-801	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental science				

COURSE DESCRIPTION:

Measurement of human induced changes to the environment and their remediation are essential for long term sustenance. Biotechnology based methods are useful for monitoring pollution and environmental remediation. This course describes the applications of biotechnology for pollution monitoring, methods for waste treatment and the applications of genetically engineered microbes for bioremediation.

Course Educational Objectives:

1. Describe the relation between biodiversity and environmental pollution
2. Describe sources of pollution
3. Describe methods for biomonitoring of pollution
4. Describe applications of biotechnology for environmental remediation
5. Explain potential of genetically engineering microbes for bioremediation

UNIT-1

Issues and Scope of Environmental Biotechnology: Introduction to Biodiversity, environmental pollution, chemical pesticides and their effects, metal pollution, bioaccumulation of toxicants, Biotechnological methods for measurement of pollution. Biomonitoring of air and water pollution, remediation of pollutants.

UNIT- 2

Biological Treatment of waste water: Aerobic suspended and attached growth system- activated sludge process, trickling filters, Rotating biological contractors (RBC). Anaerobic suspended and attached growth systems- anaerobic digestion, anaerobic filter process, fluidized expanded bed reactor , upflow anaerobic sludge blanket reactor(UASB), contact process , fixed / packed bed Reactor, hybrid reactor, sequential batch reactor, Removal of biological nitrogen and phosphorus.

UNIT- 3

Treatment of waste water of food processing industries : Starch, Dairy, Fruit &Vegetable, Confectionary, Beverages, meat and vegetable oil .

UNIT- 4

Kinetic models for biological waste treatment. Solid waste management- Sources, preliminary operations, sludge thickening, sludge stabilization, conditioning of sludge, dewatering, heat drying, disposal of sludge, Composting, Vermicomposting, Biofertilizers

UNIT-5

Biodegradation and bioremediation- In situ and ex situ bioremediation, biodegradation of hydrocarbons, pesticides, herbicides and xenobiotics. Bioremediation of contaminated soil, genetically engineered microorganisms in bioremediation. Phytoremediation.

Text Books:

1. M.H. Fulekhar, Environmental biotechnology,2017, CRC publishers
2. U. Satyanarayana, Biotechnology, 1st Edition, Books and Allied (P) Ltd, 2005

References:

1. Bruce E. Rittmann and Perry L. Mc Carty, Environmental Biotechnology: Principles and applications, Mc Graw Hill Company, 2012.
2. Martin Alexander, Biodegradation & Bioremediation, 2nd Edition, Academic press, 2012

Course Outcomes:

After the completion of the course the student should be able to:

1. Describe methods for biomonitoring of pollution
2. Describe principles and methods for biological treatment of wastewater
3. Describe methods for solid waste management
4. Describe principles and applications of biodegradation and bioremediation
5. Explain potential of genetically engineering microbes for bioremediation

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	2	1	1	1	2	3	1	1
CO2	3	1	3	3	2	1	3	2	2	1	1	1	3	2	2
CO3	3	1	1	2	3	1	3	2	1	1	2	2	3	3	3
CO4	3	2	2	3	3	1	3	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	1	3	1	2	1	2	1	3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

BTE-802	BIOSAFTEY, BIOETHICS AND IPR	L	T	P	C
		3	0	0	3
Pre-requisite					

COURSE DESCRIPTION:

This course is designed to make students learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products

Course Education Objectives:

1. The biotechnology students supposed to understand and follow the regulatory framework important for the product safety and benefit for the society.
2. The students are given case history to discuss and express their views.

UNIT-1

Introduction and Development of Biosafety Practices and Principles, General lab requirements, Definitions and Biosafety levels: 1,2,3,4, Biological safety cabinets: centrifuges, Shipment of biological specimens, Biological waste management, Decontamination, Biosafety manuals, Medical surveillance, Emergency response

UNIT -2

Risks and Assessment of Risks, Biosafety at small scale and large-scale processes Biosafety for genetically engineered microbes, plants and animals, National biosafety committees, Biosafety and environment protection International conventions

UNIT-3

History and Introduction, Ethics and genetic engineering, Genetic Privacy Patent of genes, Human races, Human Cloning Stem Cells, Eugenics, Christian faith, Human genome and religious considerations Case Studies and Final Considerations

UNIT-4

Introduction and Types of Intellectual Property Rights Patents, Copyrights, Trademarks, Industrial

designs, Trade secrets, Geographical Indications and Farmers rights & Plant variety Protection.

UNIT-5

IPR for Biotechnology, Patenting of transgenic organisms and isolated genes, microbes International conventions and cooperation Current status of IPR in India

Recommended Books:

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill

Course outcomes:

On completion of the course students will have:

1. Adequate knowledge about the safety and risk of the use of genetically modified organisms and
2. their effect on human health
3. Insights into the regulatory affairs linked with biosafety and bioethics
4. Knowledge regarding ethics to be followed during biological experiments and research
5. Awareness about the concepts and significance of Intellectual Property Rights and take measures to protect their innovative ideas

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3									1	
CO2	3	3	3	3	1									1	
CO3	3	3	3	3	1									1	
CO4	3	3	3	3	1									1	
CO5	3	3	3	3	1									3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

LBT-701	CAPSTONE PROJECT PHASE - II	L	T	P	C
		0	0	16	8
Pre-requisite					

Students should devote themselves to prepare something tangible, which could be a working model of their thoughts based on their subject of choice. The project shall be finalized by the students based on the VII semester project work report and shall be completed and submitted at least one month before the last teaching day of the VII semester, date of which shall be notified in the academic calendar. The assessment of performance of students should be made at least twice in each semester i.e. VII and VIII. In this semester student shall present the final project live as also using overheads project or power point presentation on LCD to the internal committee as also the external examiner. The evaluation committee shall consist of faculty members constituted by the college which would comprise of at-least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the Director. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Principal.