B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2017

Curriculum and Syllabi

(Amendments updated upto June 2020)

B.Tech. (Biotechnology)

B.S. Abdur Rahman Crescent Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2017
CURRICULUM AND SYLLABI
(Amendments updated upto June 2020)

B.TECH.
BIOTECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

VISION

B.S. Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

SCHOOL OF LIFE SCIENCES

VISION AND MISSION

Vision

To attain new heights in biotechnology education and research, shaping life sciences into a premier precision tool for the future for creation of wealth and ensuring social justice-specially for the welfare of the socially weaker group

Mission

- The mission of the school of life sciences is to maximize the benefits of Biotechnology to the Institute, the nation and the globe
- Being an excellent quality, comprehensive, multidisciplinary school that supports, coordinates, disseminates knowledge to the community
- Apply biotechnology in the areas of social welfare and entrepreneurship

PROGRAMME EDUCATIONAL OBJECTIVES ANDOUTCOMES

B.Tech. (Biotechnology)

PROGRAMME EDUCATIONAL OBJECTIVES:

- This course will facilitate the graduates to be professionally competent in Biotechnology to solve the problems in environmental, food, biochemical and biomedical sciences.

- This course will offer students with a solid foundation in Biological Sciences, to enable them to work on applications in biotechnology as per the requirement of the industries, and also will enable the students to pursue higher studies and research.

- This course will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology to enable them to understand basic concept in modern biology and help them to build their carrier in this field.
- This course will facilitate the students to acquire knowledge in skill based courses such as Biofertilizer Technology, Agricultural Biotechnology, Medical Biotechnology, Herbal Technology, Disease Management and Mushroom Culture Technology enabling their skills and give confidence to them for business opportunities.

- This programme will teach students the importance of Bioethics, entrepreneurship, communication and management skills.

- This course will also offer the graduates to demonstrate their proficiency in theory and practice of bio-techniques through life-long learning and provide confidence to perform as an individual and / or member of a team with professional and ethical behavior.

PROGRAMME OUTCOMES:

On successful completion of the programme, the graduates will be able to:

- Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 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.
- 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.
- Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 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.
- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 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.

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

PROGRAMME SPECIFIC OUTCOMES:

On completion of B. Tech. Biotechnologyprogramme, graduates will be able to

1. Apply knowledge to find innovative solutions for biotechnological problems
2. Explore problems related to biotechnology and provide valid conclusions through industry academia interface
3. Infer the potentials and impact of biotechnological innovations for finding sustainable ethical solutions to issues pertaining to health, environment and agriculture

REGULATIONS - 2017

B.TECH. DEGREE PROGRAMMES

(With Amendments incorporated up to June 2020)

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programmelike Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in asemester like Mathematics, Physics, Engineering Graphics, Fluid Mechanics, etc.,

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology.

vi) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology.

vii) **"Controller of Examinations"** means the Controller of Examination ofB.S. Abdur Rahman Crescent Institute of Science and Technologywho is responsible for conduct of examinations and declaration of results.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight - semester B.Tech.degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

2.1b) Candidates for admission to the third semester of the eight-semester B.Tech.programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the

Institution for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for Ten plus Two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. Degree programmes in various branches of Engineering and Technology, each distributed over eight semesters with two semesters per academic year.

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Mechanical Engineering
10. Polymer Engineering
11. Biotechnology
12. Artificial Intelligence and Data Science
13. Computer Science and Engineering(Cyber Security)
14. Computer Science and Engineering(Internet of Things)

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme has a curriculum with syllabi consisting of theory and practical courses such as,

i) Basic Sciences (BS)
ii) Humanities & Social Sciences (HS)
iii) Management Sciences (MS)
iv) Engineering Sciences Fundamentals (ESF)
v) Engineering Core Courses (EC)
vi) Professional Electives (PE)
vii) General Electives (GE)
viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits :

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions
- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training or 80 hours per semester.

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, etc., of total number of credits not exceeding 26.

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the respective programme of study.

4.5 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry student).

5.2 Each semester shall consist of a minimum of 90 working days.

5.3 Semester end examination shall normally follow within a week after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member shall be nominated by the HoD as Class Advisor for the class throughout the period of study except first year.

The Class Advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

However, for the first and second semester, the class advisors (First year class advisors) are nominated by the first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

7.0COURSE COMMITTEE

7.1 Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

8.0 CLASS COMMITTEE

A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman is constituted branch wise and semester wise

8.1 The composition of class committees for first and second semester is as follows:

i) The first year coordinator shall be the chairman of the class committee
ii) Faculty members of all individual courses of first / second semester
iii) Six student representatives (male and female) of each class nominated by the first year coordinator
iv) The class advisor and faculty advisors of the class.

8.2 The composition of the class committee for each branch from 3rd to 8th semester is as follows:

i) One senior faculty member preferably not handling courses for the concerned semester appointed as chairman by the Head of the Department
ii) Faculty members of all courses of the semester
iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors
iv) All faculty advisors and the class advisors.
v) Head of the Department

8.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

8.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi, etc.

8.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLLMENT

9.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

9.2 For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

10.0 COURSE CHANGE / WITHDRAWAL

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

10.2 WITHDRAWAL FROM A COURSE

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

11.0 TEMPORARY BREAK OF STUDY FROM PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first continuous assessment test of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1). If any student is debarred for want of attendance or suspended due to any act of indiscipline, it shall not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only.

12.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 32 credits during a semester including Redo / Pre-do Courses.

12.2 The minimum earned credit required to move to the higher semester shall be

- Not less than 20 credits, to move to the 3rd semester
- Not less than 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

13.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Examination	Full course	3 hours	50%

13.2 Appearing for semester end theory examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

13.3 Every practical course shall have 60% weightage for continuous assessments and 40% for semester end examination. However a student should have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

13.4 For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory component shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical component shall be through continuous assessment.

13.5 The components of continuous assessment for theory / practical / laboratory integrated theory courses shall be finalized in the first class committee meeting.

13.6 In the case of Industrial training, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research organisation.

The weightage for Industry internship report shall be 60% and 40% for viva voce examination.

13.7 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the Viva Voce examination.

13.8 Assessment of seminars and comprehension shall be carried out by a committee of faculty members constituted by the Head of the Department.

13.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall be ignored.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab component.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of School for that purpose. However there is no substitute examination for semester end examination.

14.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of assessment test. However the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

15.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the in approved events etc.) to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course. The cases in which the student is awarded “I” grade, shall register and repeat the course when it is offered next.

15.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the Class Advisor. The Class Advisor shall consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department/ Dean of School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.

15.3 A student who has obtained ‘I’ grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall repeat all the courses of the semester in the subsequent academic year.

15.4 A student should register to redo a core course wherein “I” or “W” grade is awarded. If the student is awarded, “I” or “W” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of Head of the Department / Dean of School.

15.5 A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course in the evening when the course is offered by the department. Marks scored in the continuous assessment during the redo classes shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtained “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

15.6 If a student with “U” grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier “U” grade and continuous assessment marks shall continue.

16.0 REDO COURSES

16.1 A student can register for a maximum of two redo courses per semester in the evening after regular college hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters.

16.2 The Head of the Department with the approval of Dean Academic Affairs may arrange for the conduct of a few courses during the evening, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

16.3 The number of contact hours and the assessment procedure for any redo course shall be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

17.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	0
I	0
AB	0

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from semester end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

17.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department / Dean of the School and it shall be declared by the Controller of Examinations.

17.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to Controller of Examination. Subsequently the Head of the Department / Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as Convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

17.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If Ci, is the number of credits assigned for the i^{th} course and GPi is the Grade Point in the i^{th} course

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n}C_i}$$

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

“I” and "W" grades are excluded for calculating GPA.

"U", “I”, "AB" and **"W"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage Equivalent of Marks = CGPA X 10

17.6 After successful completion of the programme, the Degree shall be awarded with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within

	the prescribed period of 8 semester for normal entry and 6 semesters for lateral entry
First Class	6.50 and above and completing the programme within a maximum of 10 semester for normal entry and 8 semesters for lateral entry
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained 'U' or 'I' grade in any course during his/her study and should have completed the U.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within the specified minimum number of semesters reckoned from his/her commencement of study. For this purpose, the authorized break of study is not counted. The students who do not satisfy the above two conditions shall be classified as second class. For the purpose of classification, the CGPA shall be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

18.0 ELECTIVE CHOICE:

18.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

18.2 ONLINE / SELF STUDY COURSES

Students are permitted to undergo department approved online courses under SWAYAM up to 20% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

19.0 SUPPLEMENTARY EXAMINATION

Students of final year can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise students with less credits can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both Odd and Even Semester.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes such as NCC, NSS, NSO, YRC, Rotaract, etc., and undergo related activities during the period of study.

21.0 DISCIPLINE

21.1 Every student is expected to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

21.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

22.0 ELIGIBILITY FOR THE AWARD OF DEGREE

22.1 A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study

ii) no dues to the Institution, Library, Hostels, etc.

iii) no disciplinary action pending against him/her.

22.2 The award of the degree must have been approved by the Institution.

23.0 MINOR DEGREES OFFERED FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020- 21

23.1 The students admitted in the following B.Tech. Programmes from the academic year 2020 – 21 can graduate with a minor degree, which is optional, along with a major degree:

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation Engineering	• Computer Science and Engineering
• Information Technology	• Artificial Intelligence and Data

	Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering(Cyber Security)

23.2 The eligibility for choosing the minor degree is given as below:

Sl. No.	Minor Degree (Optional)	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg.
2.	Block Chain	
3.	Cyber Security	
4.	Data Science	
5.	Internet of Things (IoT)	
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engineering Electronics & Instrumentation Engg. Electronics & Communication Engg.
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engg.
8.	Robotics	Artificial Intelligence and Data Science Computer Science &Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg.

9.	3D Printing	Artificial Intelligence and Data Science Computer Science &Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science &Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electronics &Communication Engg.
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science &Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics & Communication Engg.
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science &Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering

		Automobile Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science &Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.

23.3 A student shall earn an additional 18 to 20 credits for the award of minor degree.

23.4 A student shall be awarded a minor degree only when he / she completes the requirements for the award of major degree stipulated in the respective programme.

24.0 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

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B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

B.TECH. BIOTECHNOLOGY

CURRICULUM & SYLLABUS, REGULATIONS 2017

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC 1182	Mathematics for biotechnology	3	1	0	4	
2.	HS	ENC 1181/ ISC 1181/ LNC 1181/ LNC 1182/ LNC 1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3	
3.	BS	PHC 1182	Physics I	3	0	2	4	
4.	BS	CHC 1181	Chemistry	3	0	2	4	
5.	ESF	BTC 1101	Fundamentals in Biotechnology	3	0	0	4	
6.	ESF	GEC 1102	Engineering Design	2	0	0	2	
7.	ESF	BTC1102	Fundamentals in Biotechnology Laboratory	0	0	2	1	
8.	ESF	GEC 1104	Computer Programming I	1	0	2	2	**23**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1282	Biostatistics	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	BTC1211	Biochemistry	4	0	0	4
5.	ESF	BTC1212	Cell Biology	4	0	0	4
7.	ESF	BTC1213	Microbiology	4	0	0	4
8.	ESF	BTC1214	Biochemistry – Lab	0	0	4	2

9.	ESF	BTC1215	Cell Biology– Lab	0	0	3	1	
10.	ESF	BTC1216	Microbiology – Lab	0	0	2	1	**26**

SEMESTER III

Sl. No.	**Course Group**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	
1.	HS	-	Humanities Elective I	2	0	0	2	
2.	HS	ENC 2181	Oral Communication	0	0	2	1	
3.	EC	BTC2101	Enzyme Technology	4	0	0	4	
4.	EC	BTC2102	Fundamentals of Chemical Engineering	4	0	0	4	
5.	EC	BTC2103	Molecular Biology	4	0	0	4	
6.	EC	BTC2104	Basic Bioanalytical Techniques	3	0	0	3	
7.	EC	BTC2105	Molecular Biology – Lab	0	0	3	1	
8.	EC	BTC2106	Enzyme Technology –Lab	0	0	3	1	
9.	EC	BTC2107	Bioanalytical Techniques – Lab	0	0	3	1	**21**

SEMESTER IV

Sl. No.	**Course Group**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	
1.	HS	-	Humanities Elective II	2	0	0	2	
2.	HS	ENC 2282	Written Communication	0	0	2	1	
3.	EC	BTC2211	Genetic Engineering	4	0	0	4	
4.	EC	BTC2212	Immunotechnology	4	0	0	4	
5.	EC	BTC2213	Chemical and Bio Thermodynamics	4	0	0	4	
6.	EC	BTC2214	Plant and Animal Biotechnology	3	0	0	3	
7.	EC	BTC2215	Genetic Engineering Lab	0	0	3	1	
8.	EC	BTC2216	Immunology Lab	0	0	3	1	
9.	EC	BTC2217	Animal and Plant cell culture Lab	0	0	3	1	**21**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3	
2.	GE	-	General Elective I	3	0	0	3	
3.	HS	ENC3181	Communication & soft skill I	0	0	2	1	
4.	EC	BTC3101	Protein Engineering	4	0	0	4	
6.	EC	BTC3102	Chemical Reaction Engineering	4	0	0	4	
7.	EC	-	Programme Elective I	3	0	0	3	
8.	EC	-	Programme Elective II	3	0	0	3	
9.	EC	BTC3107	Chemical Reaction Engineering Lab	0	0	3	1	
10.	PE	BTC3109	Protein Engineering Lab	0	0	3	1	**23**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	BS	-	Mathematics Elective II	3	0	0	3
3.	HS	-	Communication & soft skill IV	0	0	2	1
4.	EC	BTC3211	Structural Biology	3	1	0	4
5.	EC	BTC3212	Bioprocess Engineering	4	0	0	4
6.	EC	BTC3213	Bioinformatics	4	0	0	3
7.	PE	-	Programme Elective III	3	0	0	3
8.	PE	-	Programme Elective IV	3	0	0	3

9.	EC	BTC3214	Bioprocess Lab	0	0	3	1	
10.	EC	BTC3215	Bioinformatics- Lab	0	0	3	1	**26**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	BTC4101	Bioreactor Design and Analysis	4	0	0	4	
2.	EC	BTC4102	Fermentation Technology	4	0	0	4	
3.	EC	BTC4103	Nano Biotechnology	4	0	0	4	
4.	EC	-	Programme Elective V	3	0	0	3	
5.	PE	-	Programme Elective VI	3	0	0	3	
6.	PE	-	Programme Elective VII	3	0	0	3	
7.	PE	-	General Elective II	3	0	0	3	
8.	GE	BTC4104	Fermentation- Lab	0	0	3	1	
9.	EC	BTC4105	Bioreactor Design and Drawing laboratory	0	0	3	1	
10.	EC	BTC4106	Internship.	0	0	0	1*	**27**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	BTC4211	Project Work	0	0	24	12	**12**

Total credits – 174

*Industrial training will be undertaken during Third year summer vacation. The credit will be awarded in the 7th Semester.

PROGRAMME ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	BTCX01	Biophysics	3	0	0	3
2.	PE	BTCX02	Industrial Biotechnology	3	0	0	0
3.	PE	BTCX03	Bio-Organic Chemistry	3	0	0	3
4.	PE	BTCX04	Molecular Pathology	3	0	0	3
5.	PE	BTCX05	Food Biotechnology	3	0	0	3
6.	PE	BTCX06	Cancer Biology	3	0	0	3
7.	PE	BTCX07	Tissue Engineering	3	0	0	3
8.	PE	BTCX08	Developmental Biology	3	0	0	3
9.		BTCX09	Bioseparation Technology				
10.	PE	BTCX10	Proteomics & Genomics	3	0	0	3
11.	PE	BTCX11	Biomedical Instrumentation	3	0	0	3
12.	PE	BTCX12	Pharmaceutical Biotechnology	3	0	0	3
13.	PE	BTCX13	Medical Biotechnology	3	0	0	3
14.	PE	BTCX14	Drug Design and Development	3	0	0	3
15.	PE	BTCX15	Intellectual Property Rights	3	0	0	3
16.	PE	BTCX16	Recombinant DNA Technology	3	0	0	3
17.	PE	BTCX17	Material science	3	0	0	3
18.	PE	BTCX18	Molecular & Cellular Diagnostics	3	0	0	3
19.	PE	BTCX19	Biomedical Engineering	3	0	0	3
20.	PE	BTCX20	Biosafety and Bioethics	3	0	0	3
21.	PE	BTCX21	Healthcare Biotechnology	3	0	0	3

22.	PE	BTCX22	Molecular Farming	3	0	0	3
23.	PE	BTCX23	Stem Cells in Health Care	3	0	0	3
24.	PE	BTCX24	Transport phenomena in Bioprocess	3	0	0	3

Physics Elective Courses

(to be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX 02	Heat and Thermodynamics	2	0	2	3
3.	PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX 04	Lasers and their applications	2	0	2	3
5.	PHCX 05	Materials Science	2	0	2	3
6.	PHCX 06	Non-Destructive Testing	2	0	2	3
7.	PHCX 07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

Chemistry Elective Courses

(to be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CHCX01	Analytical Instrumentation	2	0	2	3
2.	CHCX02	Corrosion and its Control	2	0	2	3
3.	CHCX03	Electrical Materials and Batteries	2	0	2	3
4.	CHCX04	Engineering Materials	2	0	2	3
5.	CHCX05	Fuels and Combustion	2	0	2	3

6.	CHCX06	Fundamentals of Physical Chemistry	2	0	2	3
7.	CHCX07	Green Technology	2	0	2	3
8.	CHCX08	Organic Chemistry of Biomolecules	2	0	2	3
9.	CHCX09	Polymer Science and Technology	2	0	2	3

Humanities Elective I

(to be offered in III Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX01	Fundamentals of Economics	2	0	0	2
2.	SSCX02	Principles of Sociology	2	0	0	2
3.	SSCX03	Sociology of Indian Society	2	0	0	2

Humanities Elective II

(to be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX04	Economics of Sustainable Development	2	0	0	2
2.	SSCX05	Industrial Sociology	2	0	0	2
3.	SSCX06	Law for Engineers	2	0	0	2

General Elective
Group I Courses
(To be offered in V semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 101	Disaster Management	Civil
2.	GECX 102	Total Quality Management	Mechanical
3.	GECX 103	Energy Studies	Mechanical
4.	GECX 104	Robotics	Mechanical
5.	GECX 105	Transport Management	Automobile
6.	GECX 106	Control Systems	EEE
7.	GECX 107	Introduction to VLSI Design	ECE
8.	GECX 108	Plant Engineering	EIE
9.	GECX 109	Network Security	CSE
10.	GECX 110	Knowledge management	CSE
11.	GECX 111	Cyber security	IT
12.	GECX 112	Genetic Engineering	LS
13.	GECX 113	Fundamentals of Project Management	CBS
14.	GECX 114	Operations Research	Mathematics
15.	GECX 115	Nano Technology	Physics / Chemistry
16.	GECX 116	Vehicle Maintenance	Automobile
17.	GECX 117	Fundamentals of Digital Image Processing	ECE

Group II Courses
(To be offered in VII semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 201	Green Design and Sustainability	Civil
2.	GECX 202	Appropriate Technology	Civil / Mechanical
3.	GECX 203	Engineering System Modelling and Simulation	Mechanical
4.	GECX 204	Value Analysis and Engineering	Mechanical
5.	GECX 205	Industrial Safety	Mechanical
6.	GECX 206	Advanced Optimization Techniques	Mechanical
7.	GECX 207	Matlab Simulation	EEE
8.	GECX 208	Embedded Systems and its Applications	ECE
9.	GECX 209	Usability Engineering	CSE
10.	GECX 210	Supply Chain Management	CBS
11.	GECX 211	System Analysis and Design	CA
12.	GECX 212	Advanced Materials	Physics & Chemistry
13.	GECX 213	National Service Scheme	School of Humanities
14.	GECX 214	Automotive Pollution and Control	Automobile
15.	GECX 215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX 216	Principles of Communication Systems	ECE
17.	GECX 217	Lean Management	Civil

Sl. No.	Course Code	Course Title	Offering Department
18.	GECX 218	Spatial Data Modeling & Analysis	Civil
19.	GECX 219	Advanced Entrepreneurship	MBA
20.	GECX 220	Electric Vehicles	EEE
21.	GECX 221	Artificial Intelligence and Evolutionary Computing using Matlab	EEE

SEMESTER I

MAC 1182	MATHEMATICS FOR BIOTECHNOLOGY	L	T	P	C
		3	1	0	4

OBJECTIVES:

The course is aimed to

- develop the skills in the areas of Biotechnology, necessary to become a successful biologist.
- serve as basic tools for specialized studies in biological fields.
- help students to apply basic mathematic tools to solve biological problems.
- Introduce students to matrices, differential calculus
- Help students to form equations to solve problems

MODULE I MATRICES 10

Rank of a Matrix - Gauss Elimination method - Gauss Jordan method - Eigenvalues and eigenvectors of a real matrix - Properties of eigenvalues and eigenvectors – Applications.

MODULE II DIFFERENTIAL CALCULUS 10

Derivatives of simple functions – Successive Differentiation – Various forms of Algebraic, Trigonometric, Exponential and Logarithmic functions – Simple problems.

MODULE III INTEGRAL CALCULUS 10

Various types of Integration – Reduction formulae (without Proof) for $e^{ax}x^n, sin^n x, cos^n x$ – Simple Problems

MODULE IV FIRST ORDER ORDINARY DIFFERENTIAL EQUATION 10

Variable separable, homogenous and nonhomogenous of first degree, exact, linear and Bernoulli's Equations – problems

MODULE V ORDINARY DIFFERENTIAL EQUATIONS OF SECOND ORDER 10

Second order linear differential equation with constant coefficients, variable coefficients (Legendre and Cauchy).

MODULE VI APPLICATIONS 10

Role of Pattern is Biology- Reaction Differential Relation-Microbial Population Models- Interpretation of Analytical and Numerical Solutions.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
5. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengagelearning,UK

OUTCOMES:

After completing the course, student will be able to

- Understand the matrix techniques and compute eigenvalues and eigenvectors of a given matrix.
- Do the problems based on three dimensional analytic geometry.
- Apply differential calculus in engineering problems.
- Differentiate more than one variable and their applications.

- Solve the differential equations with constant coefficient and variable coefficient.
- Form and solve differential equations.

ENC 1181	ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop students' listening skill for comprehending and analyzing information.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I **8**

L: Listening for general information

S : Self Introduction, Introducing one another.

R: Predicting the content

W: Paragraph Writing

Language Focus: Affixes, Simple Present tense , Connective & Prepositions.

MODULE II **8**

L: Listening for specific information (from dialogues)

S: Exchanging opinion.

R: Skimming technical Passages

W: Argumentative Writing (using the concept of Flipped Learning), Letter to the Editor.

Language Focus: Idioms, use of Modals, Simple Past tense & use of "Wh" and question tags.

MODULE III **7**

L: Learning the ways of describing images and presenting specific information (focusing on note making)

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

Language Focus: Homophones, Homographs, Simple Future & Collocations.

MODULE IV **7**

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V **8**

L : Understanding Non- Verbal Communications while listening to narration of incidents.

S: Narrating an expereince

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI **7**

L: Learning Story telling techniques (stories& visuals) through audio files

S: Discussion in groups

R: Reading for critical appreciation

W: Developing an idea, Slogan writing, Interpreting a Bar Chart.

Language Focus: If clause and phrasal verbs.

TOTAL HOURS :45

REFERENCES:

1. Carol Rosenblun perry(2011). The Fine Art of Technical Writing. Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan. G and Prakash , C.L.N. (2007) A course in Communication Skills. Cambridge Univesity Press, India.
3. Kala, Abdul & Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and A bridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

ISC1181	**ARABIC**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC 7

Introducing Arabic Alphabets.
Listening and Reading.
Audio & Video aided listening, Tajweed listening,
Writing Arabic Alphabets (connected & unconnected).
Introducing words.
Reading simple sentences.
Learning names of the things in and around the class room.
Exercises.

MODULE II FUNCTIONAL ARABIC 7

Listening Arabic texts, stories and action verbs
Communicating Simple sentences.
Jumla' Ismiyya and Jumla' Fi'liyya
Situational Conversation:
Greetings, Introduction.
Classroom, College, Picnic.
Dining and Kitchen.
Reading skills.
Exercises

MODULE III FUNCTIONAL ARABIC 8

Implication of effective listening.
Audio aids.
Writing Simple sentences.
Communicating ordinal and cardinal numbers.
Situational communication:
Playground, library.
Forms of plural – Sample sentences.
Introduction to tenses.
Exercises.

MODULE IV FUNCTIONAL ARABIC 8

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

MODULE V TECHNICAL ARABIC 8

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises

MODULE VI TECHNICAL ARABIC 7

Situation communication:

Contractual work, machineries and equipments..

Computer, internet browsing.

Banking,

Exercises.

TOTAL HOURS :45

TEXT BOOKS:

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

REFERENCES:

1. Arabic Reader for Non Arabs (UmmulQura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

OUTCOMES:

On successful completion of the course, the student will be able to:

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

LNC1181	MANDARIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in Mandarin language.
- To develop their knowledge of vocabulary.
- To train them in using appropriate grammatical forms during communications.
- To empower them for successful communication in social and academic contexts.
- To make them appreciate the language usage in real life situations.

MODULE I **8**

· General Introduction to Chinese • Pinyin and Tones • Introduction to the Writing System: basic strokes and stroke order · Numbers 1-100, song · Days of the Week · Months of the Year

MODULE II **8**

· Chinese names and related culture · Chinese family structures and values · Greetings

· Introducing Yourself · Family members · Occupations

MODULE III **7**

· Languages and Nationalities · Daily Routine · Chinese breakfast · Negative Sentences and Interrogative Sentences · Asking for Personal Information · The Verb *shi*and Basic Sentence Structures

MODULE IV **7**

· Answering an Affirmative-negative Question · Food and drinks · Transportation · Likes and dislikes · Adverbs *bu*, *jiu*and *dou*· Verb-absent Sentences

MODULE V **8**

·*Jisui*and *duoda*Questions · S+V+O Construction · Routines and Daily Activities ·*Haishi*Questions · Modal Verbs · Hobbies and Habits

MODULE VI **7**

· Making Suggestions with *haoma*·Colors · Clothing · Body parts · Talking about Likes and Dislikes · Measurement Words in Chinese

TOTAL HOURS :45

TEXT BOOKS:

1. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol*. *1 Textbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.
2. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Workbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

OUTCOMES:

On completion of the course, students will be able to

- Exhibit proficiency in Chinese Language.
- Use vocabulary in appropriate contexts.
- Use appropriate grammatical forms effectively.
- Use the language in social and academic contexts.
- Appreciate the use of language forms.

LNC1182	GERMAN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in German language.
- To create awareness of using vocabulary among students.
- To expose them to correct grammatical forms of the language.
- To empower them for successful communication in social and academic contexts.

MODULE I **8**

Introduction to German alphabets, phonetics and pronunciation- Introducing themselves and others using simple sentences and answer to some basic personal questions-: Introduction to different types of articles and verbs, Nouns

MODULE II **8**

Understanding and responding to everyday queries like instruction, questions, -number & gender, pronouns, present and past tense.

MODULE III **7**

Short telephone messages, requests etc., if spoken slowly and clearly-- Detailed overview of articles, adjectives with/without articles, Prepositions

MODULE IV **7**

Ask and giving directions using simple prepositions- Ability to fill basic information on forms while registering for courses / classes.

MODULE V **8**

Ability to extract and understand relevant information in a public announcement, broadcast, newspaper, radio etc-- dative & accusative

MODULE VI **7**

Ability to describe about people, work, immediate environment, education and other topics related to personal needs in a concise manner-- Understanding of matters that are familiar and are encountered regularly like instances at school, work, at public places, places of leisure etc.

TOTAL HOURS :45

TEXT BOOKS:

1. Course book : Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuchmit Audio-CD zumArbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, TilSchönherr, Hueber Publisher, ISBN 978-3-19-001801-7, 2004
2. Practice book: Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuchmit Audio-CD zumArbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, TilSchönherr, HueberPublisher, ISBN 978-3-19-001801-7, 2004

REFERENCES:

1. NETZWERK A1 TEXTBOOK, Deutsch alsFremdsprache,StefanieDengler,PaulRusch, Helen Schmitz, Tanja Sieber, Langenscheidt and Klett, ISBN : 9788183076968, 2019
2. STUDIO D A1 (SET OF 3 BOOKS + CD), Hermann Funk. Cornelsen, ISBN: 9788183073509, 2011
3. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. 2nd edition. (chapter 1 - 6) ISBN: 9781444165159, 2012
4. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. ISBN: 978-1-444-16518-0, 2018
5. An Introduction to the German Language and Culture for Communication, Updated Edition Lovik, Thomas A., J. Douglas Guy & Monika Chavez. Vorsprung -. New York, Houghton Mifflin Company, 1997/2002. ISBN 0-618-14249-5.

OUTCOMES:

On completion of the course, students will be able to

- Show their proficiency in German Language.
- Use appropriate vocabulary in real life contexts.
- Use appropriate grammatical forms while communicating with people.
- Effectively use the language in social and academic contexts.

LNC1183	JAPANESE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I **7**

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji*, word-building, writing foreign names and loan words in Katakana.

MODULE II **8**

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things;

MODULE III **7**

Making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes.

MODULE IV **8**

Extensive practice of basic patterns at the lower intermediate level through drills and exercises.

MODULE V **7**

Comprehension of passages in simple Japanese and writing of composition in Japanese applying lower intermediate grammatical patterns.

MODULE VI **8**

Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately

TOTAL HOURS :45

REFERENCES:

1. Nihongo I, Kokusaigakuyukai, and other supplementary material, 2019
2. Exersice book 1of Nihongo 1, and other supplementary material, 2019

   Nippon, the Land and its People & Encyclopedia of Contemporary Japanese, Nippon Steel Corporation; First Thus edition (May 1, 1988), ISBN-10 : 4311700024
3. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus, 2019
4. Chukyu Nihongo, Tokyo GaikokugoDaigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material, 2019

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

PHC 1182	PHYSICS I	L	T	P	C
		3	0	2	4

OBJECTIVES

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I CRYSTAL PHYSICS 8

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures –Defects in crystals-Point defects –Edge and screw dislocations and their significance - Surface Defects.

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt’s tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe’s method- Thermal Conductivity of bad Conductor – Lee’s Disc method.

MODULE III APPLIED OPTICS
8

Interference – Air Wedge – Michelson’s Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, CO_2 laser and Nd:YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers - Applications – Fibre optic communication system (block diagram only)- Fibre optic sensors - displacement and pressure sensors (qualitative) - Medical endoscope.

MODULE V QUANTUM MECHANICS 7

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Harmonic oscillator(qualitative).

MODULE VI MODERN ENGINEERING AND BIOMATERIALS 7

Modern Engineering Materials: Shape memory alloys - Metallic glasses – Advanced Ceramics – Composites.

Bio-materials: Classification of bio-materials (based on tissue response) – Comparison of properties of some common biomaterials – Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) – Tissue replacement implants – Soft and hard tissue replacements.

L:45 periods

PRACTICALS

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.

6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.
8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

P: 30 periods

TOTAL HOURS :75

REFERENCES:

1. Gaur R.K. and Gupta S.L., "Engineering Physics'', 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

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

- understand the different types of crystal structures
- apply the concept of ultrasonic principle in engineering and medical field
- calculate thermal conductivities of good and bad conductors
- differentiate the various laser systems and its applications in engineering and medical field
- apply the principle of fibre optics for communication and sensor applications
- formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.
- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

CHC1181 CHEMISTRY

	L	T	P	C
	3	0	2	4

OBJECTIVES

To make the students conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water and treatment processes involved.
- types of electrodes, determination of pH, emf measurement, conductometric and potentiometric titration.
- the basic analytical techniques like colorimetry, UV-Visible, flame photometry and AAS.
- concepts of photochemistry related to physical processes and chemical reactions induced by photon absorption and their applications.
- the non-renewable sources such as thermal and nuclear energy, importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean with their advantages and limitations.
- the synthesis, properties and applications of nanomaterials.

MODULE I WATER TECHNOLOGY 9

Impurities present in water – hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment :– zeolite process (principle only), ion-exchange process – internal treatment :– colloidal, carbonate, phosphate and calgon methods – drinking water standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration and disinfection} – desalination by reverse osmosis.

MODULE II ELECTROCHEMISTRY 8

Types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode) – pH determination using glass electrode – concentration cells (problems) – standard cell (Weston-cadmium) – EMF measurement (problems) – conductometric titrations – potentiometric titrations.

MODULE III ANALYTICAL TECHNIQUES 7

Spectroscopy: (relation between interaction of electromagnetic radiation withmatter and type of spectroscopy), electromagnetic spectrum – types of transitions – types of spectra (atomic and molecular) – Beer-Lamberts law (problems) – principles, instrumentation (block diagram only) and applications of: colorimetry (includes estimation of concentration of a solution) – UV-Vis spectrophotometer – atomic absorption spectroscopy – flame photometry (includes estimation of concentration of alkali metal).

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission – laws of photochemistry: Grotthus-Draper law, Stark Einstein law – quantum efficiency – determination of quantum yield (problems) – photochemical decomposition of HI – photo physical processes: fluorescence and phosphorescence – Jablonski diagram (electronic states and transitions) – quenching – photosensitization: principle and applications – chemiluminescence – bioluminescence.

MODULE V ENERGY SOURCES 8

Renewable and non-renewable energy: comparison, advantages and limitations – non-renewable energy : thermal energy (principle only) – nuclear reactor (components and functions) – nuclear energy (problems) – renewable energy: needs of renewable energy – solar energy : solar photovoltaic, advantages and limitations – wind energy: wind resources, wind turbines, advantages and limitations – bioenergy: biogas generation, factors affecting biogas generation, biomass gasifier, advantages and limitations – geothermal energy: principle, types of geothermal resources, advantages, limitations and applications – ocean energy: tidal and ocean thermal energy (principle, advantages and limitations).

MODULE VI NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis :– top-down approach: chemical vapour deposition, laser ablation, electrodeposition – bottom-up approach: precipitation, thermolysis (hydrothermal and solvothermal) – properties and applications of nanomaterials.

L:45 periods

PRACTICALS

1. Estimation of hardness in the given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of dissolved oxygen in the given water sample.
4. Determination of EMF of the cell.
5. Estimation of a strong acid by conductometry.
6. Estimation of Fe^{2+} present in the given sample by potentiometry.
7. Verification of Beer-Lamberts law and estimation of metal ion concentration of the given sample.
8. Estimation of sodium and potassium present in the given sample by flame photometry (demonstration).

P:30 periods

TOTAL HOURS :75

REFERENCES

1. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India Ltd., New Delhi, 2011.
2. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, Thomas Graham House, Cambridge,2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
4. S SUmare& S S Dara, A text Book of Engineering Chemistry, S. Chand& Company Ltd, New Delhi, 2014.
5. G.D.Rai, "Non conventional energy sources," Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, "Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- describe the various types of electrodes, determine pH, measure EMF, explain and determine the concentration of acid and ions using conductometric and potentiometric titrations.

- verify and derive Beer-Lambert's law, state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- describe the various components and functions of nuclear reactor, explain the principle and enumerate the advantages and limitations of various renewable energy sources.
- classify nanomaterials and discuss their properties & applications; and apply nanochemistry approach to synthesize the nanomaterials.

BTC 1101	FUNDAMENTALS INBIOTECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- Provide a breadth of knowledge of basic principles and concepts. Provide a broad background in the biological sciences.
- Provide knowledge content across the full range of biology.
- Demonstrate knowledge of form, function, mechanism, organization, scale, hierarchy, diversity and evolution.

MODULE I INTRODUCTION TO BIOTECHNOLOGY 10

Introduction -Biotechnology: an interdisciplinary pursuit -Biotechnology: a three-component central core Product safety -Public perception of biotechnology -Biotechnology and the developing world.

MODULE II GENERAL PHYSIOLOGY AND CELL BIOLOGY 8

General Physiology: The gastrointestinal System- The circulatory System-The respiratory System- Nervous system- The Endocrine System.

Cell Biology:Cell structure and function of cell organelles - Eukaryotic and prokaryotic cells - Cell division, Mitosis, Meiosis.

MODULE III BIOCHEMISTRY 10

Introduction to Carbohydrates, fats, proteins, nucleic acids, vitamins- structure and classification. Enzyme nomenclature, Classification of Enzymes, enzymes specificity, mechanisms of enzyme action.

MODULE IV GENETICS 10

Mendelian Inheritance-Mendelism and Mendel's experiments, Laws of Segregation and Independent Assortment- Genetic disorders in man- Sexlinked traits hemophilia and colour blindness in man. Sex limited and sex influenced traits DNA Structure, Transcription of DNA to RNA, Translation of RNA to Protein. Epigentics, Genetic Engineering - Application of Genetic engineering.

MODULE V MICROBIOLOGY 12

Microbiology –Microbial diversity –Major types of micro-organisms - Sterilization techniques - Phases of microbial growth, Microbial growth curve, Cell growth kinetics,-Batch and continuous growth, Kinetics of batch and continuous culture - microorganism and Biofilm - Microorganims in Food, medicine and industry – Microbes associated human diseases - Communicable and non communicable diseases

MODULE VI FERMENTATION TECHNOLOGY 10

FERMENTATION TECHNOLOGY

Fermentation- Types of media and media components- Fermentors and their accessories - Types of Fermentors, Airlift fermentor, Tower fermentor, Continuous stirred tank fermentor. Downstream Process – introduction - stages in downstream operations- Cell disruption, solid liqid separations, Concentration-purification, formulation.

TOTAL HOURS – 60

TEXT BOOKS:

1. Text Book of Microbiology by Michael J Pelczar, Mc Graw Hill Education, 5th Edition, 2001.
2. Text Book of Biochemistry for Medical Students by D M Vasudevan, 6th edition, 2011.
3. Text Book of Medical Physiology by Guyton and Hall, 13th Edition, 2015

REFERENCES:

1. Principles of Fermentation Technology by P.F.Stanbury and A.Whitaker, 2nd Edition , 2003
2. Biotechnology by John. E.Smith, Cambridge University Press,5th Edition, 2012

OUTCOMES:

At the end of the course students will be able to

- Understand and apply fundamental biological principles from the major areas of biology (ecology, genetics, evolution, cell and molecular biology, and organism biology).
- Describe basic biological concepts and principles.
- Understand that biology has a chemical, physical, and mathematical basis.
- Explain the importance of the scientific method to understanding natural phenomena.

GEC 1102 ENGINEERING DESIGN

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the role of design in Engineering
- To understand the basic design concepts
- To understand the role of innovation in design

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

Product design – products and processes – product design methodologyDesign of systems; Software design

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

Voice of customers – product specification - need analysis Bench marking Product architecture – concept generation and evaluation;

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

Product design – process design; system design; software design -Ergonomics – usability

MODULE IV INNOVATION AND DESIGN 07

Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – case studies.

TOTAL HOURS – 30

REFERENCES:

1. Clive L. Dym and David C. Brown,“Engineering Design: Representation and Reasoning”, 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, “Information Needs Analysis: Principles and practice in information organizations”, Published by Faced Publishing, London. 2015.
3. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, “The Design-Inspired Innovation Workbook”, World Scientific, 2011.
5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “Jugaad Innovation”, Published by Random House India, 2012.

OUTCOMES:

The students will be able to

- Apply the basic knowledge of design in engineering products / process / service.
- Analyse the problems and give innovative solutions.
- Correlate the basic knowledge of design in the real world problems.
- Apply innovative approaches to engineering design.

BTC1102	FUNDAMENTALS IN BIOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Provide a breadth of knowledge of basic principles and concepts. Provide a broad background in the biological sciences.
- Provide knowledge content across the full range of biology.
- Demonstrate knowledge of form, function, mechanism, organization, scale, hierarchy, diversity and evolution.

Experiments

1. Lab safety procedure
2. Lab instrumentation
3. Visualization of Bacteria and its structure in the microscope
4. Visualization of fungi and its structure in the microscope
5. Visualization of protozoa and its structure in the microscope
6. Visualization of algae and its structure in the microscope
7. Visualization of other organism and its structure in the microscope
8. Simple test for carbohydrates,
9. Simple test for lipids
10. Simple test for proteins
11. View of the structure of chromosome
12. Spotter: Gastrointestinal system (liver)
13. Spotter : circulatory system (heart)
14. Spotter: respiratory system (lungs)
15. Spotter : nervous system (brain)

TOTAL HOURS – 30

OUTCOMES:

At the end of the course students will be able to

- Describe basic biological concepts and principles.
- Explain the importance of the scientific method to understanding natural phenomena.

GEC 1104	COMPUTER PROGRAMMING I	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To identify the hardware and software components of the computer.
- To know the basic concept of operating system and get knowledge about different operating systems.
- To learn various database concepts and operations
- To develop efficient algorithms for solving a problem.
- To implement the algorithms in C language.
- To use arrays in solving problems.

MODULE I COMPUTER FUNDAMENTALS 7

Introduction -. Number System - Planning the computer program - Computer Software - Basic operating system concepts - Database Operations

MODULE II PROGRAMMING IN C 8

Introduction to C Programming Language – Operators - Control statements - Iterative statements - Arrays.

LIST OF EXPERIMENTS:

1. Computer organization –Hardware in a typical computer Identification – Booting- error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types: Type conversions
5. Input / Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching.

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

1. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012
2. Paul J. Deitel, Deitel& Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012

OUTCOMES:

Students who complete this course will be able to

- Recognize Modular design, logic flow, data abstraction
- Analyze the working of the programming constructs, functions, and I/O.
- Write down programs for sorting and searching algorithms
- Write down programs developing cycle for different applications
- Debug the programs and solve some practical problems in programming
- Develop programs using arrays.

SEMESTER II

MAC1282	BIOSTATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The course is aimed to

- make informed decisions based on data
- correctly apply a variety of statistical procedures and tests.
- know the uses, capabilities and limitations of various statistical procedures.
- interpret the results of statistical procedures and tests.

MODULE I INTRODUCTION TO STATISTICS 10

Exploratory Data Analysis - Motivation, Population vs Sample, ”Scientific Method” - Definitions, Examples, Medical Study Designs – Graphical Displays: Dot plots, Stem plots, Pie chart, Histograms - Summary Statistics: Measures of Central tendency.

MODULE II MEASURES OF DISPERSION 10

Range, Quartile deviation, Mean deviation, Standard deviation, Variance , Coefficient of Dispersion: coefficient of variation, Moments: Relationship between raw and central moments , Effect of change of Orgin and Scale, Pearson beta and gamma cofficiencts,Skewness: Measures of Skewness , Kurtosois.

MODULE III CORRELATION AND REGRESSION 10

Bi-variate data – Correlation and Regression coefficients and their relation, properties - Effect of change of origin and scale on correlation coefficient, Linear regression, Association and Independence of attributes.

MODULE IV PROBABILITY AND ITS DISTRIBUTIONS 10

Events - exhaustive, mutually exclusive and equally likely - Baye’s theorem (without proof) - Binomial, Poisson, Exponential and Normal distributions - Simple properties of the above distributions (without derivation).

MODULE V SAMPLING TECHNIQUES 10

Concept of population and sample, Random sample, Methods of taking a simple random sample, Tests of Significance: Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.); small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, Paired and unpaired t-test for correlation and regression coefficients, t-test for comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit.

MODULE VI EXPERIMENTAL DESIGNS 10

Analysis of variance (ANOVA) - Principles of experimental designs, Completely randomized, Randomized block and Latin square designs.

TOTAL HOURS – 60

TEXT BOOKS:

1. Gupta .S.C and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons ,NewDelhi, 3rd Edition, 2002.

REFERENCES:

2. Norman T J Bailey, "Statistical Methods in Biology " (3rd Edition), Cambridge University Press 1995
3. Gerald van Belle, L.D.Fisher, P.J.Heagerty, and T.Lumney, "Introduction to Biostatistics" Second Edition, John Wiley & Sons, New Jersey 2004
4. Wong Limsoon, "Essence of biostatistics" , NUS Lecture Notes Series 2003.
5. Gupta .S.C and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons ,NewDelhi 2002.
6. Gupta.S.C.,"Fundamentals of Applied Statistics", Sultan Chand & Sons ,NewDelhi 2014.
7. Ross,S.M.,"Probabilty and Statistics for Engineers and Scientists" John Wiley & Sons, New Jersey 2007

OUTCOMES:

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

- represent the data in pictorial form.
- make decision based on statistical data.
- correlate the real time data.

- apply Baye’s theorem and probability distributions
- interpret the results of hypothesis tests
- make an informed decision, based on the results of inferential procedures.

BTC1211	**BIOCHEMISTRY**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**3**

OBJECTIVES:

The course aims to

- provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis,
- enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.
- Help students to understand concepts related to metabolism
- Provide knowledge to the defects related to metabolic disorders

MODULE I AMINO ACIDS, CARBOHYDRATES AND LIPIDS 07

Structure, Function, Methods of Characterization, Separation Techniques based on the structure and properties of amino acids, Classification, Structure, Function, Separation and Characterization Techniques of mono and polysaccharides and lipids.

MODULE II NUCLEIC ACIDS AND VITAMINS 06

Nucleic Acids and Polynucleotides, Classification, Structure, Function,Separation and Characterization Techniques, Clinical Significance.Vitamins: classification, Structure, Function,Separation and Characterization Techniques, Clinical Significance.

MODULE III METABOLISM OF AMINO ACIDS 06

Nitrogen metabolism and urea cycle – Biosynthesis of amino acids (Gly, Ser, Cys, Met, Thr, Lys, Ile, Val and Leu) – Regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feedback) from oxaloacetate and pyruvate – Biosynthesis of aromatic amino acids – Metabolic disorders associated with branched chain and aromatic amino acid degradation – Important molecules derived from amino acids (auxins, DOPA, Serotonian, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines).

MODULE IV METABOLISM – NUCLEIC ACIDS, 08

POLYSACCHARIDES AND LIPIDS

Biosynthesis of nucleotides – *de novo* and salvage pathways for purines and pyrimidines – Regulatory mechanisms – Degradation of nucleic acid by exo and endo nucleases – Biosynthesis and degradation of starch and glycogen – Biosynthesis and degradation of Lipids –Fatty acid synthesis and oxidative degradation – Triacylglycerol and phospholipid biosynthesis and degradation – Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs.

MODULE V BIOMEMBRANE, TRANSPORT AND ELECTRICAL CONDUCTIVITY 08

Micelles – Lipid bi-layer structure of membranes – Membrane proteins – Passive – Careermediated and active transport – Ion-selective channels – Trans-membrane potential coupled ATP generation – Receptors – Acetylcholine receptor as a ligand gated ion-channel – Neuronal sodium channel as voltage-gated ion channel – Neurotransmitters and their mechanism of action – Action potential – Depolarization and nerve conduction – Ion-channel agonists and antagonists as drugs – Ion channel defects (Cystic Fibrosis)

MODULE VI BIOCHEMICAL ENERGETICS 10

Energy Yielding and Energy Requiring Reactions, Calculations of Equilibrium Concentrations, Oxidation-Reduction Reactions, Metabolism and ATP Yield. Photosynthetic Phosphorylation, Active Transport, Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy.

TOTAL HOURS – 45

REFERENCES:

1. Biochemistry by LubertStryer. W. H. Freeman & Company, NY, 9th Edition, 2019
2. Biochemistry by Lehninger. McMillan publishers, 7th Edition, 2017
3. Biochemistry by Zubey. Wm. C. Brown publishers, 3rd Edition, 1993

OUTCOMES:

At the end of the course students will be able to

- demonstrate broad knowledge of the biomolecules, machinery and information flow within living cells, and an appreciation of how these underpin all biological processes,in both normal and diseased states

- demonstrate knowledge of key facets of modern biochemistry including: proteins and structural biology, bioinformatics, advanced molecular biology, cell organisation, signal transduction and its role in diseases such as cancer; and the identification of drug targets
- demonstrate proficiency in core biochemical laboratory techniques, understanding both the principles and applications of these methods within the molecular biosciences
- demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment
- collect, organise, analyse, evaluate and interpret biochemical data using appropriate quantitative, technological and critical thinking skills

BTC1212 CELL BIOLOGY L T P C

4 0 0 3

OBJECTIVES:

- To get overview of classes of cells and structural and function aspects of plasma membrane.
- To obtain knowledge of various cell organelles.
- To develop skill to understand molecular aspects of cell cycle and cell division.
- To get familiar with transcription and translation in details

MODULE I INTRODUCTION TO CELL 7

Discovery of cells-a brief history: Cell Theory; Basic properties of cell, Different classes of cell: Prokaryotic and eukaryotic cell; Chemical basis of life, Water, inorganic and organic constituents, covalent and non covalent bonds, basic composition of cells-biomolecules.

MODULE II CELL MEMBRANE 8

Structure and function of plasma membrane, Transport of substances through cell membrane- osmosis, diffusion and its types, Active transport (sodium pump) and passive transport; membrane potential, measuring membrane potential, ion channels- Na^+ and K^+ channels, action potential and nerve impulse.

MODULE III CELL ORGANELLE 8

Nucleus-structure and function, concept of chromosomes; Mitochondria, Chloroplast- photosynthesis, Endoplasmic reticulum, Golgi apparatus, lysosome, Membrane transport- exocytosis and endocytosis.

MODULE IV CYTOSKELETON 7

Eukaryotic cytoskeleton structures- intermediate filaments and their role in organelle movements, microtubules- tubulin, centrosome structure, actin filaments, muscle contraction. Prokaryotic cytoskeleton - FtsZ - MreB- ParM - Crescentin.

TOTAL HOURS – 45

TEXT BOOKS:

1. Lodish H. F.Cell and Molecular Biology. W.H. Freeman & Co Ltd, 2000.

2. Cooper G. M. Cell: a Molecular Approach.Sinauerassociates,USA, 2000.
3. Lewin B. Gene VIII. Prentice Hall, USA 2003.

REFERENCES:

1. Molecular Biology of Cell by Alberts et.al. John Wiley & Sons, 6th Ed, 2015.
2. Cell and Molecular Biology by Karp. John Wiley & Sons, 7th Ed, 2013.

OUTCOMES:

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

- Obtain overview of classes of cells and structural and function aspects of plasma membrane and various cell organelles.
- Develop skills to obtain fundamental understanding of the molecular aspects of cell cycle, cell division, transcription and translation.

BTC1213 MICROBIOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- Describe how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.
- Identify ways microorganisms play an integral role in disease, and microbial and immunological methodologies are used in disease treatment and prevention.
- To provide an introduction to the science of microbiology, particularly medical microbiology, to the student with both limited background in the biological sciences and limited interest in pursuing this field further.

MODULE I MICROBES AND FUNCTIONAL ANATOMY 12

Types of microorganisms. Brief history of microbiology. Microbes& human warfare. Microbes & human disease, Classification of microorganism and methods of classifying and identification of microorganism.Size, shape, and arrangement of bacterial cells. Structures external to cell wall, structures internal to cell wall.

MODULE II OBSERVING MICROORGANISMS THROUGH A MICROSCOPE 8

Types of Microscopy -Light Microscopy,Two-Photon Microscopy, Scanning Acoustic Microscopy, Electron Microscopy, Confocal Microscopy, Scanned- Probe Microscopy; Preparation of Specimens for Light Microscopy- Preparing Smears for Staining, Simple Stains, Differential Stains, Special Stains

MODULE III VIRUSES, VIROIDS AND PRIONS 10

General Characteristics of Viruses -Host Range, Viral Size; Viral Structure -Nucleic Acid, Capsid and Envelope, General Morphology, Isolation, Cultivation, and Identification of Viruses - Growing Bacteriophages in the Laboratory, Growing Animal Viruses in the Laboratory, Viral Identification; Viral Multiplication- Multiplication of Bacteriophages, Multiplication of Animal Viruses; Prions- Plant Viruses and Viroids.

MODULE IV MICROBIAL METABOLISM,GROWTH AND CONTROL 10

Microbial metabolism and Biochemical Tests and Bacterial Identification; Growth requirements, culture media, obtaining pure cultures and preservation of cultures, growth of bacterial cultures, Control of Microbial Growth, Action of microbial control agents, physical and chemical methods of microbial control.

MODULE V APPLIED & INDUSTRIAL MICROBIOLOGY 10

Food Microbiology- Foods and Disease, Industrial Food Canning, Aseptic Packaging, Radiation and Industrial Food Preservation, High-Pressure Food Preservation, The Role of Microorganisms in Food Production; Industrial Microbiology Fermentation Technology, Industrial Products, Alternative Energy Sources Using Microorganisms, Biofuels, Industrial Microbiology and the Future.

MODULE VI MICROBIAL GENETICS 10

Recent advances in molecular genetics of viruses and bacteria. The Regulation of Bacterial Gene Expression-Pre-transcriptional Control and Post-transcriptional Control; Genetic Transfer and Recombination- Transformation in Bacteria, Conjugation in Bacteria, Transduction in Bacteria, Plasmids and Transposons.

TOTAL HOURS – 60

TEXT BOOKS:

1. Microbiology: An Introduction: Tortora, Funke & Case. 7th edition, 2001
2. Microbiology: Davis, Dulbecco, Eisen and Ginsburg, 3rd Edition, 1980
3. Introduction to Microbiology: Ross, 2nd Edition, 1986
4. General Microbiology: Stainier, Adelberq and Ingraham, 4th Edition, 1979

OUTCOMES:

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

- demonstrate a broad understanding of the diversity and range of microorganisms, the interactions between humans and microorganisms, the role of microorganisms in industrial and environmental processes, and their role in the development of the techniques that underpin modern molecular biology
- demonstrate proficiency in a set of core microbiological and molecular biological technical methods, including both an understanding of the principles of the methods and their utilisation in laboratory settings
- demonstrate familiarity with the risk assessment process, and use this

information to operate safely in the laboratory environment

- collect, organise, analyse, evaluate and interpret experimental data using appropriate quantitative, technological and critical thinking skills
- critically evaluate relevant scientific data and literature and comprehend the nature and scope of the scientific literature in microbiology and related areas
- communicate microbiological principles and information effectively to diverse audiences, using a variety of formats

BTC1214 BIOCHEMISTRY – LAB

	L	T	P	C
	0	0	4	2

OBJECTIVES:

The students should be able to understand and develop their skills in

- Accuracy and Precession of analysis
- Qualitative testing of Carbohydrates
- Identification of amino acids and proteins
- Quantitative analysis of nucleic acids and enzymes.

LIST OF EXPERIMENTS

1. Preparation of solutions: 1)percentage solutions, 2) molar solutions, 3) normal solutions
2. pH measurements and preparation of buffers.
3. Determination of Wavelenght maximum and concentration of a given solution.
2. Qualitative tests for Carbohydrates.
3. Quantitative estimation of reducing sugars.
4. Estimation of proteins by Lowry's method.
5. Estimation of cholesterol by Zak's method.
6. Estimation of Urea by DAM Method.
7. Determination of saponification number of lipids.
8. Estimation of Amino acids.
9. Separation of amino acids - Thin layer chromatography.
10. Separation of sugars - Paper chromatography
11. Biochemical estimation of DNA /RNA using Spectrophotometer

BOOKS:

Laboratory Manual

OUTCOMES

Students will learn

- about the biomolecules,
- estimation of biomolecules and
- analytical techniques including
- spectrophotometer and chromatography

TOTAL HOURS – 30

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BTC1215 **CELL BIOLOGY LAB** **L T P C**

0 0 3 1

OBJECTIVES:

- Provides an opportunity to experimentally verify the theoretical concepts alreadystudied.
- It also helps in understanding the theoretical principles in a more explicitand concentrated manner.
- Understand explicitly the concepts
- Develop their skills in the preparation and identification of cellstructures andtheir functions.

LIST OF EXPERIMENTS

1. Microscope and its working principle
2. Microscopic study of cell diversity
3. Osmosis in onion
4. Fixation and Staining of blood cells : Blood cell morphology
5. Buccal smearing and Barr body identification
6. Mitosis in onion root tips
7. Isolation of Mitochondria
8. Nuclear staining

REFERENCE BOOK

Laboratory Manual

OUTCOMES

Students will learn about the and identification of cell structures and their functions.

TOTAL HOURS – 30

BTC1216	MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES

The students should be able to

1. Understand explicitly the concepts
2. Develop their skills in the preparation, identification and quantification of microorganisms

LIST OF EXPERIMENTS

1. Sterilization techniques
2. Media preparation (solid and liquid)
3. Isolation, enumeration and purification of microbes from a given sample
4. Staining Techniques (Gram staining, spore staining)
5. Motility test by Hanging drop method
6. Biochemical Characterization of Bacteria Oxidation/Fermentation Test
7. Biochemical Characterization of Bacteria Catalase, Oxidase and Urease Tests
8. Biochemical Characterization of Bacteria- IMViC test
9. Biochemical Characterization of Bacteria- Hydrogen Sulfide Test
10. Biochemical Characterization of Bacteria - Nitrate Reduction Test.
11. Biochemical Characterization of Bacteria - Casein and Starch Hydrolysis
12. Antibiotic Assay - Antimicrobial Sensitivity Test (Disc Diffusion Method)
13. Growth Kinetics (Bacterial Growth Curve)
14. Isolation of antibiotics producing bacteria
15. Isolation and characterization of plant microbes

REFERENCE BOOK

1. Laboratory Exercises in Microbiology, Fifth Edition by Harley−Prescott, The McGraw−Hill Companies, 2002
2. Lab manual

OUTCOMES

Students will learn about

- Basic methods in microbiology
- Characterization and isolation of bacteria isolated from various sources
- Growth kinetics of Bacteria

TOTAL HOURS – 30

SEMESTER III

BTC2101 ENZYME TECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- To learn basics of enzymatic reactions and its characteristics.
- To understand the diverse nature of enzyme based on mechanism of catalysis.
- To learn the strategies needed to purify enzymes for industrial use

MODULE I INTRODUCTION TO ENZYMES 08

The Enzyme- Introduction-- Distinct features of Enzymes, Characteristics of Enzyme Catalysis, Specificity of Enzyme action- The active site-General features and regulation, Hypothesis and Models for Enzyme Substrate action. Enzyme classification and Nomenclature

MODULE II ENZYME KINETICS 07

Enzyme kinetics-Michaelis-Menten equation- Brigg's-Haldane steady state hypothesis & estimation of constants using graphical technique, Lineweaver Burk Plot-Kinetics for reversible reactions-basics of enzymatic reaction-collision theory and transition state theory and role of entropy in catalysis- Enzyme inhibition- Competitive, Uncompetitive and Mixed. Effect of pH and temperature on Enzyme action, Bisubstrate reactions

MODULE III CHEMICAL NATURE OF ENZYME CATALYSIS 08

Mechanisms of catalysis- Acid base catalysis- Electrostatic catalysis- Covalent catalysis- Proximity and Orientation effects, Enzyme catalysis- Mechanisms of reactions catalyzed by enzymes without cofactors- Metal activated enzymes and metalloenzymes. Mechanism of Reactions catalyzed by Ribonuclease, carbonic anhydrase, Lysozyme, Triose phosphate Isomerase and Lactate dehydrogenase, Involvement of Coenzymes in enzyme catalyzed reactions.

MODULE IV EXTRACTION OF ENZYMES AND ASSAY 08

The extraction of soluble enzymes, Membrane bound Enzymes, nature of extraction medium. Purification of Enzymes by analytical techniques, Criteria of

Purity, Determination of Molecular Weight of Enzymes. Enzyme assay- Introduction, Enzyme assay by kinetic determination of catalytic activity, Coupled kinetic assays, Radioimmunoassay (RIA) of enzymes, Investigation of sub-cellular compartmentation of enzyme, and enzyme histochemistry

MODULE V APPLICATIONS OF ENZYMATIC CATALYSIS 08

Applications in Medicine- Assay of Plasma Enzymes, Enzymes in Inborn errors in metabolism, Application of enzymes in food industry, Forensic Science and others Large-scale production and purification of enzymes, Synthesis of artificial enzymes, Immobilization of enzymes, its preparation, properties and applications.

MODULE VI INSTRUMENTAL TECHNIQUES USED IN ENZYME CATALYSIS 06

Principles of – Manometry – Spectrophotometry – Spectrofluorimetry – Electrochemical methods – Enthalpimetry – Radio chemical methods – Automation in enzymatic analysis.

TOTAL HOURS – 45

TEXT BOOKS:

1.Trevor Palmer , Enzymes IInd Horwood Publishing Ltd, 2nd Edition, 2008

2. Enzymes by Robert A. Copeland, 2nd edition, 2000

REFERENCES:

1. Biochemical Engineering by Harwey W. Blanch and Douglas S. Clark, 2nd Edition, 1996.
2. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub, 1977

OUTCOMES:

- Understand the fundamentals of enzyme properties and distinguish based on reaction mechanism
- Apply biochemical calculation and plot graphs for enzyme kinetics
- Compare methods for production, purification, characterization and immobilization of enzymes
- Understand various application of enzymes that can benefit human life
- Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

BTC2102	FUNDAMENTALS OF CHEMICAL ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To refresh and strengthen the concept of units used in chemical engineering and conversion from one system of units to another.
- To provide insight on the behavior of ideal gas behavior and applications of gas laws
- To introduce the concept of material flow in an industry
- To emphasize the significance of energy, energy flow and its significance in industries
- To highlight the types of fluid and its behaviour
- To introduce basic calculations involved in chemical reactions.

MODULE I BASIC CHEMICAL CALCULATIONS 10

Units and dimensions, Systems of Unit, Conversion from one unit system to another, basic/fundamental units, multiple units, derived units, Dimensional Homogeneity, Significant figures, concept of mass, volume and concentration, composition of mixtures and solutions- solids, liquids and gases - mass fraction, mole fraction, mass %, mole %, density, specific gravity, ppm ,molarity, molarity and normality, flow rate –mass, volumetric and molal, Determination of molecular mass of a mixture, Pressure measurements- atmospheric pressure, absolute pressure, gauge pressure, temperature scale- conversion from one temperature scale to another scale.

MODULE II BASIC CONCEPTS OF GASES AND GASEOUS MIXTURE 10

Ideal gas, Ideal gas equation, mixture of ideal gases- partial pressure- Dalton's law, Amagat's law, average molecular weight of gaseous mixtures, real gases, van der Waals equation, compressibility factor, vapour pressure, Vapour liquid equilibria, Humidity, Humidity chart, Psychrometer.

MODULE III MATERIAL BALANCE 10

Unit operations and process, Classification and Types of system, Conservation of mass/material, Concept of Degree of freedom, Concept of material balance in different systems, Chemical reactions, Stoichiometry, material balance with chemical reactions, yield, selectivity, percent conversion, specificity, recycle , bypass and purge operations.

MODULE IV ENERGY BALANCE 10

Law of conservation of energy, components of energy balance equation- Heat, work, kinetic, potential energy, enthalpy, internal energy, heat capacity, steam tables and its application, concept of heat associated with physical process- Hess's law, heat associated with chemical reactions, applications of energy balance in bioprocess.

MODULE V FLUID AND ITS PROPERTIES 10

Fluids, fluid flow, concept of viscosity, Newtonian and non-Newtonian fluid, Fluid flow in pipes- laminar, transient and turbulent, flow measurement-applications and devices, Transport of fluids- pumps and its types.

MODULE VI BASICS OF CHEMICAL REACTION KINETICS 10

Rate of a reaction, rate equation, order of a reaction, factors that affect rate of a reaction, methods to determine the rate equation, homogeneous and heterogeneous reactions, chemical reaction equilibrium, introduction to biochemical reactions and bioreactors.

Total Hours –60

TEXT BOOKS:

1. Stoichiometry and process calculations by KV Narayanan and B. Lakshmikutty,PHI Learning Pvt Ltd., 5th Edition, 2016
2. Basic principles & Calculations in Chemical engineering by David Himmelblau, 6th edition, PHI Learning Pvt Ltd, 2012
3. Elementary Principles of Chemical Processes by Richard Felder, 3rd Edition, John Wiley & Sons, Inc., 2005

REFERENCES:

1. Unit operations of chemical engineering, McCabe WL and JC Sonith and P Harriot, 6th edition, McGraw Hill 2001.
2. Transport process and Separation process principles, Geankoplis, 4th edition, PHI Learning Pvt Ltd., 2009

OUTCOMES:

- To perform simple calculations using different unit systems, concentration, humidity, pressure and temperature
- To differentiate ideal gas and non-ideal gas behavior.
- To apply material balance calculations on simple systems
- To apply energy balance and can demonstrate the direction of flow of energy
- To identify and categorise the different types of fluid
- To determine the order and the rate of a chemical reaction.

BTC2103	MOLECULAR BIOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To develop an in-depth knowledge about the DNA replication process
- To conceptualize the types of DNA mutation and DNA damage repairing process
- To get a detailed idea about the transcription process
- To understand the protein synthesis by ribosomes
- To develop concepts about the Gene regulation mechanisms in prokaryotes and eukaryotes
- To get an overview of the basic molecular biology techniques

MODULE I DNA REPLICATION 10

Prokaryotic and eukaryotic DNA replication, models of DNA replication – semi-conservative replication, mechanism of DNA polymerase, Semi-discontinuous replication, replication fork-DNA synthesis at replication fork, initiation, elongation and termination of replication, telomere, end replication problem and telomerase enzyme

MODULE II MUTATION AND DNA REPAIR 10

Molecular basis of mutations, sources of mutation- replication error and chemical damage, transition and transversion, mutational hotspots, hydrolysis and deamination DNA repair mechanisms, light dependent repair, excision repair, mismatch repair, double strand break repair; homologous recombination and non-homologous end joining mechanism of DSB repair.

MODULE III TRANSCRIPTION 10

RNA polymerases in prokaryote and eukaryote, types and function. Initiation, elongation and termination of transcription, promoters in prokaryotes and eukaryotes; Transcription of mRNA in Prokaryote and eukaryote – initiation, elongation and termination models. Post transcriptional processing of mRNA – G-capping, poly-A tail, RNA splicing (including different types).

MODULE IV TRANSLATION 10

Genetic code and Wobble hypothesis. Translation in prokaryote and eukaryote. Translation- codons, ribosomal assembly, initiation, elongation and termination, ribosomal cycle, Post translational modifications.

MODULE V REGULATION OF GENE EXPRESSION 10

Operon system, Constitutive and non-constitutive, Inducible operon, Positive and negative regulation, regulation of inducible system, regulation of repressible system, Lac operon,operator, inducer and catabolite repression, cAMP regulation, regulation in Eukaryotes; Trp Operon, repression and attenuation, organization of trp operon

MODULE VI TOOLS IN MOLECULAR BIOLOGY 10

Isolation of nucleic acids- gel electrophoresis, restriction endonucleases-properties, restriction mapping, Nucleic acid hybridization, Southern blot, Northern blot, microarray, DNA fingerprinting, DNA sequencing and Physical mapping- Sanger sequencing, automated DNA sequencing, High-through sequencing

Total Hours – 60

TEXT BOOKS:

1. Molecular Biology of the Gene. James D Watson, 7Ed. Cold Spring Harbor Laboratory Press. 2014
2. Molecular Biology. Robert F Weaver, 5Ed, McGraw Hill, 2013

REFERENCES:

Molecular Biotechnology. Glick and Pasternak, 4Ed, ASM Press, 2010

OUTCOMES:

- The students should be able to understand the replication machinery
- To explore the DNA mutation and the repair mechanism in understanding diseases
- To explore the mechanism and functions of different enzymes and proteins involved in transcription
- To understand the mechanism of translation and post-translational events
- To understand the mechanisms of gene expression regulation
- To understand and apply the basic molecular biology techniques

BTC2104 BASIC BIOANALYTICAL TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- The students will be exposed to basic concepts related with techniques and instrumentation widely used in Biotechnology.
- Understand calorimetry and techniques of spectroscopy
- Learn electrophoretic processes
- Chromataographic techniques and principles
- Technniques and principles associated with radiology

MODULE I CHROMATOGRAPHY 9

Adsorption and partition chromatography– Paper chromatography – Thin Layer Chromatography – Column chromatography – Gas Chromatography and HPLC (principles and instrumentation) – Ion exchange chromatography– affinity chromatography.

MODULE II ELECTROPHORESIS AND BLOTTING METHODS 9

Electrophoresis: types of electrophoresis – paper and gel-agarose and SDS-PAGE.pulsed field- Immunoelectrophoresis capillary electrophoresis - Iso-Electric Focusing - 2D gel electrophoresis- sedimentation – blotting methods- Western, Southern and Northern application in life science

MODULE III SPECTROSCOPY 9

Principles and instrumentation and applications: Beer- Lamberts Law, Colorimetric analysis – UV spectroscopy , hypo and hyper chromicity,– Atomic absorption spectroscopy – Flame emission spectroscopy – Spectrofluorimetry– Nuclear magnetic resonance spectroscopy – Mass spectrometry.

MODULE IV CENTRIFUGATION 9

Principle of centrifugation, different types of centrifuges, small bench centrifuges, large capacity bench centrifuges, large capacity refrigerated centrifuges, high speed refrigerated centrifuges, continuous flow centrifuges, preparative ultracentrifuges, analytical centrifuges, different types of rotors.

MODULE V MICROSCOPY AND OPTICAL METHODS 9

Basic principles of microscopy and application of light : Compound – Phase contrast inverted microscopy– Scanning Electron Microscopy (SEM) – Transmission Electron Microscopy (TEM) – Fluorescence Microscopy – Scanning Tunneling Microscopy (STM) – Automated Fluorescence Microscopy – Confocal Microscopy - Optical Rotary Dispersion (ORD) and Circular Dichroism (CD).

MODULE VI RADIOISOTOPE TECHNIQUES 9

Radioisotope techniques – basic concepts – autoradiography – radioimmunoassay (RIA), applications in biological science – types of radioisotopes– half life – units of radioactivity – uses of radioisotopes in life sciences and biotechnology- detection and measurement of radioactivity**:** liquid scintillation counting, solid state counting, Geiger counter – radiation hazards

Total Hours –45

TEXT BOOKS:

1. Pierre C. ORD and CD in chemistry and biochemistry: An Introduction. Academic Press, 1972.
2. Paddock S. W. Confocal Microscopy methods & protocols.1st Ed., Human Press, 1999.

REFERENCES:

Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st Ed., Wiley-Liss, 2001.

OUTCOMES:

- At the end of the course, the students will have sufficient scientific understanding of the basic concepts in instrumentation used in Biotechnology.
- Understand calorimetry and techniques of spectroscopy
- Learn electrophoretic processes
- Chromataographic techniques and principles
- Technniques and principles associated with radiology

BTC2105 MOLECULAR BIOLOGY LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

- To learn basic techniques in molecular biology
- To study and to differentiated the electrochemical properties of nucleic acids
- Learn the diffeences in DNA extraction techniques
- Learn gel preparation

MODULE I

Agarose gel electrophoresis of chromosomal & plasmid DNA
Extraction of genomic DNA from bacteria
Extraction of plasmid DNA from bacteria
Extraction of genomic DNA from yeast cells
Isolation of RNA from bacteria
Isolation of DNA fragment from agarose gel

Total Hours –30

TEXT BOOKS AND REFERENCES:

1. Michel R. G and Sambrook J. Molecular Coning- A laboratory manual. Cold spring harbor laboratory press, 2012.

OUTCOMES:

- On the completion of the above experiment's students will be able to handle DNA samples and also to isolate, purify and visualize nucleic acid
- Develop skill to prepare and run gels
- Develpoe skill for DNA extraction from different sources

BTC2106	ENZYME TECHNOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand the basics of enzyme, its function and the factors which affects its kinetic properties
- To know the steps involved in calculation of enzyme kinetics parameters.

MODULE I

1. Isolation and Screening of amylase producing microorganisms from soil and saliva
2. Construction of Protein standard curve by Folin's Lowry method and Determination of specific activity of enzyme.
3. Effect of substrate concentration on Enzyme kinetics and determination of Km and Vmax
4. Effect of temperature on Enzyme kinetics
5. Effect of time on Enzyme kinetics
6. Effect of pH on Enzyme kinetics

Total Hours –15

TEXT BOOKS AND REFERENCES

1. Bioctalaysis and Enzyme Technology by Klaus Buchholz, Volker Kasche, and Uwe T. Bornscheuer, 2005

OUTCOMES:

- Explain why enzymes have an optimal pH and temperature to ensure greatest activity
- Explain why the same type of enzyme reaction performed at different temperatures revealed different results/enzyme activity

BTC2107	**BIOANALYTICAL TECHNIQUES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

- To learn basic techniques in different instruments.
- To learn the concept of different techniques and to handle independently.

MODULE I

1. Preparation of buffers (acetate and PBS buffer).
2. To check the purity of proteins using SDS PAGE.
3. To find out the concentration of unknown protein using absorption techniques.
4. To see the effect of different denaturant in protein by absorption spectroscopy.
5. Purification of proteins using affinity chromatography.
6. Purification of carbohydrates by paper chromatography.
7. Purification of amino acids using thin layer chromatography.

Total Hours –45

TEXT BOOKS:

1. Lab Manual

OUTCOMES:

- Students will be able to learn the handling of instruments.
- They can learn different techniques to be applied according to the requirement of purification.

SEMESTER IV

BTC2211	GENETIC ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To learn about genetic engineering, principles involved in manipulating genes and DNA.
- To know about cloning strategies and expression systems.
- To acquire basic understanding of techniques in genetic engineering.

MODULE I Mendelian Genetics 10

Introduction to genetics, Mendel's experiment-monohybrid and dihybrid cross, Test cross and back cross, Concept of alleles and allelic variation- incomplete dominance and codominance, ABO blood group system, chromosomal theory of inheritance, sex linkage, non disjunction, hemophilia, colour-blindness

MODULE II Applications of Mendelian Genetics 10

Punnett square method and Fork line method of gene heritance, Probablity method of gene heritance, Multiplicative and additive rule, Pedigree analysis, Mendelian segregation in human, Genetic counseling

MODULE III Basic Techniques in Genetic Engineering 10

Polymerase Chain Reaction – its applications; Molecular cloning, vectors - plasmid, viral and artificial chromosomes, Human genome project.

MODULE IV Application of Molecular Genetics 10

Diagnosis of Huntigton's disease, Diagnosis of Sickle cell anemia, Gene therapy-somatic cell gene therapy, Vectors for gene therapy, Retroviral, Lentiviral and adenoviral vectors Reverse Genetics-Gene knockouts, RNA interference (RNAi) - miRNA, siRNA

MODULE V Transgenic animals and plants 10

Generation of transgenic mouse models – microinjection method and transfection to Embryonic cells method, applications of transgenic animal models; generation of transgenic plants, Agrobacterium mediated transgenic plants, Ti plasmid, T DNA, Vir gene, applications of transgenic plants

MODULE VI Transposable genetic element 10

Introduction, Transposable element in bacteria, IS elements, Composite transpososns, Tn3 elements, Transposons in eukaryotes, Drosophila P elements, hybrid dysgenesis, applications in drosophila genetics, Retrotransposons, Transposable element in humans

Total Hours –60

REFERENCES:

1. Concepts of Genetics, Klug & Cummings, Prientice Hall, 11th Edition, 2014
2. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory, 4th Edition, 2012

OUTCOMES:

- On completion of the course the scholars will acquire knowledge on the concepts and terminology in genetic engineering.
- Students will be familiar with various cloning strategies in prokaryotes as well as in eukaryotes.
- Students will learn various techniques in genetic engineering.
- They will also get awareness about the social and ethical issues concerning cloning by genetic engineering

BTC2212	IMMUNOTECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- An understanding of immunity, history of immunology, cells and organ involved in immune system
- An understanding of Antigen-Antibody interaction
- An understanding of cytokines and complement system involved in immune system.
- An understanding of receptors, MHC class of molecules and regulation of immune response

MODULE I INTRODUCTION TO IMMUNE SYSTEM 10

General concepts of the immune system, Innate and acquired immunity, active and passive immunity, humoral and cell mediated immunity, Inflammation-basic concept, components, functions and properties. Complement System.

MODULE II CELLS & TISSUES OF IMMUNE SYSTEM 10

Hematopoeisis, T and B-lymphocytes, antigen presenting cells, Natural killer cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils, Mast Cells, Dendritic Cell, Organs of the Immune System, Bone marrow, Thymus, Lymph node, Spleen, CALT, MALT.

MODULE III ANTIGEN AND ANTIBODY 10

Antigens:Different characteristics of antigens (foreignness, molecular size, heterogeneity), epitope, Hapten,immunogen,,adjuvants. Antibody:Molecular structure of antibody, Classification, Isotypes, Synthesis assembly and expression of immunoglobulin molecules, Antigen-antibody interaction.

MODULE IV INTRODUCTION TO ANTIBODY ENGINEERING 10

Definitions of chimeric and hybrid monoclonal antibodies, Hybridoma technology: - Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application.

MODULE V IMMUNE SYSTEM IN HEALTH AND DISEASE 10

Autoimmunity, hypersensitivity,Transplantation immunology: Types of grafts, immunologic basis of graft rejection, properties and types of rejection, immunosuppressive therapy and transplants to immunologically privileged sites, Tumor immunity- tumor antigens (TSTA and TAA), immune response to tumors. Tumor evasion of the immune system.Immunotherapy for tumors.Synthetic vaccines.

MODULE VI IMMUNOLOGICAL TECHNIQUES 10

Immunological principles of various reactions and techniques: Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immunoelectrophoresis, rocket immunoelectrophoresis, ELISA (indirect, sandwich, competitive, chemiluminescence, ELISPOT assay), DOT ELISA, immunoblotting, immunofluorescence, flow cytometry and fluorescence, and immunoelectron microscopy.

Total Hours –60

TEXT BOOKS

1. Immunology – an Introduction by Tizard, Thomson., 2nd Edition, 1988
2. Immunology by J Kuby, WH Freeman, 7th Edition, 2011
3. Immunology &Immunotechnology by Ashim K Chakravarthy, Oxford University Press, 7th Edition 2006.
4. Immundiagnostics by S C Rastogi, New Age International, 1st Edition, 1996

REFERENCES:

1. Essential Immunology by Roitt I. Blackwell Scientific Publications, Oxford, 10th Edition, 2001
2. Molecular Immunology ByBenjamini E., 1990
3. Immunology a short course by Benjamini E. and Leskowitz S. Wiley Liss, 2nd Edition, 1992
4. The Immune System by Peter Parham, Garland Science, 4th Edition, 2014
5. Understanding Immunology by Peter Wood, Pearson Education., 1st Edition, 2006

OUTCOMES:

- Describe and explain the fundamental principles of modern immunology
- Understand and apply related immunological techniques in medical laboratory profession
- relate and apply medical laboratory science

BTC2213	CHEMICAL AND BIOTHERMODYNAMICS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To impart fundamental concepts of solution thermodynamics involving ideal and non-ideal systems.
- To use solution thermodynamic concepts to compute phase & reaction equilibrium data

MODULE I THERMODYNAMIC PROPERTIES OF FLUIDS 10

Volumetric properties of fluids exhibiting non ideal behavior – Residual properties – Estimation of thermodynamic properties using equations of state – Calculations involving actual property exchanges – Maxwell's relations and applications.

MODULE II SOLUTION THERMODYNAMICS 10

Partial molar properties – Concepts of chemical potential and fugacity – Ideal and non-ideal solutions – Concepts and applications of excess properties of mixtures – Activity coefficient – Composition models – Gibbs Duhem equation.

MODULE III PHASE EQUILIBRIA 10

Criteria for phase equilibria – VLE calculations for binary and multi component systems – Liquid-liquid equilibria (LLE) and solid-solid equilibria (SLE).

MODULE IV CHEMICAL REACTION EQUILIBRIA 10

Equilibrium criteria for homogeneous chemical reactions – Evaluation of equilibrium constant – Effect of temperature and pressure on equilibrium constant – Calculation of equilibrium conversion and yields for single and multiple reactions.

MODULE V THERMODYNAMIC ANALYSIS OF PROCESSES 10

Concept of lost work – Entropy generation – Calculation of real irreversible processes – Power cycle – Liquefaction.

MODULE VI BIOCHEMICAL THERMODYNAMICS 10

Energetics of metabolic pathways energy coupling (ATP and NADH), stoichiometric and energetic analysis of cell growth and product formationelemental balances, degree of reduction concepts-available –electron balance, yield coefficients, oxygen consumption and heat evolution in aerobic cultures, thermodynamics efficiency of growth.

Total Hours –60

TEXT BOOKS:

1. Smith, J.M., Van Ness H.C. and Abbott M., “Introduction to Chemical Engineering Thermodynamics”, 6th Edition, Tata McGraw- Hill, 2001.
2. Narayanan, K.V., “A Text Book of Chemical Engineering Thermodynamics”, Prentice Hall India, 2001.
3. Sandler, S.I., “Chemical, Biochemical and Engineering Thermodynamics”, 4th Edition, John Wiley and Sons Inc., 2006.
4. Haynie, D.T., “Biological Thermodynamics”, 2nd Edition, Cambridge University Press, 2008.
5. Nicholls, D.G. and Ferquson, S.J., “Bioenergetics 3”, 2nd Edition, Elsevier Science Ltd., 2002.

OUTCOMES:

- Students will derive fundamental equations that govern the estimation of solution properties.
- Students will compute phase equilibrium data and construct P-x-y, T-x-y diagram for ideal binary miscible vapour-liquid systems. The student will describe salient features of liquid-liquid and liquid-solid phase equilibrium plots. The student will compute bubble and flash point for a given data
- Students will compute phase equilibrium data for non-ideal binary miscible vapour-liquid systems using van Laar and Margules model and for ideal binary immiscible vapour-liquid systems
- Students will estimate equilibrium conversion in reversible reactions at given pressure and temperature following rigorous thermodynamic method and Van'tHoeff method.

BTC2214 PLANT AND ANIMAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- The purpose of the course is to provide training in the science behind plant biotechnology,
- an appreciation of the current scope and limits to its industrial application, and the implications of modern methods of genetic modification for plant industries.
- Also, the main mechanism of cell, tissues, organs and apparatus functionality and the current methods of animal cell culture and its application in research

MODULE I INTRODUCTION TO PLANT TISSUE CULTURE 8

Introduction, History, Applications of Plant tissue culture, Laboratory facilities and operations, Nutrition medium composition and preparation, Sterilization Techniques and Types of culture.

MODULE II MICROPROPAGATION, INVITRO PRODUCTION OF HAPLOIDS AND SOMATIC HYBRIDIZATION 10

Micro propagation techniques- different methods, advantages and disadvantages. Haploid plants -generation, significance, method, advantage disadvantage. Protoplast preparation, isolation, purification, viability and culturing, somatic hybridization- techniques, methods to screen, methods of verification/ characterisation. Advantage and disadvantage; Somatic hybridization Applications.

MODULE III TRANSGENICS FOR CROP IMPROVEMENT AND METABOLITE PRODUCTION 12

Transgenic plant generation, Agrobacterium infection-Ti and Ri plasmid, plant vectors, methods of gene transfer, selection and screening, transgenics in crop improvement, terminator seed technology, transgenics in molecular farming, Cell suspension culture, secondary metabolite production, selection of high yielding line, Molecular farming.

MODULE IV SOMACLONAL VARIATION, GERMPLASM STRORAGE AND CRYOPRESERVATION 10

Somaclonal variation - method, applications ,advantages and disadvantage, causes; germ plasm storage- in situ and ex situ, cryopreservation, slow growth method.

MODULE V NTRODUCTION TO ANIMAL TISSUE CULTURE, MEDIA AND CRYOPRESERVATION OF ANIMAL CELLS 10

Background, Advantages, Limitations, Application, Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation. Planning, Construction, Layout, Essential Equipments, Aseptic Technique, Objectives, Elements, Sterile Handling.Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Serum-Free Media, Disadvantages of Serum, Advantages of Serum Free media, Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation,Immortalization of cell lines, Cell line designations, Routine maintenance. Need of Cryopreservation, Preservation, Cell banks, In Vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involved in IVF

MODULE VI TRANSGENIC ANIMALS AND GENE THERAPY 10

Methodology, Embryonic Stem Cell method, Microinjection method, Retroviral vector method, Applications of transgenic animals.Ex-vivo gene therapy, In vivo gene therapy, Viral gene delivery system, Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vector system, Herpex simplex virus vector system, Non-viral gene delivery system, Prodrug activation therapy, Nucleic acid therapeutic agents.

Total Hours –60

TEXT BOOKS:

An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002
Animal Cell Culture by John R.W. Masters Oxford University Press

OUTCOMES:

At the end of the course the students will acquire:

- An understanding of the theoretical background knowledge in molecular, biochemical and plant sciences needed for an understanding of plant biotechnology.
- A working knowledge of laboratory techniques used in plant biotechnology.

- An appreciation of the issues associated with growing and using transgenic plants as food crops.
- An understanding of the aims and needs of industrial enterprises using plant biotechnology techniques to develop new products.
- Apply biotechnological methods for basic research;
- Apply bimolecular methods to veterinary pharmacology, to the design, correct use and traceability of medicines;
- Apply reproduction methods with particular reference to gamete and embryo manipulation techniques, production of transgenic animals and cloning;
- A capacity to undertake research in plant biotechnology and animal biotechnology

BTC2215	GENETIC ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To learn basic techniques in molecular biology
- To study and to differentiated the electrochemical properties of nucleic acids

List of Experiments:

1. Preparation of competent cells
2. Transformation of bacterial cells using foreign DNA
3. Formaldehyde gel electrophoresis of nucleic acid
4. Restriction digestion of nucleic acid
5. UV mutation analysis

Total Hours –15

TEXT BOOKS:

1. Michel R. G and Sambrook J. Molecular Coning- A laboratory manual. Cold spring harbor laboratory press, 2012.

OUTCOMES:

On the completion of the above experiments students will be able to

- handle DNA samples
- and also to isolate, purify and visualize nucleic acid.

BTC2216 **IMMUNOLOGY LABORATORY**

L	T	P	C
0	0	3	1

OBJECTIVES:

- To learn basic techniques in Immunology
- To understand antigen-antibody interaction
- To understand various techniques to identify antigen.

List of Experiments:

1. Blood grouping
2. Immunodiffusion, Immunoelectrophoresis.
3. Antigen-antibody reaction-Haemagglutination, precipitation-Widal and VDRL
4. Affinity chromatography for antibody purification.
5. ELISA-DOT and plate ELISA
6. Western blotting

Total Hours –15

REFERENCES:

1. Rose et al., Manual of Clinical laboratory Immunology, 6th Ed ASMPublications, 2002.
2. Lefkovis and Pernis. Immunological methods. Academic Press, 1978.
3. Hudson L. and Hay F.C. Practical Immunology. Black Well publishers, 1989

OUTCOMES:

- Provides an opportunity to experimentally verify the theoretical concepts already

BTC2217 ANIMAL AND PLANT CELL CULTURE LABORATORY

	L	T	P	C
BTC2217 ANIMAL AND PLANT CELL CULTURE LABORATORY	0	0	3	1

OBJECTIVES:

- to learn basic techniques of animal cell culture
- to learn basic techniques in plant tissue

Experiments:

1. Introduction to animal cell culture lab
2. Animal cell culture media preparation
3. Subculturing of animal cells
4. Cell counting by hemocytometer
5. Cell viability study (trypan blue)
6. Cell viability study (mtt assay)
7. Plant tissue culture lab introduction
8. Tissue culture media preparation (liquid and solid)
9. Effect of sugar on the growth of root explant
10. Callus culture
11. Establishment of suspension culture

Total Hours –15

TEXT BOOKS:

1. Ian Freshney (2010) Culture of Animal Cells. J Wiley Publishers, 1st Edition
2. Tarek Capiel. CELL AND TISSUE CULTURE Lab manual, 3rd Edition

OUTCOMES:

- Students shall be able to do animal cell culture
- Students shall be able to perform plant tissue culture

SEMESTER V

BTC3101	PROTEIN ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

The course aims to provide the students with

- a knowledge on the biosynthesis, structure and function of proteins and furthermore,
- the techniques associated with gene cloning and the expression of recombinant proteins.
- To provide knowledge about the design of proteins with specific properties

MODULE I PROTEIN STRUCTURE AND ENGINEERING 10

Introduction, Overview of protein structure, Higher level structure, protein classification on the basis of structure, Protein structural stability, higher order structure prediction, protein folding, intrinsically disordered protein

MODULE II POST-TRANSLATIONAL MODIFICATION 10

Introduction: post translational modification, types of post translational derivatives, types of post translational reactions, chaperones involved post translational modification, biological functions of post translational modification: regulation, cross links, covalent cofactors, membrane anchors, other functions.

MODULE III PROTEIN SOURCES 10

Recombinant versus non-recombinant production, Heterologous protein production in E.coli, bacteria other than E.coli, yeast and fungi, proteins from plants, animal tissue as protein source, Heterologous protein production in transgenic animals, Heterologous protein production in using cell culture.

MODULE IV PROTEIN PURIFICATION AND CHARACTERIZATION 10

Protein detection and quantification, Initial recovery of protein, removal of whole cells and cell debris, Concentration, chromatographic purification, Protein inactivation and stabilization, protein characterization.

MODULE V DIRECTED MUTAGENESIS 10

Site-directed mutagenesis by traditional PCR, Site-directed mutagenesis by primer extension, Site-directed mutagenesis by inverse PCR, applications

MODULE VI INDUSTRIAL ENZYMES AND THERAPEUTIC PROTEINS 10

Sources and engineering, environmental benefits, immobilized enzymes, extremophiles, enzymes in organic solvents, industrial enzymes: future use. Blood products, anticoagulants, thrombolytic agents, additional blood-related products, vaccine technology therapeutic enzymes.

Total Hours –60

TEXT BOOKS:

1. Proteins: Biochemistry and Biotechnology by Gary Walsh. (2002): John Wiley & Sons Ltd., 2nd Edition, 2002
2. Proteins Analysis and Design. Ruth Hogue Angeletti, Albert Einstein College of Medicine of Yeshiva University Bronx, New York., 1st Edition, 1998

REFERENCES:

1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina,Harwood Academic Publishers, 1st Edition, 2000

OUTCOMES:

This Course will provide

- theoretical and methodological knowledge in Protein Engineering.
- In particular, the student will get acquainted with enzyme kinetics,
- rational protein engineering, and directed evolution of enzymes.
- In addition, expertise in enzyme immobilization and in enzymology in non-conventional media will also be credited.

BTC3102 CHEMICAL REACTION ENGINEERING

L	T	P	C
4	0	0	4

OBJECTIVES:

To impart knowledge

- to design different types of chemical reactors.
- Students gain knowledge on different types of chemical reactors,
- the design of chemicalreactors under isothermal and non-isothermal conditions

MODULE I REACTION KINETICS 10

Rate equation, elementary, non-elementary reactions, theories of reaction rate andtemperature dependency; Design equation for constant and variable volume batch reactors,analysis of experimental kinetics data, integral and differential analysis.

MODULE II DESIGN OF CONTINUOUS REACTORS 10

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors,combination of reactors, size comparison of reactors.

MODULE III MULTIPLE REACTIONS 9

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions – factorsaffecting choice, optimum yield and conversion, selectivity, reactivity and yield.

MODULE IV KINETICS OF COMPLEX REACTIONS 11

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchangesfor different reactors, design for constant rate input and constant heat transfer coefficient,operation of batch and continuous reactors, optimum temperature progression.

MODULE V RESIDENCE TIME DISTRIBUTION 10

The residence time distribution as a factor of performance; residence time functions andrelationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

MODULE VI CHEMICAL REACTOR DESIGN 10

Transient and steady state analysis, Optimal design of reactors, Multiphasereactors: fixed, fluidized, trickle bed, slurry etc, Non-ideal continuous flow reactors.

Total Hours – 60

TEXT BOOKS and REFERENCES:

1. Levenspiel O, “Chemical Reaction Engineering”, Wiley Eastern Ltd., IInd Edition, 2000.
2. Smith, J.M, “Chemical Engineering Kinetics”, McGraw Hill, IIIrd Edition, 1981.
3. Fogler.H.S., “Elements of Chemical Reaction Engineering”, Prentice Hall of India Ltd.,IIIrd Edition, 2000.
4. Froment. G.F. &K.B.Bischoff, “Chemical Reactor Analysis and Design”,John Wiley andSons, 1979

OUTCOMES:

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

- Develop rate laws for use in reactor design based on reaction data from a reactor or set of reactors.
- Make comparisons of ideal reactor types (batch, plug flow, mixed flow, etc.) and be able to determine the best choice for simple objectives when using a single reactor or a set of reactors.
- Predict reactor performance in situations where a reacting gas has a significantly changing density, including the case of variable pressure within an ideal plug flow reactor.
- Determine optimal ideal reactor design for multiple reactions for yield or selectivity.
- Predict reactor performance for reactors when the temperature is not uniform within the reactor.
- Predict reactor performance in situations where the observed reaction rate is significantly influenced by internal mass transfer in porous heterogeneouscatalysis (the iso-thermal effectiveness factor).

BTC3107 CHEMCIAL REACTION ENGINEERING LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- This laboratory course will reinforce the students' understanding of basic concepts pertaining to analyze kinetics for complex reactions using differential and integral methods.
- Batch reactor will be employed to analyze rate kinetics for isothermal and exothermic reactions. The tracer dynamics in reactors will be studied using Residence Time Distribution.
- Familiarize with suitable measurement techniques and devices to measure concentration and temperature.
- Learn to employ various methods to determine the kinetics of reactions
- Quantify the effect of non-ideality of flow in chemical reactors
- Calculate the effects of mass transfer on chemical reactions.
- Predict errors in experimentation and compare experimental data with models

Experiments:

1. Solvent extraction of Iodine using Hexane / Dichloromethane
2. Solvent extraction of iodine using Chloroform / Toulene
3. Separate acetone from the mixture of acetone and water by distillation
5. Retrieve ethanol, methanol and water from its mixture by distillation. Confirm using iodoform and boric acid test.
6. Hydrolysis of ester (Ethylacetate)
7. Estimation and removal of hardness of water

Total Hours –15

TEXT BOOKS:

1. Lab Manual

OUTCOMES:

At the end of the course the students should:

- Explain the different steps in reaction mechanisms on catalytic surfaces and identify the rate-determining step.
- Understand the different importance of kinetic and thermodynamic

considerations for the choice of feed temperature in reactor systems for equilibrium reactions.

- Understand the effect of variation flow rate, temperature and particle size on the total reaction rate in a system that is controlled both by mass transfer and reaction.

BTC3109	PROTEIN ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- to understand the concept of protein engineering and how to different nature of amino acids help for this aspect
- to engineer a new protein with different properties

Experiments:

1. To study the Acid hydrolysis of protein
2. To study Alkaline hydrolysis of Protein
3. Procedure for Quantitating Sulfhydryl Groups Using a Cysteine Standard using Ellmans reagent
4. Procedure for Quantitating Sulfhydryl Groups Based on Molar Absorptivity
5. Isolation of Proteins Cross-linked to DNA by Formaldehyde.
6. Modification of Arginine Side Chains with p-Hydroxyphenylglyoxal.
7. Chemical Cleavage of Proteins at Methionyl-X Peptide Bonds.
8. Enzymatic Digestion of Proteins in Solution and in SDS Polyacrylamide gel.

Total Hours –15

TEXT BOOKS:

1. Lab Manual

OUTCOMES:

Student will be able to:

- Estimate the disulfide using different conditions.
- Design a new protein with novel properties.

SEMESTER VI

BTC3211	STRUCTURAL BIOLOGY	L	T	P	C
		3	1	0	4

OBJECTIVES:

The course aims to provide the students with

- a detailed understanding of the behavior of proteins in solution and
- how their properties may be altered by changing the physical surroundings.
- To provide an understanding of the theory and practical techniques involved in developing a purification process.

MODULE I STRUCTURAL STATES OF PROTEINS-I 5

chemical nature of polypeptide chains,Secondary structure,beta structure, collagen triple helix, higher structure determination, prediction of secondary structure, Domains and super secondary structures.

MODULE II STRUCTURAL STATES OF PROTEINS -II 5

Association of protein subunits, helical or continuous protein polymers.Thequaternary structure of closed aggregates -oligomeric enzymes, biological implication of quaternary structure, surface accessibility.

MODULE III CRYSTALLOGRAPHY 9

Diffraction methods, X-ray crystallography, crystallization, resolution, temperature factors, electron density maps, NMR methods for protein structure determination

MODULE IV PROPERTIES OF MACROMOLECULES IN CRYSTALLINE STATE 9

Protein crystal, physical properties, chemistry of crystalline proteins, chemical reactivity, enzymatic and biological activities, crystal versus solution NMR studies, Crystallographic temperature factors, structural heterogeneity in protein crystals

MODULE V CONFORMATIONAL STATES IN CRYSTAL AND NUCLEAR MAGNETICRESONANCE STRUCTURES 9

Comparison of two conformational states, Oxygenation of hemoglobin: two crystals conformation, Hydrogen Bonds andWater Molecules inCrystalline Proteins- hydrogen bonding positions in proteins, water molecules observed in crystalline proteins, the distribution of protein bound water, water network in crystalline proteins.

MODULE VI PROTEIN COMPLEXES 8

Structural data describing DNA, interaction between DNA and site-specific proteins, DNA-binding motifs, helix-turn-helix, leucine zipper.functional reason for metal ion bindingmetalloproteins, membrane protein structure by electron microscopy and X ray methods

Total Hours –60

TEXT BOOKS:

1. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.), 2nd Edition, 2002
2. Foundations of Structural Biology by Leonard J. Banaszak (2000) Academic Press, 1st Edition, 2000

OUTCOMES:

At the end of this course, students will be able to understand methods to determine and study protein structures.

BTC3212	BIOPROCESS ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

The course aims to provide the students with

- the theoretical basis Bioprocess principles and
- the integration of biochemistry, microbiology, cell biology and process engineering.
- It aims to exploit the potential of microorganisms and cells by technical means.

MODULE I INTRODUCTION TO ENGINEERING CALCULATION, PRESENTATIONS AND ANALYSIS OF DATA 10

Physical variables, dimensions, Modules, errors in data and calculations, testing mathematical models, process flow diagram

MODULE II MATERIAL & ENERGY BALANCES 10

Thermodynamics Law of conservation of mass, types of material balance products, electron balances, biomass yield, General Energy balance equations, Enthalpy calculations, Enthalpy changes in non-reactive processes, Types of heat reactions, problems

MODULE III UNSTEADY STATE MATERIAL AND ENERGY BALANCES 10

Material balance equation for CSTR, Energy balance equations, solving differential equations, solving mass balances, solving energy balances, problems.

MODULE IV FLUID FLOW AND MIXING 10

Classification of fluids, Reynolds number, Momentum transfer, Non – Newtonian fluids, Two-Parameter models, rheological properties of fermentation broths, mixing, power requirements for mixing, scale-up of mixing systems, role of shear in stirred fermentors, problems.

MODULE V HEAT& MASS TRANSFER 10

Equipments, mechanism of heat transfer, conduction, heat transfer between fluids, design equation for heat transfer systems, applications of design equations, problems, Mass transfer: Molecular diffusion, role of diffusion in bio-processing, film theory, convective mass transfer, oxygen uptake and transfer in cell cultures, kLa determination, problems

MODULE VI REACTOR ENGINEERING 10

Bioreactor configurations, practical considerations for bioreactor construction, monitoring and control of bioreactors, ideal reactor operations, batch operation of a mixed reactor, case studies of production process.

Total Hours –60

TEXT BOOKS:

- Bioprocess Engineering Principles by Pauline M. Doran, Academic Press, 2nd Edition, 1995.
- Bioprocess Engineering - Basic concepts by M. L. Schuler & F. Kargi, Entice Hall. 1st Edition, 1992

REFERENCES:

Fermentation & Biochemical Engineering Hand Book (1983), Principles, Process

OUTCOMES:

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

- Understand the basic role of engineering in bio-processing applications
- Obtain a basic understanding of how cells work and become familiar with theenvironmental conditions (i.e. nutrients, pH, etc.) required for applications ofbiological components (cells or enzymes) to bio-processing systems
- Understand and model enzyme kinetics and apply the models for analysis of immobilized enzymatic bioreactors. • Utilize material balances to evaluate cell growth and substrate/product utilization in bioreactors.
- Design bioreactors to achieve desired results (i.e. specified cell concentration, production rates, etc.).
- Understand and apply scale-up methods for designing bioreactors.
- Become familiar with principles of recovery and purification techniques of bioprocesses.

BTC3214 BIOPROCESS LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

- Enables the student to develop their skills in the field of enzyme isolation, its assay, enzyme kinetics and microbial fermentation.
- Develop their practical skills in enzyme isolation and purification.
- Evaluate enzyme kinetics
- Carry out enzyme immobilized reaction and microbial culture
- Develop practical skill in submerged and solid state fermentation

Experiments:

1. Isolation of proteolytic organism from soil sample
2. Glucose assay by DNS method
3. Evaluations of enzyme kinetic parameters
4. Enzyme activity calculation
5. Determination of optimum pH for enzyme
6. Determination of optimum temperature for an enzyme
7. Enzyme immobilized by alginate gel method
8. Hydrolysis of starch by immobilized method
9. Effect of substrate concentration on biomass yield
10. Solvent extraction techniques for product recovery

Total Hours – 15

TEXT BOOKS:

1. Lab Manual

OUTCOMES:

- At the end of the syllabus students will be able to understand the fundamentals of bioprocess techniques.
- Students will be familiar with techniques involved in downstream process.

BTC3213	**BIOINFORMATICS**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**3**

OBJECTIVES:

The course aims to provide the students with

- an experimental and computational knowledge to embrace a systems biology approach and
- experience authentic systems genetics research by designing and conducting independent research projects.
- Understanding of alingnment tools and techniques
- Phylogenetic analysis methods
- Predictive models and methids

MODULE I INTRODUCTION TO BIOINFORMATICS AND RESOURCES-I 7

History and Scope of Bioinformatics, Central Dogma-biological information, Biological Databases, Primary and Secondary, Nucleotide-Protein Sequence and Structure databases, Data- formats, Accession, Submission,Retrieval, NCBI Data Model, GenBank,PDB

MODULE II SEQUENCE ALIGNMENT AND DATABASE SEARCHING -II 8

Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements, Multiple Sequence Alignment: Progressive alignment methods, Motifs and patterns

MODULE III PHYLOGENETIC ANALYSIS 8

Elements of phylogenetic models, data analysis: Alignment, substitution model building, tree building and tree evaluation, building methods, searching for trees, hooting trees, Evaluating trees and data, phylogenetic software Some simple practical consideration

MODULE IV PREDICTIVE METHODS 8

Gene structure Genome-types,Gene Prediction tools, Genome

Browsers,Genome Annotation pipeline Codon Bias Detection, Protein identity based on composition, Propsearch, Physical properties based on sequences, secondary structure features prediction, Tertiary structure, homology modeling, ab initio methods threading

MODULE V ADVANCED BIOINFORMATICS-I 7

Drug Discovery overview, Computational Drug Designing- Structure Based, Protein target identification, Molecular Docking, Scoring, MD Simulations, Ligand Based, ligand databases, virtual HTS, Molecular Similarity, QSAR, Pharmacophore

MODULE VI ADVANCED BIOINFORMATICS-II 7

Machine Learning-Supervised vs Unsupervised, Genomics, Proteomics Analysis, Data Classification-Bioinformatics Pipelines, R, Python- Basics and Applications

Total Hours –45

TEXT BOOKS:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

REFERENCES:

Latest Research and Review articles

OUTCOMES:

At the end of the course students will be

- Familiar with principles used in modelling dynamic phenomena in cells and methods that are used to analyze computational models
- Able to understand basic research methods in bioinformatics
- Able to understand the data structure (databases) used in bioinformatics and interpret the information (especially: find genes; determine their functions), understand and be aware of current research and problems relating to the area of their research project, to be able to critically evaluate the literature and identify the most important body of work
- Aware of the range of technologies available to computer scientists in

bioinformatics

- Able to carry out data mining gene and protein expression patterns and modelling cellular interactions and processes.

BTC3215	BIOINFORMATICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To gain knowledge on bioinformatics internet resources and algorithms
- To understand the sequence of protein and nucleic acids
- To understand the structural prediction of protein primary secondary, tertiary and quaternary structures.
- To learn basics of Python language and to apply in bioinformatics problems

EXPERIMENTS :

1. Study of internet resources in Bioinformatics
2. Similarity search using BLAST
3. Similarity search using FASTA
4. Algorithm used in bioinformatics
5. Multiple sequence alignment
6. DNA Prediction Methods
7. Protein Prediction Methods
8. Phylogenetic analysis
9. Python basic syntax
10. Python programming

Total Hours –15

REFERENCES:

1. Laboratory Manual

OUTCOMES:

Students will get

- complete knowledge about sequence alignment,
- structure prediction,
- Phylogeny and algorithms and
- basic working knowledge of python language

SEMESTER VII

		L	T	P	C
BTC4101	**BIOREACTOR DESIGN AND ANALYSIS**	**4**	**0**	**0**	**4**

OBJECTIVES:

The course imparts

- advanced knowledge on bioreactor design for efficient utilization of the principles in bioprocess technology.
- To familiarize the Basic concepts of bioreactor design ,
- Bioreactor instrumentation and control,
- Methods and strategies for fermentation control,
- Modelling and simulation of fermentation processes and Plant and animal cell bioreactors.

MODULE I REACTION KINETICS 8

Definitions of rate constant, reaction order - Elementary and nonelementary reactions - Mechanisms and kinetics - Reactions with constant volume and variable volume-Conversion yield - Kinetics of chemical reactions - Elementary and non - elementary reactions, nth order kinetics - Rate equations with multiple rate constants, shifting - Order kinetics, interpretation of batch reactor data for simple and complex reactions, dependence of reaction rate on environmental conditions – Arrheniu’s equation

MODULE II IDEAL REACTORS 7

Introduction to ideal reactors - Performance equations for ideal reactors and non-isothermal reactors - Rate data analysis – Multiple reactors and multiple reactions -Polymerization reactions, enzymatic reactions, microbial growth and

MODULE III NON-IDEALITY IN REACTORS 7

RTD studies - Dispersion effects, models for non-ideal reactors – Non isothermal reactors - External diffusion effects on heterogeneous reactions Diffusion and reaction in porous catalysts.

MODULE IV BIOREACTOR 7

Definition of bioreactor, basic principles of bioreactor – Interaction of heat and mass transfer in the microbial processes – Classification of bioreactors and their configurations - Analysis of batch, continuous, fed batch and semicontinuous bioreactors, non-ideal effects, mechanical design of bioreactors and its components

MODULE V BIOREACTOR SCALE – UP 8

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

MODULE VI SIMULATION AND OPTIMIZATION OF BIOPROCESSES 8

Simulation techniques (Numerical Methods): Programs based on numerical methods like algebraic equations, Newton-Raphson method for algebraic convergence, interpolation, arbitrary function generation (FUN1, FUN2 subroutines). Programs based on solution of differential equations: Euler method for 1st and 2nd order integration, subroutines INT and INTI; Fourth order Runga – Kutta method: stability of numerical integration variable slip size method. Case studies, Numerical problems

Total Hours –45

TEXT BOOKS:

1. Levenspiel, O., Chemical Reaction Engineering, Wiley Easter Ltd, New York, 5th Edition, 1999
2. Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice Hall Pvt Ltd, 4th Edition, 2006

REFERENCES:

1.Smith, J.M., Van Ness, H.C., Abbott, M. M., Introduction to Chemical Engineering Thermodynamics , McGraw Hill, New York, 6th Edition, 2001

OUTCOMES:

At the end of the course students will be able to

- Design reactors with mass transfer between two ideally mixed fluid phases, for continuous, fed-batch, batch operation.
- Design reactors with mass transfer between an ideally mixed fluid phase and a fluid phase moving in ideal plugflow, for continuous, fed-batch, batch operation design reactors with mass transfer between two ideally mixed fluid phases and an ideal plugflow compartment with conversion, for continuous, fed-batch, batch operation.

BTC4102	FERMENTATION TECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To educate the students about microorganisms, development of media, and anaerobic digesters
- To make the students understand the fermentation process using these tools and its combination of bioprocess engineering

MODULE I PILOT PLANT FERMENTATION 10

Microbial fermentation, Mammalian cell culture system, Plant cell tissue and organ cultures.

MODULE II FERMENTATION DESIGN 11

Fermentation department, equipment and space requirements, the design of large fermenters (based on aeration), Statistical Methods for Fermentation Optimization.

MODULE III ENVIRONMENTAL CONCERNS ABOUT FERMENTATION 13

Environmental regulations and technology, laws and regulations, Technology (waste water), Waste water treatment strategy, Air (emissions of concerns), Selecting a Control Technology, Inorganics, and volatile Organic Compound Emission Control.

MODULE IV ANAEROBIC DIGESTERS 12

An overview of aerobic and anaerobic fermentation. Substrates, Products and Biogas, Operational Conditions, Types of anaerobic digesters. Bioreactor for

MODULE V PLANT CELL CULTRE 14

Biochemical Engineering of the Production of Plant – specific Secondary metabolites by Cell Suspension Cultures, Gas Concentration Effects on Secondary Metabolite Production by Plant Cell Cultures, Integrated Bioprocessing for Plant Cell Cultures and Large – Scale plant micro propagation.

Total Hours –60

TEXT BOOKS:

1. Fermentation and biochemical engineering handbook by Henry C. Ogal, 2nd edition, Noyes Publications.
2. Advances in Biochemical Engineering Biotechnology by T. Sceper and J.J Zhong; Springer Publication.
3. The Microbiology of anaerobic digesters by Michael H. Gerardi, A John Wiley & Sons, Inc., Publication, 2003.

OUTCOMES:

- This course will give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.
- This course is taught to give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.

BTC4103 NANO BIOTECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

The course aims at

- introducing the underlying principles and applications of the emerging field of nanotechnology and nanoscience intended for a multidisciplinary audience with a variety of backgrounds.
- Introduces tools and principles relevant at the nanoscale dimension and
- discusses current and future nanotechnology applications in engineering, materials, physics, chemistry, biology, electronics and energy.

MODULE I INTRODUCTION 10

Technological impact of nano-scale systems, Micro and nano-systems and technologies - Overview of nano-devices and techniques

MODULE II NANOSCALE MATERIALS 10

Strategies for nano architecture (top down and bottom up approaches) - Fabrication technologies and characterizations – Selfassembly systems, some aspects of nanofluidics- Surfactants, polymers, emulsions and colloids.

MODULE III INORGANIC NANOSCALE SYSTEMS FOR BIOSYSTEMS 10

Nano-structured materials, fullerenes - Properties and characteristics, carbon nanotubes - Characteristics and applications quantum dots and wires, gold nanoparticles and nanopores.

MODULE IV APPLICATIONS OF NANO-MOLECULES IN BIOSYSTEMS 10

Molecules of life - Proteins, lipids, RNA and DNA – Nanoscale elements for delivery of materials into cells, peptides coupled nanoparticles - DNA based artificial nanostructure proteins as components in nanodevices.

MODULE V APPLICATION OF NANO-BIOTECHNOLOGY IN DRUG DELIVERY 10

Nanoscale devices for drug discovery Micelles for drug delivery protein targeting - Small molecule - Protein interactions, microarray and genome chips.

MODULE VI NANOTECHNOLOGY FOR CANCER DIAGNOSIS 10

Nanobiosensors and nanobiochips, Nanomedicines, Drug targeting, Nanotechnology for cancer diagnosis and treatment – tumour targeted drug delivery system –nanotechnology for imaging and detection .Nanotechnology for cell destruction

Total Hours –60

TEXT BOOKS and REFERENCES:

1. Mick Wilson, KamaliKannangra, Geoff Smith., Nanotechnology, Oversees Press India Private Ltd, New Delhi, 2nd Edition, 2005.
2. Jain, K.K., Nanobiomolecular Diagnostics: Current Techniques and Application, Taylor and Fransis Publishers, New York, 1st Edition, 2006.
3. Kimball Nill., Glossary of Biotech and Nanobioterms, CRC Publisher, California, 4th Edition, 2005.

OUTCOMES:

At the end of the course students will be able to

- Use knowledge of nano science and mathematics to: Follow protocols, Conduct science or engineering procedures, Fabricate products, Make conclusions about results, Troubleshoot, Discover
- Function effectively in a laboratory environment using complex instrumentation machinery and protocols
- Independently seek out innovations in the rapidly changing field of nanotechnology
- Compile and analyze data and draw conclusions at the nano level.
- Design, implement and document experiments • Collaborate and communicate effectively in a high tech environment

BTC4104 FERMENTATION LABORATORY

L	T	P	C
0	0	3	1

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. The students will be able to
- Develop the skills of large scale production of secondary metabolites.
- Identify the growth factors
- Study the batch and continuous culture growth
- Evaluate the temperature effect on culture growth

LIST OF EXPERIMENTS:

1. Temperature effect on growth-estimation of energy of activation and Arrhenius constant for microorganisms. Batch, fed batch and continuous cultures a) Estimation of Monod parameters b) Pure and mixed cultures.
2. Production of secondary metabolite by plant cells in a photobioreactor. Production of secondary metabolites in synthetic and complex industrial media.
3. Production of wine by yeast.
4. Production of Aminoacid.
5. Screening of process variables single dimensional search, Plackett Burman design, design expert etc.
6. Study of rheology of fermentation broth and power determination.

Total Hours –15

REFERENCES:

Laboratory manual

OUTCOMES:

- On the completion of the above objectives student will be able to perform
- production and analysis fermented products.
- Screen for different products
- Design fermentation experiments

BTC4104	**BIOREACTOR DESIGN AND DRAWING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

- Develop the skills of designing and drawing various types of bioreactors with advanced features.
- Develop skill to establish fermentation experimnets
- Design bioreactors on miniature scale

LIST OF EXPERIMENTS:

1. Draw neat labelled diagram of simple stirred tank bioreactor.
2. Draw labelled sketch of sparged-stirred tank bioreactor
3. Tank reactor with Draft tube configuration
4. Sequencing batch reactor
5. Membrane Bioreactor
6. Design of Vascular Graft Bioreactors
7. Design of miniaturised bioreactor

Total Hours –15

REFERENCES:

Laboratory manual

OUTCOMES:

- On the completion of the above objectives student will be able to
- design various bioreactors and
- detail about the components such as sparger, agitator etc

PROGRAMME ELECTIVES

BTCX01	BIOPHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Students will learn the detailed structure of biomolecules.
- They will understand the importance of structures in the field of biotechnology.
- They will learn some techniques which help to elucidate the structures.

MODULE I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 7

Interaction of Biomolecules – Covalent and Ionic bond, co-ordinate-covalent bond, non-covalent bond, hydrophobic interaction, hydrogen bonds, water structure, examples of bonds present in biomolecules, stereochemistry, chirality and isomerism.

MODULE II CONFORMATION OF NUCLEIC ACIDS 8

Primary structure –Bases, sugars, phosphodiester bonds – Double helical structure, A, B and Z forms of DNA, properties of circular DNA – Topology – Polymorphism and flexibility of DNA, Structure of ribonucleic acids, Thermodynamics of DNA denaturation and Tm values.

MODULE III CONFORMATION OF PROTEINS 7

Conformation of the peptide bond – Secondary structures, – Ramachandran's plots, alpha-helices and factors stabilizing the alpha helix, beta turns, random coils, torsion angles, dihedral angles, hydration of proteins, Tertiary structure-types of interaction present in tertiary structure, hydropathy plots.

MODULE IV STRUCTURE DETERMINATION OF MACROMOLECLUES 9

Ultraviolet/Visible Absorption Spectroscopy, Applications of Absorption Spectroscopy, Fluorescence Spectroscopy, Applications of Fluorescence, Spectroscopic Techniques Using Plane-Polarized Light, CD of Biopolymers, Crystallization of biomacromolecules, X-ray diffraction by crystals, structure determination by NMR

MODULE V MEMBRANE BIOLOGY 7

Phospholipids-major class of membrane lipids, lipid bilayer-noncovalent and cooperative structures, liposome- its significance, molecular structure of membranes-fluid mosaic model, carbohydrate and proteins molecules associated with membrane, lipid movement in membranes, membrane channels and their motifs, hydrophobicity plots.

MODULE VI BIOCALORIMETRY 7

Thermodynamic parameters, activation energy of reactions, enthalpy, entropy, free enrgy, Isothermal titration calorimetry, changes in heat capacity by isothermal titration calorimetry, differential scanning calorimetry, equilibrium constant.

Total Hours –45

TEXT BOOKS:

1. Cantor, C.R. and Schimmel, P.R., Biophysical Chemistry, W.H Freeman and Company, Press, New York, 4th Edition, 1999.
2. Sheehan. D. Physical biochemistry, principles and Applications, Second Edition, 2006
3. Crieghton, T.E, Biophysical Chemistry, 1st Edition, 1994

OUTCOMES:

The students should be

- able to understand the chemistry of the structures of biomolecules.
- able to have the all basic information related to the biological structure.
- able to know about the detail structure elucidation by using the basic techniques.

BTCX02 INDUSTRIAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- This course helps the students to provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of biotechnology.
- To update students knowledge of new developments in biology of industrial relevance.
- To give students a broad understanding and experience of technological processes involved in biotechnological industries

MODULE I INTRODUCTION TO INDUSTRIAL BIOPROCESS 10

Overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology.Biotechnology and the developing world.

MODULE II METABOLIC STRATEGIES 10

General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis, Bioprocess/fermentation technology: Bioreactor, Scale-up, Media design, Technology for microbial, mammalian and plant cell culture, Downstream processing.

MODULE III PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 10

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenylalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.) Study of production processes for various classes of secondary metabolites.

MODULE IV ENZYME TECHNOLOGY&BIOPHARMACEUTICALS 10

Nature, Application, Genetic engineering & protein engineering, Immobilised enzymes and Technology of enzyme production, Introduction to genetic engineering, Antibiotics, Therapeutic proteins, Vaccines & monoclonal antibodies, Gene therapy.

MODULE V APPLICATIONS 10

Introduction, Fermentation, Food processing, Sweeteners, Food wastes, Rapid diagnostics, Public acceptance & safety, Plant biotechnology, Forestry, Biological control, Animal biotechnology, Diagnostics in agriculture, Bioremediation. IPR, Safety, Social, moral and ethical aspects of Biotechnology.

MODULE VI PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 10

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant and animal cell culture.

Total Hours – 60

TEXT BOOKS:

1. Presscott, Dunn, “Industrial Microbiology”, Agrobios (India), 5th Edition, 2004

REFERENCES:

1. Biochemistry by LubertStryer. W. H. Freeman & Company, NY, 3rd Edition, 2004
2. Biochemistry by Zubey. Wm. C. Brown publishers, 1st Edition 1998
3. Biotechnology, John E. Smith, 1st Edition, 2000
4. Bioprocess Engineering Principles, Pauline M. Doran, 5th Edition, 2009

OUTCOMES:

At the end of the course students will be able to acquire knowledge on

- The facts, concepts, principles and theories relevant to the broad area of Biotechnology.
- The professional and ethical responsibilities of the Biotechnologist.
- Current themes and/or insights, at/or informed by, the forefront of the Biotechnology Industry and its related disciplines.
- The techniques applicable to the area of Biotechnology.
- Processes which facilitate the critical evaluation of research, scholarship and methodologies within the area of Biotechnology.

BTCX03	BIO-ORGANIC CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The course aims to develop skills of Students in the area of Organic Chemistry and its applications in Biology.
- Introduce to enzymes and kinetics of enzymes
- Conepts related to dufferent enzyme models
- Introduce to protein folding problem

MODULE I Introduction to Bioorganic Chemistry 9

Overview of Bioorganic Chemistry- Historical Connection Between Organic and Biological Chemistry; Weak Interactions in Organic and Biological World; Proximity Effect in Organic Chemistry; Molecular Adaptation; Molecular Recognition; Chemistry of the Living Cells; Analogy Between Biochemical and Organic Reaction

MODULE II Bioorganic Chemistry of Amino Acids and Polypeptides 9

Chemistry of the Living Cells ;Analogy Between Organic Reactions and Biochemical ; Chemistry of the Peptide Bond ; Nonribosomal Peptide Bond Formation ; Asymmetric Synthesis of a-Amino Acids; Asymmetric Synthesis with Chiral Organometallic Catalysts; Transition State Analogs ; Antibodies as Enzymes ;Chemical Mutations; Molecular Recognition and Drug Design

MODULE III Enzyme Chemistry 9

Introduction to Catalysis ;Introduction to Enzymes; Multifunctional Catalysis and Simple Models; a-Chymotrypsin ; Other Hydrolytic Enzymes ; Stereoelectronic Control in Hydrolytic Reactions ; Immobilized Enzymes and Enzyme Technology ; Enzymes in Synthetic Organic Chemistry ; Enzyme-Analog-Built Polymers ; Design of Molecular Clefts

MODULE IV Enzyme Models 9

Host-Guest Complexation: Chemistry New Developments in Crown Ether Chemistry; Membrane Chemistry and Micelles; Polymers; Cyclodextrins; Enzyme Design Using Steroid Template; Remote Functionalization Reactions; Biomimetic Polyene Cyclizations

MODULE V Bioorganic Chemistry of Nucleic Acids 9

History, Sugars and bases; Conformation of sugar-phosphate backbone; hydrogen bonding by bases; the double helix; A, B, and Z double helices; Stability of Double Helix ; DNA intercalators; Chemical synthesis of DNA

MODULE VI Protein Folding 9

Fundamentals of cellular protein folding, mechanism of in vitro protein folding and unfolding, basics of protein misfolding and aggregation process, protein misfolding disorders, Basics of Molecular and chemical Chaperones, Molecular and chemical chaperone as potential therapeutic agents, Applications of molecular chaperones in cellular system.

Total Hours –45

TEXT BOOKS:

1. Structure and Mechanism In Protein Science: A Guide To Enzyme Catalysis and Protein Folding; A. R. Fersht, W.H. Freeman, 1999.
2. Bioorganic Chemistry; H. Dugas, Springer Verlag, 1999.

OUTCOMES:

At the end of this course students will be able to

- Understand enzyme actions
- Understand enzyme kinetics
- Understand the mechanisms of protein folding

BTCX04 MOLECULAR PATHOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

Students shall know about

- introduction to cellular and molecular basis of diseases
- molecular biology and genetics of disease and human genome and techniques
- principle of molecular pathology
- molecular basis of human diseases
- molecular therapeutics

MODULE I INTRODUCTION TO MOLECULAR BASIS OF DISEASE 9

Mechanisms of cell death, apoptosis, necrosis, pathways to apoptosis, acute and chronic inflammation, infection and host response, neoplasia

MODULE II MOLECULAR BIOLOGY AND GENETICS 9

Structure and organization of human genome, human genome project, genetic diseases, gene expression profiling- microarray, SAGE, RNA-seq, genetics of Acute myeloid leukemia and cystic fibrosis

MODULE III PRINCIPLES OF MOLECULAR PATHOLOGY 8

History of approaches to disease, current practice and future prospect, role of computer in disease diagnosis, pathogenesis of Hepatitis C, HIV, Dengue

MODULE IV MOLECULAR BASIS OF HUMAN DISEASES 12

Cardiovascular diseases-atherosclerosis, ischemic heart diseases, cardiomyopathies; Cancer-genetic basis, major types, pathology of breast and colon cancer, leukemia; diseases of immune system- types, pulmonary diseases-Asthma, COPD, diseases of gastrointestinal tract, neuropathological disorders-ALS, Alzheimers, Huntington’s

MODULE V MOLECULAR THERAPEUTICS 7

Pharmacogenetics, SNPs, cytochrome P450 system, High throughput, screening techniques, Gene therapy- emphasis to CRISPR-Cas system, Immunotherapy, recombinant drugs, embryonic stem cells

Total Hours –45

TEXT BOOKS:

Coleman and Tsongalis (Eds.). Essential Concepts in Molecular Pathology. Elsevier, 3rd Edition, 2010

REFERENCES:

Related research papers

OUTCOMES:

Students shall be able to

- Understand basic cellular and molecular processes in cell that cause disease
- Learn structure of human genome, expression techniques and diseases with gene mutation
- Understand principle of molecular pathology and infectious disease
- Learn fundamentals of different types of diseases
- Understand different types of molecular therapeutics

BTCX05 **FOOD BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to

- Provide a programme of education which can enable its graduates to enter a career in the food industry as technologists capable of ensuring the production and marketing of safe and quality foods.
- Provide a broadly based technological education whose graduates can also enter into employment in other sectors of the food chain, or related technical sectors, where they can apply their technological skills.
- Allow individuals to develop their capacity to undertake research into problems relating to the production and marketing of safe and quality foods.

MODULE I INTRODUCTION 8

History of Microorganisms in food, Historical Developments, Taxonomy, role and significance of microorganisms in foods. Intrinsic and Extrinsic Parameters of Foods that affect microbial growth, Microorganisms in fresh meats and poultry, processed meats, seafood's, fermented and fermented dairy products and miscellaneous food products, Starter cultures, cheeses, beer, wine and distilled spirits, SCP, medical foods, probiotics and health benefits of fermented milk and foods products.

MODULE II PRIMARY & SECONDARY FERMENTATION 8

Brewing malting, mashing, hops, primary & secondary fermentation: Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl. Beer, wine and distilled spirits.

MODULE III FOOD QUALITY PARAMETERS 8

Emerging processing and preservation technologies for milk and dairy product, Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms,Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods

MODULE IV FOOD PRESERVATION 7

Food Preservation Using Irradiation, Characteristics of Radiations of Interest, in

Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Processing of Foods for Irradiation, Application of Radiation, Radappertization, Radicidation, and Radurization of Foods Legal Status of Food Irradiation, Effect of Irradiation of Food constituents

MODULE V STORAGE 7

Stability Food Preservation with Low Temperatures, Food Preservation with HighTemperatures, Preservation of Foods by Drying, Indicator and Food-borne Pathogens, Other Proven and Suspected Food-borne Pathogens.

MODULE VI FOOD QUALITY AND CONTROL 7

Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination.

Total Hours – 45

TEXT BOOKS:

1. Modern Food Micro-Biology by James M. Jay, (2000), 6th edition, An Aspen Publication, Maryland, USA.
2. Food Microbiology: Fundamentals and frontiers by M.P. Doyle, L.R. Beuchat and Thoma J. Montville, (2001), 2nd edition, ASM press, USA.
3. Food Science and Food Biotechnology by G.F.G. Lopez & G.V.B. Canovas (2003), CRCPress, Florida, USA

OUTCOMES:

At the end of the course students will be able to

- Integrate the scientific disciplines relevant to food
- Apply and communicate technological knowledge to meet the needs of industry and the consumer for the production and marketing of safe and quality foods.

BTCX06 CANCER BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

This course will cover

- the origins of cancer and the genetic and cellular basis for cancer.
- It will examine the factors that have been implicated in triggering cancers;
- the intercellular interactions involved in cancer proliferation;
- current treatments for cancer and how these are designed;
- and future research and treatment directions for cancer therapy.

MODULE I FUNDAMENTALS OF CANCER BIOLOGY 8

The six hallmarks of cancer, characteristic properties of cancers and cancer cells, benign tumors, classification of cancers, causes of cancer, regulation of cell cycle, cyclin dependent protein kinase, cell cycle check points, mutations, DNA damage and DNA repair.

MODULE II TUMOR MICROENVIRONMENT 8

Physiological parameters- hypoxia, gene expression and metastatsis, Malignant cells-aberrant DNA methylation, vascular and stroma, immune mediated cells, extracellular matrix, secreted ptoteins.

MODULE III CANCER GENETICS 7

Cancer genes, Oncogenes-retroviral oncogenes, approaches to the identification of human oncogenes, Tumor suppressor genes in hereditary cancers, TP53 as a different kind of tumor suppressor, cancer epigenetics.

MODULE IV CANCER SIGNALING 7

Cancergene pathways, individual biochemical reactions, multistep pathways and network, signal from cell surface: protein tyrosine kinase, the ras pathways, The PI3K/AKT pathways, The WNT/APC pathways, TGF-Beta/SMAD signaling.

MODULE V TUMOR IMMUNOLOGY 8

Historical perspectives, Tumor Antigen, Mechanism to immune response to cancer, role of gene rearrangement in tumor response, Heat shock protein as the regulator for immune response, Inflammation and cancer, Immunotherapy, Adoptive immunotherapy.

MODULE VI CANCER DIAGNOSTIC 7

Categories of Tumor markers, Nucleic Acid based marker, Gene expression microarrays in breast cancer, lung cancer and colorectal cancer, Proteomics methods for cancer detection, molecular imaging, importance of Pharmacogenomics in Cancer.

Total Hours – 45

TEXT BOOKS:

1. Dimmock, N., Keith., Introduction to Modern Virology, Blackwell Scientific Publications, Oxford, 6th Edition,2007

REFERENCES:

1. Maly, B.W.J., Virology a Practical Approach, IRL Press, Oxford, 2nd Edition, 1995

OUTCOMES:

At the end of the course students will be able to

- Explain how scientists Hippocrates and Galen coined the terms cancer and oncology.
- Describe how surgeon John Hunter and microscopic researcher Rudolf Virchow connected their observations to the pathology and treatment of cancer.
- List the common theories used to describe the cause of cancer.
- Overview the impact that the discovery of DNA by scientists Watson and Crick had on the cancer ommunity.
- Discuss the finding of Nobel Prize winner Peyton Rous, that certain viruses can cause cancer.
- Differentiate between carcinoma, sarcoma, leukemia, and lymphoma and how these terms are used to name cancer types.
- Summarize why it is important to understand basic biology in the study of cancer.
- Name the six hallmarks of cancer.
- Outline how cancer starts and how it spreads.
- Identify common causes of cancer.

BTCX07	TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

Students shall know about

- Basic concept of types of tissues, cell migration and therapeutic importance of tissue engineering
- Different aspects of cell culture and 3 dimensional cell culture
- Importance of growth factors, hormones and signalling method
- Scaffold synthesis and its application in tissue engineering
- Case studies and regulatory issues

MODULE I INTRODUCTION 9

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

MODULE II CELL-CELL COMMUNICATION and IN VITRO CULTURE 9

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization,3-D cell culture, Bioreactors.

MODULE III MOLECULAR BIOLOGY ASPECTS 9

Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

MODULE IV SCAFFOLD AND TRANSPLANT- SYNTHESIS and APPLICATION 9

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells: introduction, hematopoiesis.

MODULE V CASE STUDY AND REGULATORY ISSUES 9

Case study of multiple approaches: cell transplantation for liver, cardiovascular, neural, fetal tissue engineering and artificial womb, prosthetics. Ethical, FDA and regulatory issues of tissue engineering.

Total Hours –45

TEXT BOOKS:

1. Lanza, Langer and Vacanti(eds). Principles of Tissue engineering. Academic Press, 2nd Edition 1999
2. Minoth, Strehl, Schumacher. Introduction to Tissue engineering. Wiley VCH., 3rd Edition, 2005

REFERENCES:

related research papers

OUTCOMES:

Students shall be able to

- understand fundamentals of tissue engineering
- understand cell-cell communication and cell culture techniques
- understand how cell signaling molecules help in cell proliferation
- understand and apply the knowledge of scaffold synthesis and tissue engineering application
- apply to concept to different tissue engineering applications and will know the ethical and regulatory issue

BTCX08 DEVELOPMENTAL BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide insight on the history, formulation of theories and the processes associated with embryonic development in humans.
- To enlighten on the molecular intricacies of the organ formation.
- To highlight the types, significance, advantages and disadvantages of model organisms.
- To introduce the different molecular techniques employed to decipher the molecules/ process/ signalling mechanism of developmental processes.
- To provide an understanding of post embryonic development and its need.
- To impart the application of developmental biology in other fields of life science.

MODULE I BASIC CONCEPTS IN DEVELOPMENTAL BIOLOGY AND STAGES OF DEVELOPMENT 8

Theories in Developmental Biology, Stages of development, Gametogenesis, Egg types, Cell division or cleavage- types, purpose, laws,regulation. Cell specification and determination, Different types of cell specification (autonomous and conditional) - organiser, morphogen, gradient theory. Gastrulation- different modes, molecular mechanism and process.

MODULE II ORGANOGENESIS: NEURULATION, SOMITOGENESIS, LIMB DEVELOPMENT, HEART FORMATION 8

Neurulation- different stages, Hensen's node, primitive streak, Neural crest, neural tube, notochord, Molecular mechanism, Neuronal cell proliferation- vertical and horizontal, neuronal birthday. Somitogenesis- Stages, Molecular mechanism- clock and wave model of somite formation, Hox genes (master genes) Limb formation- Stages, Molecular details- specification and coordination of different axes. Heart formation- Heart field, Heart tube formation , cardiac looping and chamber heart formation , left and right specification.

MODULE III MODEL ORGANISM IN DEVELOPMENTAL BIOLOGY 8

Ideal characteristics of model organisms, Genetic and Non genetic model organism, Genetic model- Bacteria, Fungi, Slime mold, Nematode, Fruit fly, Mice.

Non Genetic Model- Chick, Frog, Rat. Life cycle, Applications, advantages and disadvantages of model organisms. Importance of unicellular organisms, Drosophila a genetic work horse- segmentation genes, C.elegans-cell number constancy (defined number of cells), Dictyostelium- unicellular and multicellular, Mice-Mammalian model.

MODULE IV MOLCEULAR TECHNIQUES TO DECIPHER DEVELOPMENTAL PROGRAM 8

Forward genetics- approaches- chemical, physical and genetic- genetic screens(random mutant library)-REMI- Random mutagenesis, Reverse Genetics- Knock out, homologous recombination, traditional and conditional knock out. Knock in, Gene Silencing/knock downv- importance and different strategies- RNAi , RNA morpholino. Advantages and disadvantages. Differential Screening-Transcriptomics and Proteomics Approaches

MODULE V POST EMBRYONIC DEVELOPMENT 7

Different types of post embryonic development- Growth, Metamorphosis, aging and regeneration. Growth- different modes-hyperplasia, hypertrophy and accretion-regulation by hormones, Metamorphosis- types of metamorphosis, universal set of events.Amphibian and insect -stages and molecular details , Regeneration- 4 Types with example, Aging- Mechanisms.

MODULE VI DEVELOPMENTAL BIOLOGY IN MEDICINE, ECOLOGY AND EVOLUTION 6

Birth defects, teratogens- types and examples, endocrine disruptors, Environmental effects on development- polyphenism- different phenotypes, Evolutionary- Modules of development, Molecular parsimony, tool kit genes, heterochrony, heterotrophy, heterometry, heterotyphy.

Total Hours – 45

TEXT BOOKS:

1. Scott Gilbert and Micheal JF Barresi, Developmental Biology, 11th edition., 2003
2. Jonathan Slack, Essentials of Developmental Biology, 3rd Edition., 2001

REFERENCES:

1. Lewis Wolpert, Principles of development, 4th Edition.

OUTCOMES:

- To design simple experiments and interpret concepts of embryonic development.
- To appreciate and describe the signaling orchestra involved in organogenesis
- To make the right choice of model organism for a problem related to development.
- To strategize a molecular method to tweeze the intricacies of signalling in development.
- To predict the impact of exogenous factors on the development of an organism.
- To apply the concepts of development in the field of medicine, evolution, ecology and systems biology.

BTCX09	BIOSEPARATION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To understand the process and challenges involved in the

- recovery, of biological products on a large scale.
- isolation, of biological products on a large scale.
- purification of biological products on a large scale.
- polishing of biological products on a large scale.

MODULE I Introduction to Bioseparation 7

Definition, Role of bioseparation in Bioprocess technology, challenges in bioseparation, Ideal bioseparation process

MODULE II Removal of solids 8

Principle and types of Filtration, Large scale filtration system, Large scale microfiltration, Large scale centrifugation, Sedimentation centrifugation, Decanter Centrifuges, Disc Stack Centrifuges, Hydrocyclones, Filter Centrifuges, Ultracentrifugation

MODULE III Volume reduction 8

Extraction, Soxhlet extraction, Maceration extraction, Ultrasound assisted extraction, Microwave assisted extraction, supercritical fluid extraction, Aqueous two-phase systems, precipitation, selective precipitation, affinity precipitation

MODULE IV Purification 7

Adsorption, Mixed mode expanded bed adsorption, adsorbents, Nano-based adsorbents, Chromatography, electrophoresis, crystallization

MODULE V Drying and Polishing 8

Drying biological materials,intermittent drying, pulse combustion drying, impinging stream drying, cyclic pressure vacuum drying, spray- freeze- drying, atmospheric freeze- drying, vacuum fluidized bed drying, low- pressure spray drying, superheated steam drying, heat pump drying, inert medium drying, supercritical fluid drying, sorption drying, spouted bed drying, jet spouted bed drying, vibrating fluidized bed drying, pulse fluidized bed drying, high electric field drying, and microwave drying, auxiliary process

MODULE VI Product based bioseparation 7

Desired purity level needed for the specific industrial product, Bioseparation in biopharma industry (Vaccines, Interferons, Interleukins, Monoclonal antibodies, hormones and other additional products)

Total Hours –45

TEXT BOOKS:

1. Industrial Bioseparations: Principles and Practice, Daniel Forciniti, Wiley, 1st Edition, 2008
2. Bioseparations Science and Engineering (2nd ed.), Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, 2008

REFERENCES:

1. Bioseparations Downstream Processing for Biotechnology-Paul A Belter and E L Cussler
2. Bioseparations Engineering: Principles, Practice, and Economics-Michael R Ladisch

OUTCOMES:

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

- apply different technologies involved in the reduction of bulk quantity after the large scale process in bioreactor and to remove specific impurities
- make rational decisions to achieve the product specifications and enrich target products

BTCX10	PROTEOMICS & GENOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

This course offers

- advanced level training on gene expression and gene therapy by covering topics such as genome mapping, proteomic techniques.
- To familiarize and expose the students to the Principle of gene expression,
- Concepts of functional genomics and proteomics in biopharmaceutical industry.

MODULE I OUTLINE ABOUT GENOME 5

Genome organization (prokaryotes and Eukaryotes) – Viral genomes, bacterial genomes, fungal genome, worm genome, plant genome and animal genomes. High capacity vectors- cosmid, Fosmid, PAC, P1 derived vectors, BAC, YAC

MODULE II FUNCTIONAL GENOMICS 8

Introduction, Northern blot, Subtractive hybridization, Differential Display reverse transcription PCR (DDRT-PCR), Serial Analysis Gene Expression (SAGE), microarray technology. DNA sequencing methods-chemical degradation, chain termination, next generation sequencing.

MODULE III PROTEOMICS AND THE PROTEOMES 8

Introduction - Traditional route of protein study, Protein isolation methods-extraction methods, protein separation technique. Branches of proteomics-quantitative proteomics, Characteristics of proteomics.

MODULE IV TOOLS OF PROTEOMICS 8

Two-dimensional gel electrophoresis of proteins- principle, 2D apparatus, sample preparation, first dimensional IEF, equilibration, second dimentional separation by SDS, image analysis, application of 2D PAGE. Mass spectrometry- protein sample preparation. Application of MS proteomics. Peptide Mass fingerprinting

MODULE V APPLICATION OF PROTEOMICS 8

Mining Proteomes, protein expression profiling, protein-protein interactions and protein complexes, Mapping protein modification, new direction in proteomics.

MODULE VI ADVANCE TOPICS 8

Metablome network, regulatory networks, methionine synthesis in *E.coli* , Protein-DNA Interactions, Gene Regulation-Lac operon.

Total Hours –45

REFERENCES:

1. Saccone, C., Pesole, G., Hand book of Comparative Genomics – Principlesand Methodology, John Wiley and Sons Publication, New Jersey, 1st Edition,2003.
2. Lesk, A.M., Introduction to Protein Science. Architecture, Function andGenomics, Oxford University press, New York, 2nd Edition, 2004.
3. Creighton, T.E., Protein Structure – A Practical Approach, Oxford UniversityPress, New York, 4th Edition, 2004.
4. Brown, T.A., Genomes III, Garland Science, Taylore and Francis Group, New York, 3rd edition, 2007.

OUTCOMES:

- Describe DNA sequencing technologies and recent advances for high throughput genomic sequencing.
- Compare and contrast different methods for functional genomic analysis.
- Provide examples of how genomics technologies have been applied to improve our understanding of biological systems.
- Compare and contrast classical approaches to understanding protein

BTCX11 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Biomedical applications of different transducers used.
- To introduce the student to the various sensing and measurement devices of electrical origin. To provide awareness of electrical safety of medical equipments
- To provide the latest ideas on devices of non-electrical devices.
- To bring out the important and modern methods of imaging techniques.
- To provide latest knowledge of medical assistance / techniques and therapeutic equipments.

MODULE I PHYSIOLOGY AND TRANSDUCERS 8

Cell and its structure – Resting and Action Potential – Nervous system: Functional organisation of the nervous system – Structure of nervous system, neurons - synapse –transmitters and neural communication – Cardiovascular system – respiratory system – Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers –Temperature measurements - Fibre optic temperature sensors.

MODULE II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 10

Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms. Electrical safety in medical environment: shock hazards – leakage currentInstruments for checking safety parameters of biomedical equipments.

MODULE III NON-ELECTRICAL PARAMETER MEASUREMENTS 10

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements.

MODULE IV MEDICAL IMAGING 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems.

MODULE V ASSISTING AND THERAPEUTIC EQUIPMENTS 8

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

Total Hours –45

TEXT BOOKS:

1. R.S. Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', IInd edition, Pearson Education, 2002 / PHI

OUTCOMES:

- The course will help the student to acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance.
- The students will be trained in radiology process
- They will be able to analyse the radiology data
- Will have latest idea of electrical devices

BTCX12	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims to provide the students with the

- Introduction to terms and concepts used in pharmaceuticals
- Concepts of drug metabolism
- Introduction to drug manufacturing process
- Regulation in drug development and manufacture

MODULE I INTRODUCTION OF BIOPHARMACEUTICALS 7

Development of drug and pharmaceutical industry – Therapeutic agents, their use and economics Regulatory aspects. current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals.

MODULE II DRUG METABOLISM AND PHARMACOKINETICS 7

Definition, rationales, absorption, distribution and metabolism pathway. Factors governing, LD50, LC50, ED50, absorption of drug, Pharmacokinetics and Pharmacodynamics, Dose response relationship, interspecies scaling, In vitro studies, In vivo studies. Route of Administration of Drugs, Angle of Injection of drug, Drug Toxicities, Animal Models in Biopharmaceutical Research

MODULE III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS 8

Bulk drug manufacturers - Type of reactions in bulk drug manufacture and processes - Special requirement for bulk drug manufacture.

MODULE IV MANUFACTURING PROCESSES & THEIR USE 8

Manufacturing Process for Tablets, Dry granulation process, Wet granulation process, Dose conversion from preclinical studies to clinical studies, Route of administration of drugs, angle of injections of drug, different phases of clinical trials of drugs.

MODULE V REGULATORY AGENCIES AND THEIR CONTROL 8

Role of Regulatory agencies in drug development, FDA guidelines for drug development, Patenting process in India, Possible therapeutic intervention against COVID-19, Scheduling process of Drugs, Amphetamines, Cannabinoids, Benzdizapines, CNS stimulant Drugs, Drug designing against apoptotic mediated diseases

MODULE VI DRUG MANUFACTURE AND MARKET SPECIFICATIONS 8

Principles of monoclonal antibodies production, design and development of ELISA kit. Monoclonal antibodies in diseases detection and treatment. Role of PCR in microbial, plant and animal cell/ virus detection. manufacture- solutions, suspensions and emulsions. Topical application of ointments, creams, suppositories. Solid dosage forms-powders, granules, capsules, coating of tablets, aerosols. Preservation, packing techniques. Indian pharmacopoeia, Guide to good manufacturing practice.

Total Hours – 45

TEXT BOOKS:

1. Curtis D. Klaassen, Casarett&Doull's Toxicology: The Basic Science of Poisons, 9th edition, 2004.

REFERENCES:

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, andPatent Issues, CRC Press, 2006.
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes intodrugs, 1stEdition, Wiley Liss, 2003.

OUTCOMES:

At the end of the course students will be able

- To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agents.
- To outline the drug manufacturing process including the role of quality control
- To quality assurance in protecting the public, workers, and the environment.
- To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical age

BTCX13	MEDICAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims to build on

- Understanding of proteins as therapeutic agents
- Preparation and use on monoclonal antibodies
- Understanding of human diseases
- Concepts of different types of vaccines
- Application of new technologies in healtcare settings

MODULE I SIMPLE PROTEINS AND THERAPEUTIC AGENTS 8

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins Engineering human interferons and human growth hormones Regulatory aspects of therapeutic proteins - Enzymes as therapeutic agents Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis.

MODULE II MONOCLONAL ANTIBODY AS THERAPEUTIC AGENT 8

Production of monoclonal antibodies Production of antibodies- Human monoclonal antibodies, its scope and limitations - Hybrid human – Mouse antibodies – in E.coli Approaches for producing HIV therapeutic agents.

MODULE III HUMAN DISEASES 8

Viral and bacterial diseases - Diseases caused by protozoan and parasitic worms (helminths) - Emerging infectious diseases – Active and passive immunity – Autoimmunity- Rational of immunization - Diseases controllable by vaccination – Vaccines, designing vaccines adjuvants - Whole organisms vaccines - Attenuated viruses and bacteria - Inactivation of pathogenic organisms by heat and chemical treatment

MODULE IV VACCINES 8

Bacterial polysaccharides, proteins and toxins as vaccines - Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS - Commercial and regulatory aspects of vaccine production and its distribution

MODULE V APPLICATION OF GENETIC ENGINEERING IN HEALTH CARE 8

Production of Recombinant Proteins having therapeutic and diagnostic applications, Recombinant vaccine.

MODULE VI DIAGNOSIS AND KIT DEVELOPMENT 8

Use of enzymes in clinical diagnosis - Use of biosensors for rapid clinical analysis - Diagnostic kit development for microanalysis

Total Hours –45

TEXT BOOKS:

1. Glick, B.R., Pasternak, J. J., Molecular Biotechnology, Principles and Application of Recombinant DNA, ASM press, Washington, 2nd Edition, 1998
2. Ratledge, C., Kristiansen, B., Basic Biotechnology, Cambridge University Press, USA, 2nd Edition, 2001.
3. David, E., Technology and Future of health care, Preparing for the Next 30 years, Jhon Wiley, Singapore, 2nd Edition, 2000.

OUTCOMES:

At the end of the course students will be able to

- Research, evaluate and critically assess the theoretical basis and practical application of selected medical biotechnologies
- Demonstrate knowledge and understanding of selected medical biotechnologies
- Describe in detail essential facts and theory in molecular biology and biotechnology when applied to medicine
- Describe and critically evaluate aspects of current research in the biosciences with refrence to reviews and research articles
- With limited guidance, deploy established techniques of analysis and enquiry within the biosciences.

BTCX14	DRUG DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get an overview of drug discovery process
- To obtain knowledge of various drug designing methods.
- To develop skill to understand the computation tools available for drug designing.
- To get familiarized with pre-clinical and clinical trial designs

MODULE I DRUG DISCOVERY AND DEVELOPMENT 8

Organized drug discovery and development – Target identification and validation strategies -Microbial, recombinant - Biochemical and molecular level screening systems and assay development - Alternative strategies in lead identification - Lead optimization.

MODULE II DRUG DESIGNING 8

Rational basis of drug designing, criteria for synthesizing drugs -Drug designing approaches - structure based drug design process - Receptor based design - Drug designing using known receptor structure - Drug design by receptor site fit, active site simulations using PDB structure data and homology modeling-Current research in drug designing , a case study

MODULE III COMPUTATION FOR DRUG DESIGNING 8

Overview of computer based tools for drug designing – Ligand Based drug design - Scoring and docking mode-QSAR principles and methods in drug designing - Pharmacophore based drug design. Similarity Principle-Molecular fingerprinting-Tanimoto coefficients- Current research in drug designing , a case study

MODULE IV MIMICKING IN DRUG DESIGNING 7

Rational design of enzyme inhibitors - Enzyme catalytic principles - Recapitulation affinity labels - Illustrative examples - Principle of suicide inactivation – Design strategies - Scope and limitations. Principles and practice of transition state mimicry – Illustrative examples - HIV protease inhibitors – Collected substrate analog inhibitors and design strategies, illustrative examples

MODULE V PEPTIDE BASED DRUG DESIGNING 7

Synthetic peptide libraries –Advantage sand limitations-venome peptides-Peptide libraries through phage display - Applications in epitope and agretope mapping, synthetic vaccine design - Artificial combinatorial - Peptides, bezodiazepines and other current examples - Selection strategies and screening methodologies

MODULE VI DRUG DEVELOPMENT 7

Preclinical trials-Pharmacokinetics, pharmacodynamics, toxicity studies, mutagenic tests Clinical trial-Phases and significance-Trial design-randomized control studies-Non-randomized studies-factorial-Hybrid-advantage sand limitations-Role and remit of regulatory authorities-FDA-IND-NDA

Total Hours –45

TEXT BOOKS:

1. Gary Walsch, Biophramaceuticals: Biochemistry and Biotechnology, Wiley Publishers, 2003.
2. Burger's Medicinal Chemistry and Drug DiscoverySixth Edition, Volume 1: Drug Discovery Edited by Donald J. Abraham 3 Rational Design of Covalently Binding Enzyme ISBN 0-471-27090-3 O 2003 John Wiey& Sons, Inc
3. Computational methods in drug discovery, http://dx.doi.org/10.1124/pr.112.007336
4. PHARMACOLOGICAL REVIEWS Pharmacol Rev 66:334–395, January 2014
5. The Future of peptide based drugs, 2012 John Wiley & Sons A/S. doi: 10.1111/cbdd.12055

REFERENCES:

1. Drug Discovery Glossary, University of Oxford, 2016.
2. David C Young, Computational Drug Design: A guide for Computational and Medicinal Chemists, Wiley Publishers, 2009.

OUTCOMES:

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

- Obtain overview of drug design and development process and its nuances.
- Develop skills to use computational tools design strategy for drug designing processes.

BTCX15 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- This course is aimed at familiarizing researchers with the nuances of Intellectual Property Rights (IPR) so as to help them integrate the IPR process in their research activities.
- To make the students familiar with basics of IPR and their implications in Research, development and commercialization.

MODULE I WTO 8

As an international agency controlling trade among nations. WTO with reference to biotechnological affairs, TRIPs.

MODULE II GENERAL INTRODUCTION TO PATENT 8

Patent claims, the legal decision – making process, ownership of tangible and intellectual property. Basic Requirements of Patentability, Patentable subject matter, novelty and the public domain, non-obviousness

MODULE III SPECIAL ISSUES IN BIOTECHNOLOGY PATENTS 8

Disclosure requirements, Collaborative research, Competitive research, plant,Plant biotechnology Indian patents and Foreign patents, The strategy of protecting plants.

MODULE IV PATENT LITIGATION AND FARMER RIGHTS 8

Substatritive aspects of patent litigation, Procedural aspects of patent litigation. Farmer rights – PPVFR act – Role and regulations

MODULE V IPR ISSUES IN INDIAN CONTEXT 7

Role of patent in pharmaceutical industry, computer related innovations, microbiological and biotechnological products

MODULE VI IPR RELATED CRITICISMS 6

Criticisms of Intellectual Property Rights, Politics of Intellectual Property Rights, Third World Criticisms, Marxist Criticisms

Total Hours – 45

TEXT BOOKS:

1. The law and strategy of Biotechnological patents by Sibley. Butterworthpublications.1st Edition, 1994
2. Intellectual property rights – Ganguli – Tat McGrawhill, 1st Edition, 2001
3. Intellectual property right – Wattal – Oxford Publishing House, 1st Edition, 1994

OUTCOMES:

At the end of the course students will be able to

- Communicate in depth knowledge on selected topics within the area ofbiotechnology
- Identify current technical problems within the area of biotechnology
- Describe the relationship between patenting and scientific discovery
- Describe the patenting process and how it relates to the international patentauthorities and organizations.
- Understand patents as strategic tools in business development
- Understand how intellectual property rights relates to and handles geneticsequences and other biological material

BTCX16 RECOMBINANT DNA TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To establish an understanding of DNA manipulation strategies
- To establish an appreciation of the advantages and disadvantages of novel
- methods for DNA purification, sequencing and mutagenesis
- To be aware of ethical issues associated with DNA engineering and cloning

MODULE I TOOLS OF GENETIC ENGINEERING 7

Cloning vehicles, Restriction enzymes, Modifying enzymes, DNA ligase,Polymeraseetc, Cloning Vectors: Plasmids, Lambda phage, Phagemids, Cosmids, Artificial chromosomes (BACs, YACs), Shuttle vectors, and virus based vector

MODULE II METHODS OF GENE TRANSFER 7

Transformation, transduction, Particle gun, Electroporation, liposome mediated, microinjection, Agrobacterium mediated gene transfer, Preparation and application of molecular probes: DNA probes, RNA probes, Radioactive labeling, Non radioactive labeling, use of molecular probes, DNA fingerprinting

MODULE III ANALYSIS AND EXPRESSION OF CLONED GENE IN HOST CELLS 8

Expression vectors, Restriction enzyme analysis, Southern blotting, Northern blotting, Western blotting, In-situ hybridization. Colony and plaque hybridization, Factors affecting expression of cloned genes, Reporter genes, Fusion proteins

MODULE IV GENE LIBRARIES 8

cDNA synthesis, Genomic DNA libraries, Amplification of gene libraries, Identifying the products of cDNA clones, Isolation, Sequencing and synthesis of gene: Different methods of gene isolation,Techniques of DNA sequencing, Artificial DNA synthesis.

MODULE V MODIFYING GENES 7

Site-directed mutagenesis, Insertion & Deletion Mutagenesis, Polymerase, Chain reaction (PCR): Basic principles, modifications, applications.

MODULE VI APPLICATION OF RDNA TECHNOLOGY 8

Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

Total Hours –45

TEXT BOOKS:

1. From Genes to Clones by Winnacker. PANIMA
2. Molecular Biotechnology by Pasternack and Glick
3. From Genes to Genomes: Concepts & Applications of DNA Technology by J.W. Dale & M.V. Schartz
4. Gene Cloning & DNA Analysis: An Introduction (4th edition) by T.A. Brown.

REFERENCES:

1. Molecular Cloning by Sambrook, et al, 4th edition, 2014
2. Principles of Gene Cloning by Old and Primrose, 7th Edition, 2007

OUTCOMES:

- Define recombinant DNA technology and explain how it is used to clone genes
- Compare and contrast different types of vectors and describe practical features of vectors and their applications in molecular biology.
- Discuss how DNA libraries are created and screened to clone a gene of interest.
- Be familiar with RNA interference (RNAi) as a powerful new technique for silencing gene expression
- Understand potential scientific and medical consequences of the Human Genome Project, and discuss its ethical, legal, and social issues

BTCX17	MATERIAL SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce concepts of materials, surface and tissue placement in biomaterial functions
- To understand diverse elements controlling biological responses to materials
- To provide contemporary biomaterial principles

MODULE I INTRODUCTION

Fundamentals of biomaterials science. Concept of biocompatibility. Classes of biomaterials used in medicine, basic properties, medical requirements and clinical significance. Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.

MODULE II METALLIC IMPLANT MATERIALS

Metallic implant materials: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vascular implants, Heart valve implants-Tailor made composite in medium.

MODULE III POLYMERIC IMPLANT MATERIALS

Polymeric implant materials: Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers).Viscoelastic behavior: Importance of molecular structure, hydrophilic and hydrophobic surface properties.

MODULE IV CERAMIC IMPLANT MATERIALS

Ceramic implant materials: Definition of bio ceramics. Common types of bioceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).

Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

MODULE V STERILIZATION OF BIOMATERIALS

Sterilization techniques: – process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization.

MODULE VI TOXICOLOGICAL SCREENING OF BIOMATERIALS

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situimplantation, tissue culture,haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

Total Hours –45

TEXT BOOKS:

1. J.H.U.Brown (Ed), Advances in Bio Medical Engineering, Academic Press 1975.
2. Andrew F.VonRacum, Hand Book of Bio Medical Evaluation, Mc-Millan Publishers, 1980.
3. Jacob Cline, Hand Book of Bio Medical Engineering, Academic Press in Sandiego, 1988.
4. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.
5. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering, 2005.
6. Buddy D.Ratner,Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine,2nd Edition, Elsevier Academic Press,San Diego,2004.

REFERENCES:

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.

OUTCOMES:

- Widen rational design approaches to biomaterials engineering Identify significant gap required to overcome challenges and further development
- Develop critical analyses of biomaterials through proposal writing and review.

BTCX18	MOLECULAR AND CELLULAR DIAGNOSTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Developing the basic concept of molecular diagnostics
- Understand the techniques involving identification of microorganism
- Understand the techniques of clinical genetics
- Understand immunological diagnostic technique
- understand biosensors activity

MODULE I INTRODUCTION TO MOLECULAR DIAGNOSTICS 8

Collection, preservation and storage of clinical samples, biopsy, Principles, and application of Biological assays used in diagnostics- PCR, ELISA, FISH, Flow cytometry, gene sequencing, microarrays, protein arrays. GLP, SOP and ethics in molecular diagnostics.

MODULE II DETECTION AND IDENTIFICATION OF MICROORGANISMS 12

Specimen Collection, Sample Preparation, Quality Control, Bacterial Targets of Molecular-Based Tests, Molecular Detection of Bacteria, Detection of Respiratory Tract Pathogens, Molecular Testing for Urogenital Tract Pathogens, Mechanism and Molecular Detection of Resistance, Molecular Strain Typing Methods for Epidemiological Studies, Viruses- Human Papillomavirus, HIV-1, Hepatitis C, Dengue, Viral Load Determination

MODULE III CLINICAL GENETICS 9

Overview of Molecular Genetics, Nucleic Acid Amplification, Molecular Detection of Inherited Diseases, Molecular Oncology, Analysis of Human Splicing Defects, Detection of Genomic Duplications and Deletions, Molecular Techniques for DNA Methylation Studies, DNA Microarrays and Genetic Testing, Genetic Counseling, Preimplantation Genetic Diagnosis

MODULE IV IMMUNODIAGNOSTICS 8

Introduction to immunodiagnostics, antigen-antibody reactions, antibody production, antibody markers, CD markers, FACS, Human Leukocyte Antigen (HLA) typing, agglutination (ABO/ Bacterial), immunoprecipitation, immunodiffusion

MODULE V BIOSENSORS 8

Concepts and applications, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, Introduction to Nanotechnology.

Total Hours 45

TEXT BOOKS:

1. George P. Patrinos and Wilhelm J. Ansorge (ed.)(2010) Molecular Diagnostics Second Edition, Academic Press
2. Lela Buckingham and Maribeth L. Flaws (2007) Molecular Diagnostics. Fundamentals, Methods, & Clinical Applications. F A Davis Company

OUTCOMES:

- Learners will be able to define function, ethics and basic technique used in molecular diagnostic lab
- Students will be able to understand different molecular techniques used to identify microbial pathogens
- Students will learn different molecular biology techniques to identify nucleic acid polymorphisms
- Students will learn different immunological techniques used in molecular diagnostic lab to identify diseases
- Students will be able to understand concept of biosensor and its application in diagnostics

BTCX19	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the application of biomedical instrumentation
- To introduce the student to the various devices of electrical origin and non electrical origin.
- To provide awareness of electrical safety of medical equipments.
- To know the important and modern methods of imaging techniques.

MODULE I FUNDAMENTALS OF MEDICAL INSTRUMENTATION 9

Role of technology in medicine, landmark developments in biomedical instrumentation, physiological systems of the body, sources of biomedical signals, basic medical instrumentation system, performance requirements of medical instrumentation systems, intelligent medical instrumentation systems, consumer and portable medical equipment, implantable medical devices, Basic components of a biomedical system, Transducers, Piezoelectric, ultrasonic transducers, Temperature measurements, Fibre optic temperature sensors. Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers Isolation amplifier.

MODULE II THERAPEUTIC EQUIPMENTS AND PATIENT SAFETY 9

Audiometers and Hearing Aids, Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart – Lung machine, Dialysers, Lithotripsy, electric shock hazards, leakage currents, safety codes for electromedical equipment, electrical safety analyzer, testing of biomedical equipment.

MODULE III BIOMEDICAL RECORDER 9

Measurement of blood pressure, Heart rate, Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analysers : pH of blood measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements, Electrocardiograph, vectorcardiograph (VCG) , phonocardiograph (PCG),digital stethoscope, electroencephalograph (EEG), electromyography, other biomedical recorders, biofeedback instrumentation.

MODULE IV CLINICAL INSTRUMENTS AND PATIENT MONITORING SYSTEMS 9

Medical diagnosis with chemical tests, spectrophotometry, spectrophotometer type instruments, colorimeters, spectrophotometers, clinical flame photometers, selective-ion electrodes based electrolytes analyser, automated biochemical analysis systems, Radio graphic and fluoroscopic techniques, Computer tomography, MRI, Ultrasonography, X-ray Machines and Digital Radiography, Blood cell counter.

MODULE V BIOELECTRIC SIGNALS AND ELECTRODES 9

Origin of bioelectric signals, recording electrodes, silver-silver chloride electrodes, Electrodes, Limb electrodes, floating electrodes, pregelled disposable electrodes, electrodes for ECG, electrodes for EEG, electrodes for EMG, electrical conductivity of electrode jellies and creams, microelectrodes, Micro, needle and surface electrodes, Typical waveforms, Electrical safety in medical environment: shock hazards, leakage current-Instruments for checking safety parameters.

Total Hours –45

REFERENCES:

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', McGraw Hill Publishing Co Ltd. 2003
2. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
3. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
4. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
5. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India)

OUTCOMES:

After the completion of the course

- understand the importance of laboratory safety and standard operating procedures of common laboratory equipment's used in medical sciences
- theoretically trained to with working knowledge of different instruments and be able design experiments
- understand the importance of measurement of blood pressure, ECG and other instruments used as biomedical recorder
- analyze and estimate biomolecules in normal and diseased conditions
- Learn the importance and gain working knowledge of medical test and instruments used in patient monitoring systems
- Understand the principle and working of therapeutic instruments such as hearing aids, vision aids etc and learn about patient safety protocols.

BTCX20	**BIOSAFETY AND BIOETHICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

The aim of this course is to teach

- biosafety issues, biosafety and biotechnological applications,
- biosafety in laboratory, waste management, registration,
- national and international regulations, bio-ethical issues in medicine,
- environment and genetics, related regulations and laws.

MODULE I BIOSAFETY 7

Introduction to biosafety, biocontaminants, biosecurity and major components, biosafety requirements, bisafety issues, bisafety levels (BSL)-I, II,III, IV, animal biosafety levels (ABSL)-I, II,III, IV, bisafety cabinets and types, types of filters, Safe use of BSC in lab, Biohazards

MODULE II BIOETHICS 8

Introduction of ethics, bioethics, different ethical issues, stem cell technology, its uses and controversies, Biosecurity, Bioterrorism, Biodefense, gene drives, biopiracy, CRISPR, ethical guidelines for biomedical research in human, guidelines for management of cancer, diabetes, retinoblastoma, guidelines for research in transplantation.

MODULE III GENETICALLY MODIFIED ORGANISM 9

Introductions of GMOs, history, advantages and disadvantages, genetic engineering vs traditional breeding, GMO regulation, risk factors, Biosafety : Indian status, traits of GMO, biosafety guidelines in india, GMO uses in food and medicine, Status of GMO today.

MODULE IV HUMAN CLONING 8

Methods of animal cloning, adverse effects and concerns, human cloning, procedure, why human cloning, ethical implications of human cloning, pros and cons of human cloning, future prospect, why no reproductive cloning in humans, legal issues: UK, UN, US, India.

MODULE V ETHICAL REVIEW AND GUIDELINES 6

Specific principles for clinical evaluation of Drugs, devices, diagnostics, vaccines, herbal remedies. specific principles for human genetics and genomic research: pedigree studies, genetic engineering, therapeutic trials including gene therapy.

MODULE VI LABORATORY ASSOCIATED INFECTION AND BIOSAFETY 7

Survey of lab associated infection with various agents, disease transmission and infection, biosafety in microbiology lab, management of laboratory accident,laboratory hazard: chemical, accidental, fire, electrical, noise. Safety organisation and training programs, biotech patenting in india and key issues.

Total Hours – 45

TEXT BOOKS:

1. Legal Perspectives on Bioethics by Ana S Iltis&Sandra H Johnson&Barbara A Hinze, 1st Edition 2007
2. Genetically Modified Microorganisms Han, Lei, 1st Edition, 2004

OUTCOMES:

On the completion of course student will be able to know:

- the importance of safety related to biological hazards and how to handle that.
- the ethics related to every field nowadays.
- the good lab practices and the recent status of GMO and human cloning worldwide.

BTCX21 HEALTHCARE BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES
:

- This course will enable students to acquire knowledge on the fundamentals of healthcare biotechnology. It enables them to understand emerging and advanced concept in molecular pathogenesis of disease and role of biotechnology in diagnosis, prevention and therapeutics.
- This programme will facilitate the students to acquire knowledge in fields various aspects and molecular tools used in clinical application in alleviation of human disease.
- It will also empower the students to have advanced focus on the molecular basis of diseases and development of advanced therapeutics.

MODULE I Introduction and Therapeutic Biomolecules 7

Molecular basis of disease, Biotechnology in disease prevention, therapeutics and diagnosis, Personalized Medicine; Therapeutic Biomolecules: Introduction, Nucleic acid, protein, carbohydrate and lipids, Role of biomolecules in diseases.

MODULE II Molecular diagnostics and Immunological products 8

Molecular diagnostics: gene based diagnosis, tools for screening of infectious disease, genetic disease; Immunological products: Overview, Vaccines, Cancer immunotherapy, Monoclonal Antibodies in Solid Organ Transplantation Monoclonal Antibodies in Anti-inflammatory Therapy.

MODULE III Oligonucleotides and Oligosaccharides 8

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozyme; Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate based cancer Vaccines

MODULE IV Radiological Agents and Cardiovascular Drugs and endocrine drugs 8

Radiological Agents: Radiosensitizers and Radioprotective agents; Cardiovascular Drugs and endocrine drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, antithrombotics and Haemostatics, Sex hormones and analogs.

MODULE V Chemotherapeutic Agents 8

Chemotherapeutic Agents: Synthetic antibacterial agents, antifungal, anti protozoal, Antihelminithic agents Antiamoebic agents, Antiviral agents

MODULE VI Drug Targeting 6

Drug Targeting: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery.

Total Hours –45

REFERENCES:

1. Pharmaceutical Chemistry by Christine M. Bladon. John Wiley & Sons, Ltd.(2002).
2. Burger’s Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E.Wolff. A Wiley (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. Wiley-VCH. (2002).
4. Medical Biotechnology, by JuditPongracz, Dr. Habil and Mary Keen. Churchill Livingstone (2008).
5. Healthcare Biotechnology: A Practical Guide 1st Edition by Dimitris Dogramatzis. CRC Press (2010)
6. Biotechnology in Healthcare: An Introduction to Biopharmaceuticals. Gavin Brooks,Pharmaceutical Press, (1998)
7. Biotechnology in Medical Sciences,ByFirdosAlam Khan, CRC press, Taylor and Francis, (2014)

OUTCOMES:

The students will be able

- To understand therapeutic biomolecules and their applications
- To get knowledge of molecular diagnosticsknow the applications of oligonucleotides and oligosaccharides

BTCX22 MOLECULAR FARMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce molecular pharming
- To create complete knowledge about the recombinant protein production.
- To create awareness about the production of pharmaceutical proteins in plants

MODULE I INTRODUCTION AND FOREIGN PROTEIN EXPRESSION 8

Introduction, foreign protein production systems -Plant tissue culture - Suspended cultures. Hairy root cultures, shoot teratoma cultures. Strategies for improving FP production in tissue culture. modifications to existing expression constructs. Secretion of foreign proteins - Foreign protein stability - Stability inside the cells

MODULE II NOVEL SPROUTING TECHNOLOGY FOR RECOMBINANT PROTEIN PRODUCTION 8

Biology of sprouting - Dicotyledonous seeds - Germination, sprout Rubisco synthesis, rubisco promoters- Inhibition of endogenous gene expression - Expression cassette design, sprouting- equipments, conditions - Sterilization, time and temperature, light, inhibition of endogenous gene expression, Growth regulators, nitrogen fertilizer - Seed production, quality and environmental aspects

MODULE III MONOCOT AND PLANT VIRAL EXPRESSION SYSTEMS 8

Technical aspects, cereal transformation, expression construct design - Prodigene and Maize. Recombinant proteins expressed in Rice - Recombinant proteins expressed in Wheat, Barley. Plant RNA viruses as expression vectors- TMV, PVX - Plant RNA viruses as expression vectors- CPMV, AIMV. Biological activity of target molecules. Efficacy of plant virus antigens. Vaccine antigens- particle based

MODULE IV CHLOROPLAST DERIVED ANTIBODIES, EDIBLE VACCINES 7

Introduction, expression of therapeutic and human proteins in plants.

Transgenic chloroplast system. Chloroplast derived human antibodies, biopharmaceuticals. Human Serum Albumin. Human insulin like growth factor-1, Human interferon, Antimicrobial peptides. Chloroplast derived vaccine antigens, *Cholera* toxin B subunit, *Bacillus anthracis* protective antigen. *Yersinia pestis* F1-V fusion antigen, Canine Parvovirus VP2 protein.

MODULE V DOWNSTREAM PROCESSING OF PLANT DERIVED RECOMBINANT THERAPEUTIC PROTEINS 7

Similarities and differences in the processing of pharmaceutical proteins from different sources Process scale. Individual steps of a Downstream process. Initial processing and extraction Chromatographic purification, Regulatory requirements for downstream processing of plant derived products. Regulatory requirements for downstream processing of plant derived products.

MODULE VI PRODUCT ISSUES 7

Biosafety aspects of molecular farming in plants; A top-down view of molecular farming from the pharmaceutical industry: requirements and expectations; The role of science and discourse in the application of the precautionary approach

Total Hours –45

TEXT BOOKS:

1.Molecular Farming, Amita Sarkar, 2019, Discovery Publishing Pvt.Ltd

REFERENCES:

1. Molecular Farming – Plant-made Pharmaceuticals and Technical Proteins, Rainer Fischer and Stefan Schillberg. Wiley.VCH Verlag GmbH and Co. KGaA. 2004
2. Molecular Pharming: Applications, Challenges and Emerging Areas 1st Edition,Allison R. Kermode, Liwen Jiang 2017

OUTCOMES:

- The student will be aware about the basics of molecular farming

BTCX23 STEM CELLS IN HEALTH CARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the underlying principles and applications in the emerging field of StemCell Technology
- To analyze the key concepts used in the debate about stem cell research
- To list the properties that define a stem cell and explain hoe stem cells are derived for scientific research
- To list the common and extrapolated potential clinical uses of stem cells

MODULE I INTRODUCTION TO STEM CELLS 7

Stem Cell Biology, Fate Mapping of Stem Cell, Stem Cell Pattern,differentiated parental DNA chain causes stem cell pattern of cell type switching in Schizosaccharomyces pombe

MODULE II CELL CYCLE CONTROL 7

Checkpoints, and Stem Cell Biology, Senescence of Dividing Somatic Cells, The Drosophila Ovary, An In Vivo Stem Cell System,Male Germ-line Stem Cells

MODULE III PRIMORDIAL GERM CELLS 8

Primordial Germ Cellsas Stem Cells, Embryonic Stem Cells, Embryonal Carcinoma Cells as Embryonic Stem Cells, Trophoblast Stem Cells

MODULE IV HEMATOPOIETIC STEM CELLS 8

Repopulating Patterns of Primitive Hematopoietic Stem Cells,Molecular Diversification and Developmental Interrelationships, Hematopoietic Stem Cells:Lymphopoiesis and the Problem of Commitment Versus Plasticity, Hemangioblast, Mesenchymal Stem Cellsof Human Adult Bone Marrow

MODULE V TYPES OF STEM CELLS 7

Stem Cells and Neurogenesis, Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

MODULE VI APPLICATION OF STEM CELLS 8

Cancer stem cells, neural stem cells for CNS repair, embryonic stem cells for heart diseases, stem cells in treatment of diabetes, stem cells in regenerative medicine, stem cell gene therapy

Total Hours –45

TEXT BOOKS:

1. Essentials of stem cell biology, Robert Lanza, 2nd Ed, Academic press, 2009
2. Stem cell biology in health and diseases. Thomas Dittmar and Kurt S. Zänker, Springer, 2009
3. Stem cell biology and Gene therapy. PETER J. QUESENBERR, Wiley, 2003

REFERENCES:

1. Developments in stem cell research. Prasad S Koka, Nova biomedical books, 2009

OUTCOMES:

- Search and read current stem cell technology literature applied to a particular problem domain
- Classify tumor stem cells which give rise to metastases and treatment-resistant remnant cells that cause relapse, and how this impacts on the development of future cancer treatment strategies.
- Outline how stem cells are currently being used in the clinic and what kinds of future treatments lie on the horizon. Students will also be exposed to current Norwegian projects lying at the frontier of stem cell research
- To demonstrate an interdisciplinary understanding of central concepts in tissue engineering, biomaterials and stem cell science, and critically evaluate different methods and techniques used

BTCX24	TRANSPORT PHENOMENA IN BIOPROCESS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand various laws in momentum transfer, types of fluids, viscosity & measurement and factors effecting it
- To understand isothermal system, mixing mechanisms and power requirement for Newtonian and Non-Newtonian fluids.
- To demonstrate the mechanisms of heat transfer in stirred tank reactor.
- To understand the requirement and effect of oxygen in the process.
- To understand the diffusional properties and various film theory concepts.

MODULE I MOMENTUM TRANSPORT-I 7

Mechanism of Momentum Transport: Newton's Law of Viscosity, Non- Newtonian fluids, theory of viscosity of liquids, time dependent viscosity, viscosity measurement (cone-and-plate viscometer, coaxial cylinder rotary viscometer, impeller viscometer), use of viscometers with biological reaction fluids, rheological properties of fermentation broth, factors affecting broth viscosity (cell concentration, cell morphology, osmotic pressure, product and substrate concentration), Velocity distribution in laminar flow and turbulent flow

MODULE II MOMENTUM TRANSPORT-II 8

Equation of change for isothermal system (equation of continuity, equation of motion, equation of mechanical energy), interphase transport in isothermal systems (friction factors for flow in tubes and in packed columns) mixing, mixing mechanism, power requirements in ungassed Newtonian and Non Newtonian fluids, gassed fluids, interaction between cell and turbulent Eddies, operating conditions for turbulent shear damage. Macroscopic Balances- mass, momentum and mechanical energy balances.

MODULE III ENERGY BALANCES 6

Shell energy balances, temperature profiles, average temperature, energy fluxes at surfaces, Equations of change (non-isothermal), equation of continuity, equation of motion for forced and free convection, equation of energy (non-isothermal). Shell mass balances, concentration profiles, average concentration, mass flux at surfaces, Equations of change (multi-component), equations of continuity for each species, equation of energy (multi-component).

MODULE III ENERGY TRANSPORT 7

Thermal conductivity and the mechanisms of energy transport- measurement of thermal conductivity, Fourier's law, steady state conduction, analogy between heat and momentum transfer. Temperature distribution with more than one independent variables- heating in a semi-infinite and finite slab, temperature distribution in turbulent flow-reference to stirred tank reactor, relationship between heat transfer, cell concentrations and stirring conditions

MODULE IV MASS TRANSPORT 7

Diffusivity, theory of diffusion, analogy between mass heat and momentum transfer, role of diffusion in bioprocessing, film theory, concentration distribution with more than one independent variable- unsteady diffusion, boundary layer theory, concentration distribution in turbulent flow- Corrosion equation. Definition of binary mass transfer coefficients, transfer coefficients at high mass transfer rates-boundary layer theory, penetration theory. Convective mass transfer, Liquid - solid mass transfer, liquid-liquid mass transfer, gas-liquid mass transfer

MODULE V OXYGEN TRANSPORT 7

Oxygen uptake in cell cultures, Factors affecting cellular oxygen demand, oxygen transfer from gas bubbles to aerobic culture, oxygen transfer in fermenters, bubbles factors affecting oxygen transport- sparging, stirring, medium properties, antifoam agents, temperature, mass transfer correlations, measurements of kLa – oxygen balance method, dynamic method.

Total Hours –45

TEXT BOOKS:

1. R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2ndedition, John Wiley and sons Singapore, 2006.
2. P. M. Doran, Bioprocess Principles, 2nd edition, Academic Press, 2012.
3. Harvey W. Blanch, Douglas S. Clark Biochemical Engineering, Marcecel, Dekker, 2007.
4. Byron, R. B., Stewart, W. E., Lightfoot, E. N., "Transport Phenomena", John Wiley & Sons, 1960.

REFERENCES:

1. M. L. Shuler and F. Kargi, Bioprocess Engineering: Basic concepts, 2nd edition, Prentice Hall of India, 2003.

OUTCOMES:

- Assessment by ability to differentiate Newtonian and Non-Newtonian fluids.
- Assessment by ability to demonstrate interphase transport in isothermal system and interactions.
- Assessment by ability to demonstrate the effect of heat transfer on cell concentration and stirring conditions in stirred tank reactor.
- Assessment by ability to analyze and demonstrate the diffusion concepts during the transport.
- To understand the requirement and effect of oxygen in the process.

Physics Elective Courses
(To be offered in II Semester)

		L	T	P	C
PHCX 01	**FUNDAMENTALS OF ENGINEERING MATERIALS**	**2**	**0**	**2**	**3**

OBJECTIVES:

- To familiarize students with basic ideas of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- To help students acquire the properties and applications of magnetic materials and dielectric materials.
- To familiarize students with basics ideas about the properties of dielectric and its applications
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 7

Conductors: properties, Fermi distribution function, Fermi energy in metals- density of states- conducting polymers-properties-applications, semiconductors: intrinsic and extrinsic semiconductors-carrier concentrations, conductivity and energy band gap, semiconducting polymers- properties- applications.

MODULE II DIELECTRIC MATERIALS 8

Polarization- dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – Internal field -Clausius Mosotti relation - dielectric loss – dielectric breakdown – applications of dielectric materials (capacitors and transformers) – Pyroelectricity, Piezoelectricity, ferroelectricity and applications in FERAM - multiferroic materials and its applications.

MODULE III MAGNETIC MATERIALS 7

Origin of magnetism-magnetic moment, susceptibility, permeability – Bohr magneton –Dia, Para and Ferro magnetism –Spontaneous magnetization- Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its application -Giant Magneto-resistance effect(GMR) - Magnetic resonance imaging(MRI).

MODULE IV NANOMATERIALS **8**

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials –quantum well, quantum wire, quantum dot - nanoporous materials - carbon nanotubes, grapheme - nanocomposites – applications.

PRACTICALS

1. Determination of energy band gap of a semiconductor.
2. Determination of resistivity of metals by four point probe method.
3. Determination of dielectric constant of dielectric material.
4. Determination of time constant of a capacitor using RC circuit.
5. Determination of paramagnetic susceptibility of given liquid.
6. Determination of hysteresis loss in a transformer using BH curve.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

L : 30 periods, P: 30 periods, Total: 60 periods

REFERENCES:

1. William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
2. Raghavan, V., Materials Science and Engineering, 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
3. Wahab.M.A, Solid State Physics: Structure and Properties of Materials,Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
2. Pillai, S.O., Solid State Physics, New Age International, New Delhi, 2005.
3. Charles P.Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
4. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.

OUTCOMES:

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

- Differentiate between the properties of the nanomaterials compared to bulk materials.
- Comprehend the significance of properties of magnetic materials and derive these properties from synthesized materials.
- Apply the concepts of conducting and semiconducting materials for solid state devices.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 02	HEAT AND THERMODYNAMICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To familiarize students with basic concepts of heat.
- To help students acquire the fundamentals of heat conduction and radiation.
- To enable students acquaint with the basics of thermodynamic concepts.
- To make students understand the fundamentals of heat based experiments.

MODULE I CONCEPTS OF HEAT 10

Definition of temperature, thermal and thermodynamic equilibrium- relationship between temperature and kinetic energy- definition of solid, liquid, gas- Introduction to phase transitions, critical and triple points- definition of heat capacity, mechanical equivalent of heat -Joule's calorimeter- latent heat- Microscopic model of ideal gas-equation of state, internal energy, equipartition theorem- equation of state for non-ideal gases.

MODULE II CONDUCTION AND RADIATION 10

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe’s method – thermal conductivity of a bad conductor – Lee’s disc method – conduction of heat through compound media-radiation – Planck’s law blackbody radiation – Wien’s law – Stefan’s law – Newton’s law of cooling from Stefan’s law – Solar constant – Pyrometry.

MODULE III FUNDAMENTALS OF THERMODYNAMICS 10

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics -Heat engine – Carnot’s engine – Carnot’s theorem – Internal combustion engines – petrol and diesel engines(qualitative) – Entropy – entropy and available energy – temperature – entropy diagram for Carnot’s cycle - Third Law of thermodynamics(qualitative).

L : 30 periods

PRACTICALS

1. Determination of mechanical equivalent of heat by Joule’s calorimeter.

2. Relation between temperature of a body and time by plotting a cooling curve-Newton's law of cooling.
3. Determination of specific heat capacity of liquid by cooling.
4. Determination of thermal conductivity of a bad conductor-Lee's disc method
5. Determination of thermal conductivity of a good conductor-Forbe's method

P: 30 periods
Total: 60 periods

REFERENCES :

1. Mathur. D.S, "Heat & Thermodynamics", S.Chand& Co., 2009.
2. Brijlal& Subramaniam, "Heat and Thermodynamics", S.Chand& Co, Delhi., 2010.
3. Gupta. A.B and Roy. H, "Thermal Physics", Books and Allied Ltd., 2002.
4. Sharma. J.K and Sarkar. K.K, "Thermodynamics and statistical Physics",Himalaya Publishing House, 1988.

OUTCOMES:

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

- Understand the concepts of heat and its properties.
- Comprehend the ideas governing the conduction and radiation processes.
- Understand and apply the ideas of laws of thermodynamics in thermodynamic systems.
- Perform heat based experiments and determine its various properties.

PHCX 03	**INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the imaging techniques of nanomaterials.
- To gain the basic concepts of fabrication techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I NANOMATERIALS AND APPLICATIONS 10

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials –quantum well, quantum wire, quantum dot- nanoporous materials-zeolite, mesoporous materials, carbon nanotubes, graphene- nanocomposites - applications (qualitative): Molecular electronics-nanoelectronics – nanophotonics - single electron transistor-drug delivery.

MODULE II SYNTHESIS AND IMAGING TECHNIQUES 12

Top-down and bottom up approaches – mechanical alloying and mechanical ball milling-sol-gel approach-hydrothermal method-precipitation method-spray pyrolysis-spin coating-self assembled monolayer (SAM)-Chemical vapour deposition method – Physical vapour deposition method: laser ablation method, sputtering method.
Optical microscopy – Phase contrast and interference microscopy –confocal microscopy- high resolution Scanning electron microscope (HRSEM)- high resolution Transmission electron microscope (HRTEM)-Atomic force microscope-Scanning Tunnelling microscope (STM).

MODULE III NANOFABRICATION 8

Photolithgraphy - electron beam lithography - X-ray and Ion beam lithography-nanoimprint lithography - soft lithograpy - nanoelectromechnical systems (NEMS) - nanoindentation principles.

L : 30 periods

PRACTICALS

1. Synthesis of nanomaterials by sol-gel method.

2. Synthesis of nanomaterials by hydrothermal method.
3. Synthesis of nanomaterials by solid state reaction method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation method.
6. Synthesis of nano thin films by spray pyrolysis method.
7. Synthesis of nano thin films by pulsed laser deposition (PLD) method.
8. Analysis of size effect on the absorption spectrum of nanomaterials.
9. SEM characterization of nanomaterials.
10. AFM characterization of nano thin films.
11. Phase confirmation by XRD.

P: 30 period

Total: 60 periods

REFERENCES:

1. Charles P.Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
2. Cao. G., “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, 2004.
3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., “Handbook of NanoScience, Engineering and Technology”, CRC Press, 2002.
4. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.
5. Chris Mack, “Fundamental Principles of Optical Lithography: The Science of Microfabrication”, John Wiley & Sons, 2008.
6. Bandyopadhyay A.K., “Nano Materials”, New Age International Publishers, New Delhi, 2008.

OUTCOMES:

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

- Understand the importance and basic concepts of the nanomaterials.
- Comprehend the imaging techniques for nanomaterials.
- Illustrate the various nanofabrication techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 04 LASERS AND THEIR APPLICATIONS

L	T	P	C
2	0	2	3

OBJECTIVES

- To recognize the fundamentals of laser and its characteristics.
- To comprehend and compare the different laser systems.
- To apply lasers in metrology and material processing.
- To understand the working of laser instrumentation.
- To correlate the experimental results for applications.

MODULE I LASER THEORY 8

Spontaneous and stimulated emission - Population inversion – Einstein's A & B coefficients - Threshold condition – super-radiance Laser – Three level and four level laser systems -conditions for CW and pulsed laser action. Q-Switching - experimental methods - cavity dumping - Mode locking - experimental methods - Spatial and Temporal coherence.

MODULE II DIFFERENT LASER SYSTEMS 8

Laser systems – General description - Laser structure - excitation mechanism - Different laser systems- He-Ne laser, Carbon-dioxide laser - Excimer laser – Free electron laser- Alexandrite laser - Ti-Sapphire laser – Semiconductor diode laser - Diode pumped solid state laser - Pulsed-CW dye laser- Fibre laser.

MODULE III METROLOGICAL AND MATERIAL PROCESSING APPLICATIONS 8

CW and Pulsed laser beam characteristics and its measurements - Beam focusing effects - spot size - Power and Energy density Measurements - Distance measurement - Interferometric techniques - LIDARS - different experimental arrangements - Pollution monitoring by remote sensing - Laser gyroscope - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition – Biophotonic applications.

MODULE IV LASER INSTRUMENTATION6

Laser for measurement of length, current and voltage – Laser Doppler Velocimetry - Holography and speckle in displacement and deformation measurements - Laser for communication with fiber optics as channel.

L : 30 periods

PRACTICALS

1. Tuning of Dye Laser using DFDL Arrangement
2. Determination of Brewster Angle using He-Ne laser
3. Study of transversely Pumped Dye Lasers
4. Study of longitudinally Pumped Dye Lasers
5. Determination of power and wavelength using Distributed Feedback Dye Laser (DFDL)
6. Determination of fibre optic losses using semiconductor laser.
7. Bandgap determination of a semiconductor diode.

P: 30 periods

Total: 60 periods

REFERENCES:

1. William T. Silfvast, “Laser Fundamentals”, Cambridge University Press, 2009.
2. Ghatak. A. &Thyagarajan. K. “Optical Electronics”, Cambridge University, 1994.
3. Laud.B.B., “Laser and Non-Linear Optics”, Second Edition, New Age International (p) Limited Publishers, 2011.
4. Nambiar. K.R., “Lasers Principle, Types and Applications”, New Age International (p) Ltd, 2004.
5. Wilson. J. & Hawkes. J.F.B., “Opto Electronics - An Introduction”, Prentice Hall, 1992.
6. William M.Steen, ”Laser Material Processing”, Springer-Verlag, Berlin, Third Edn., 2005.

OUTCOMES:

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

- To complement the knowledge acquired in the theory class.
- To work with dye lasers for tunability of laser wavelength
- To measure the loss of information involved in fibre optic communication
- To correlate the results for application.

PHCX 05 **MATERIALS SCIENCE**

L	T	P	C
2	0	2	3

OBJECTIVES

- To gain basic knowledge in conducting and semiconducting materials and their properties.
- To provide a basis for understanding properties and applications of dielectric materials.
- To impart knowledge on magnetic and optical materials and their properties & applications.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 8

Quantum free electron theory of metals and its importance - Energy distribution of electrons in metals - Fermi distribution function - Density of energy states and carrier concentration in metals - Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of Band theory – Introduction to Elemental and Compound semiconductors - Carrier concentration derivation for Intrinsic semiconductors - Density of electrons in conduction band & Density of holes in valence band- intrinsic carrier concentration - Fermi energy & Variation of Fermi energy level with temperature - Mobility and electrical conductivity - Band gap determination.

MODULE II DIELECTRIC MATERIALS 7

Introduction to dielectric materials & basic definitions – Electronic, Ionic, Orientation & space charge polarizations - Total polarization – Frequency and temperature dependence of polarization - Internal field in a dielectric material - Deduction of Clausius - Mosotti's relation - dielectric loss & loss tangent – Different types of dielectric breakdown – Applications of dielectric materials : Capacitors and Transformers.

MODULE III MAGNETIC MATERIALS 7

Introduction to magnetic materials & origin of magnetic moment - Different types of magnetic materials and their properties - Ferromagnetism & Domain theory of ferromagnetism - Hysteresis, Soft and Hard magnetic materials - Antiferromagnetic materials - Ferrites and its applications – Applications of magnetic materials : Data storage.

MODULE IV OPTICAL MATERIALS 8

Optical properties of semiconductors - Direct and Indirect bandgap semiconductors – Traps, recombination centre, color center and exciton – Luminescence : Fluorescence and Phosphorescence - Liquid crystal display : twisted nematic crystal display – Applications of Optical materials - Optical Sources : light emitting diode and laser diode - Photo detectors : PIN photodiode and Avalanche Photodiode - Pyroelectric devices - Electro optic effect : Kerr effect and Faraday effect.

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination dielectric constant of a given non-polar liquid.
5. Determination of magnetic susceptibility of a given paramagnetic liquid using Quincke's method.
6. Determination of energy loss of a given transformer core using hysteresis method.
7. To study the I-V characteristics of a photodiode.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES

1. Palanisamy P.K., ''Physics II'', Material Science for ECE, Scitech Publications (India) Pvt Ltd., 2006.
2. Kasap. S.O., ''Principles of Electronic materials and devices'', McGraw Hill Publishers, 3rd Edition, 2007.
3. Arumugam. M, "Physics II'', Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
4. Sze. S.M., ''Semiconductor Devices – Physics and Technology'', John Wiley, 2nd Edition. 2002.
5. Raghavan. V, ''Materials Science and Engineering'', Prentice Hall of India, 5th Edition, 2004.

OUTCOMES

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

- Gain knowledge about fundamentals of conducting and semiconducting materials

- Understand the concepts and applications of Dielectric, Magnetic materials
- Familiarize Optical materials and their applications in Engineering and Medical fields.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 06 **NON-DESTRUCTIVE TESTING**

L	T	P	C
2	0	2	3

OBJECTIVES:

- To study the process and applications of ultrasonic inspection method.
- To understand the basic concepts of radiographic inspection method.
- To acquire the knowledge about the various surface Non-Destructive Testing (NDT) techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I ULTRASONIC INSPECTION METHOD **10**

Ultrasonic Testing- Principle of operations- types of sound waves -types of Transducers-transmission and pulse-echo method- straight beam and angle beam, instrumentation- calibration methods-ultrasonic testing technique- data representation, A Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction-thickness determination-, advantages, disadvantages and applications.

MODULE II RADIOGRAPHIC INSPECTION METHOD **10**

Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Equipment-Exposure charts-Types of films-Fluoroscopy- Xero-Radiography –Limitations-Gamma radiography-Equipment, radiation sources- method of generation- film processing- interpretations of radiography-safety in industrial radiography.

MODULE III SURFACE NDT TECHNIQUES **10**

Liquid Penetrant Testing – Principles, Characteristics and types of liquid penetrants-developers- advantages and disadvantages of various methods- Inspection Procedure and Interpretation of results. Applications of Liquid Penetrant testing.

Magnetic Particle Testing- Principle-magnetizing technique-procedure –equipment-Interpretation and evaluation of test indications-.applications and limitations-demagnetization.

L : 30 periods

PRACTICALS

1. Inspection of welds using solvent removable visible dye penetrant.
2. Inspection of welds using solvent removable fluorescent dye penetrant.
3. Inspection on non magnetic materials by eddy current method.

4. Inspection on magnetic materials by eddy current method.
5. Inspection of welds by Eddy current Testing.
6. Inspection of welds by Magnetic Particle Testing - Dry method.
7. Inspection of welds by Magnetic Particle Testing - Wet method.
8. Ultrasonic flaw detector- Inspection of defects.
9. Demonstration of Radiographic inspection.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Baldev Raj., Jayakumar T.,Thavasimuthu., “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash., “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.
3. ASM Metals Handbook of Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.
4. Paul E Mix.,”Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.
5. Charles J., Hellier, “Handbook of Nondestructive evaluation”, McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- Illustrate the ultrasonic inspection methods of NDT.
- Understand the basic concept of radiographic inspection method.
- Test the surfaces by the various surface NDT techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 07	PROPERTIES OF MATTER AND ACOUSTICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand principles and properties of elasticity.
- To understand the basic concepts and application of viscosity.
- To analysis acoustic of building.
- To know about photoelasticity and its applications.

MODULE I ELASTICITY 8

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment - Cantilever–Expression for depression - Uniform bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II VISCOSITY 8

Viscosity- Newton's formula for viscous flow- Streamline and turbulent motion- Reynolds number - Poiseuille's formula- Determination of coefficient of viscosity- factors affecting viscosity - capillary flow method - Stoke's formula- viscosity of highly viscous liquids – Stoke's method - Lubricants and its applications –viscosity measurements- Viscometer- Variation of Viscosity with Temperature.

MODULE III ACOUSTICS OF BUILDING 7

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine's formula for reverberation time - Absorption coefficient and its measurement -Transmission of sound and transmission loss - Factors affecting the architectural acoustics and their remedy-sound absorbing materials-vibration and noise control systems for buildings.

MODULUE IV PHOTOELASTICITY 7

Polarization- double refraction-Theory of Plane, Circularly and Elliptically polarized light- Quarter wave plate and half wave plate- photo elasticity- Theory of photo-elasticity- Stress optic relations- model materials-analysis techniques- Photo elastic bench.- Three dimensional photo elasticity-Digital photo elasticity- Photo elastic coatings.

L : 30 periods

PRACTICALS

1. Determination of viscosity of liquid by Poiseuille's method.
2. Determination of viscosity of liquid by Stoke's method.
3. Analysis of stress by photo elastic method.
4. Verification of Hooke's law by spring method.
5. Determination of Young's modulus of the cantilever beam.
6. Determination of rigidity modulus by static torsion method.
7. Visit to acoustically good auditorium and identifying the sound absorbing materials in the auditorium.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S., "Elements of Properties of Matter", S.Chand& Co, Delhi, 2009.
2. Gaur R.K., Gupta S.L.,"Engineering Physics", Dhanpat Rai Publishers, 2010.
3. Brijlal and Subramaniam.," Properties of Matter", Eurasia Publishing Co, New Delhi, 2002.
4. Smith C.J.," General Properties of Matter", Orient & Longman,1960.
5. Kenneth G. Budinski and Michel K., Budinski, "Engineering Materials Properties and Selection", Pearson, Singapore, 2002.

OUTCOMES:

Upon completion of this course, the students will be able to

- Understand the basic concepts of the elasticity of materials.
- Comprehend the concepts of viscosity of liquid and measurement.
- Demonstrate the acoustical aspects of building and its importance in construction.
- Illustrate the fundamental concept of photo elasticity and its use for the stress analysis of the object.

PHCX 08	PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To impart knowledge about the principles and properties of elasticity.
- To learn the laws governing the dynamic of rigid bodies.
- To acquire the knowledge of the various techniques of Non-Destructive Testing (NDT) of materials.
- To understand the principle and basic concept of low temperature applications.

MODULE I ELASTICITY 8

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment-Cantilever–Expression for depression - Uniform Bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II DYNAMICS OF RIGID BODIES 8

Rigid bodies - angular acceleration - Torque on a particle - angular momentum - law of conservation of angular momentum - moment of inertia and its significance - Theorem of parallel and perpendicular axis - moment of inertia of a thin uniform bar - moment of inertia of a rectangular lamina - moment of inertia of uniform circular disc - Moment of inertia of hollow and solid cylinders – flywheel (qualitative) - kinetic energy of rotating body – Routh rule.

MODULE III NDT TECHNIQUES 6

Ultrasonic Testing- types of Transducers-transmission and pulse-echo method-Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Liquid Penetrant Testing**-** Inspection Procedure and Interpretation of results.

MODULE IV LOW TEMPERATURE PHYSICS 8

Definition of Refrigeration and Air-Conditioning - Types of**Refrigeration Systems-** Applications- Comfort Air Conditioning, Industrial Refrigeration, Food processing and food chain -**Cryogenic treatment - Low temperature properties of engineering materials: Mechanical properties, Thermal properties, Electrical properties.**

L : 30 periods

PRACTICALS

1. Verification of Hooke's law by spring method.
2. Determination of Young's modulus of the beam by bending method.
3. Inspection of welds using solvent removable visible dye penetrant.
4. Inspection of welds using solvent removable fluorescence dye penetrant.
5. Inspection of welds by Magnetic Particle Testing.
6. Determination of moment of inertia of the disc by torsion pendulum method.
7. Determination of moment of inertia of the disc by static torsion method.
8. Demonstration of working of flywheel.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S.,"Elements of Properties of Matter", S.Chand& Co, Delhi, 2009.
2. Brijlal& Subramaniam," Properties of Matter", Eurasia Publishing Co, Delhi,2002.
3. Gaur R.K., Gupta S.L., "Engineering Physics" Dhanpat Rai Publishers, 2010.
4. BaldevRaj.,Jayakumar T., ThavasimuthuM.,"Practical Non-Destructive testing", Narosa Publishing House, 2009.
5. Brijlal&Subrahmanyam., "Heat and Thermodynamics" S.Chand& Company Ltd, 2002.
6. Paul E Mix.," Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition, New Jersey, 2005.
7. Charles J., Hellier.," Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- understand the basic of concept of elasticity of materials.
- comprehend the basic concepts of motion of rigid bodies and its applications.
- Demonstrate the various NDT techniques and its importance.
- Illustrate the low temperature systems and its applications.

PHCX 09	SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the Physics of Semiconductor devices.
- To make the students learn the fundamentals of Photoluminous - semiconductors, Optoelectronic devices, Optical modulators/detectors.
- To make them understand the technology behind latest Display devices like LCD, Plasma and LED Panels.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I PHYSICS OF SEMICONDUCTORS 8

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors – Carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

MODULE II OPTOELECTRONIC DEVICES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED - LED structure - LED characteristics - White LED – Applications. Liquid crystal displays – Dynamic scattering and Twisted nematic display, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers.

MODULE III OPTICAL MODULATORS 7

Modulation of light – birefringence –Modulation Techniques - Electro optic effect – Electro optic materials –Types of Electro optic Modulators : Kerr and Pockel modulators –- Magneto optic effect - Magneto optic Modulators – Acousto Optic modulators.

MODULE IV OPTICAL DETECTORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode – Avalanche Photodiode (APD) characteristics - APD design of detector arrays –

Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells.

L : 30 periods

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of the wavelength of a given laser source using diffraction grating.
5. Determination of Planck’s constant using LED.
6. To study the I-V characteristics of photodiode and phototransistor.
7. To study the characteristics of a solar cell.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Arumugam. M, “Physics II”, Anuradha Publishers, 5th Edition, 2005.
2. Sze. S.M., “Semiconductor Devices – Physics and Technology”, 2nd edn. John Wiley, 2002.
3. Wilson & J.F.B. Hawkes, “Optoelectronics – An Introduction”, Prentice Hall, India, 1996.
4. Bhattacharya, “Semiconductor optoelectronic devices”, Second Edn, Pearson Education, 2002.
5. Safa O. Kasap, “Optoelectronics &Photonics:Principles& Practices”, Second Edn, Pearson Education,2013.
6. Palanisamy P.K., “Semiconductor physics and optoelectronics” Scitech Publications, 2003.

OUTCOMES:

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

- Understand the principles of Physics behind semiconductor devices.
- Choose the correct semiconductors for electronic devices and display.
- Differentiate the working principle of LED and Diode Laser.
- Apply the knowledge of modulation of light for different types of optical modulators.
- Select suitable photodetectors for different types of applications.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

Chemistry Elective Courses
(To be offered II Semester)

CHCX01 ANALYTICAL INSTRUMENTATION L T P C
2 0 2 3

OBJECTIVES

To make the student conversant with

- principles, instrumentation and applications of different electroanalytical techniques
- different chromatographic techniques
- principles, instrumentation and applications of various types of absorption and emission spectroscopy
- different thermal analytical methods and their applications

MODULE I ELECTROANALYTICAL TECHNIQUES 7

Principle and applications: conductometric titrations – potentiometrIc titrations, ion-selective electrodes and pH-metry – coulometry – voltammetry - polarography, amperometric titrations.

MODULE II CHROMATOGRAPHY 8

Basic concepts of chromatography – paper chromatography – column chromatography – thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

MODULE III SPECTROSCOPY 8

Absorptionspectroscopy (principle, instrumentation and applications): Colorimetric analysis – UV-Visible spectroscopy – FTIR spectroscopy - Emission Spectroscopy (principle, instrumentation and applications): fluorescence, phosphorescence and chemiluminescence – Atomic absorption spectroscopy – flame emission spectroscopy.

MODULE IV THERMAL ANALYSIS 7

Principle, instrumentation and applications: Thermogravimetric analysis – Differential thermal analysis – Differential scanning calorimetry

L: 30 periods

PRACTICALS

1. Conductometric titrations: acid-base and precipitation titrations
2. Potentiometric titrations
3. Determination of pH of the unknown solution
4. Estimation of alkali metals using flame emission spectroscopy
5. Estimation of metal ions of coloured solutions using colorimetric analysis
6. Separation of compounds using gas chromatography
7. Separation of compounds using high performance liquid chromatography
8. Analysis of the given sample and interpretation of the data using IR, UV-Visible spectroscopy
9. Demonstration of TGA/DTA and DSC and interpretation of data.

P:30 periods

Total: 60 periods

REFERENCES

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

OUTCOMES

The student will be able to

- state the principle and applications of various electro-analytical techniques
- identify the right separation method for a given sample using different chromatographic techniques
- explain the principle, instrumentation & applications of various spectroscopic methods and also to interpret the data
- elaborate the principle, instrumentation and applications of various thermal analytical techniques and interpret the data.

CHCX02 CORROSION AND ITS CONTROL **L T P C**
2 0 2 3

OBJECTIVES

To make the student conversant with

- Basic concepts, principles and factors affecting corrosion
- Types and mechanism of corrosion
- Control measures of corrosion by material selection, proper design and by applying organic coatings
- Control of corrosion by applying inorganic coatings

MODULE I BASIC CONCEPTS OF CORROSION 8

Corrosion – causes and impacts of corrosion – mechanism of corrosion: Dry corrosion- oxidation corrosion - corrosion by other gases – Pilling-Bedworth rule- Corrosion by hydrogen: hydrogen blistering, hydrogen embritttlement, decarburization and hydrogen attack – corrosion of silver and copper by sulphur compounds – liquid metal corrosion (embritttlement or cracking) – Wet corrosion : hydrogen evolution – presence and absence of oxygen and absorption of oxygen – difference between dry and wet corrosion-factors influencing corrosion-polarization-passivity-emf series and galvanic series- corrosion current -rate of corrosion.

MODULE II FORMS OF CORROSION 7

Forms of corrosion-conditions for electrochemical corrosion –galvanic corrosion – differential aeration corrosion: pitting, water line, wire fencing, crevice and filiform corrosion – stress corrosion – Intergranular corrosion- erosion corrosion – soil corrosion – microbiological corrosion- fretting corrosion- corrosion in composites.

MODULE III CORROSION CONTROL AND ORGANIC COATINGS 8

Corrosion control – selection of materials and designing- cathodic protection – sacrificial anode and impressed current cathodic protection – corrosion inhibitors: anodic, cathodic and vapour phase inhibitors.

Organic protective coatings – paints: constituents – functions – varnishes : types- constituents – functions – lacquers : constituents – functions –enamels- constituents – functions – special paints : fire retardant, water repellant, heat resistant, temperature indicating and luminous paints.

MODULE IV INORGANIC COATINGS 7

Treatment of metal surface-inorganic coatings- classification- metallic coatings : anodic and cathodic coatings-hot dipping : galvanizing and tinning- electroplating—

electroless plating – cementation (diffusion) : sherardizing, calorizing and chromizing – metal cladding-metal spraying – non metallic coatings (chemical conversion coatings) : phosphate, chromate, oxide coatings and anodizing – comparison of anodic and cathodic protection.

L : 30 periods

PRACTICALS

1. Determination and comparison of rate of corrosion of metals in the presence of acid, base and neutral medium by weight loss method.
2. Determination of rate of corrosion of iron in the presence of various acids by weight loss method.
3. Determination of rate of corrosion of iron in the presence and absence of anodic Inhibitor by weight loss method.
4. Determination of rate of corrosion of iron in the presence and absence of cathodic Inhibitor by weight loss method.
5. Electroplating of base metal with copper.
6. Electrolessplating of base metal with copper
7. Chemical conversion coatings such as chromate and phosphate coatings.
8. Demonstration on the study of rate of corrosion by using cyclic voltametry.

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. S SUmare& S S Dara, A text Book of Engineering Chemistry, S. Chand& Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company, NewYork, 1984.
4. S. Banerjee, A.K. Tyagi, Functional Materials- Preparation, Processing and Applications, ELSEVIER Publications, London ; Waltham, MA : 2011

OUTCOMES

The students will be able to

- explain the mechanism, compare and enumerate the factors affecting corrosion
- describe and identify the place and types for a given situation.

- choose and elaborate the suitable organic coating method for a given real time situation.
- apply a suitable metallic coating for a given situation

CHCX03 ELECTRICAL MATERIALS AND BATTERIES L T P C

2 0 2 3

OBJECTIVES

To make the student conversant with

- preparation, properties and applications of plastics used in electrical and electronic applications
- properties and uses of electrical engineering materials
- classification and description of different types of batteries.
- classification and types of fuel cells

MODULE I POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS 8

Preparation, properties and applications **:**polyethylene, polypropylene, EPDM, Nylon-6,6, PVC, PTFE, polycarbonates, ABS, phenolformaldehyde, ureaformaldehyde, epoxyresins –polymerblends and alloys.

MODULE II ELECTRICAL ENGINEERING MATERIALS 7

Conductors**:** Silver, Copper, Gold, Aluminum **–** Semiconductors: Germanium, Silicon, Gallium Arsenic **–** Insulating Materials: Rubbers, Mica, Plastics, Ceramics, Insulating papers **–** Magnetic Materials**:** ferromagnetic materials, paramagnetic materials, diamagnetic materials, antiferromagnetic materials, ferrites

MODULE III BATTERIES 7

Electrochemical and electrolytic cell – batteries**:** types (primary, secondary and flow cell) – primarybatteries**:**dry cells, alkaline batteries – secondary batteries**:** nickel-cadmium cell – lead acid storage cell, lithium battery**:** primary and secondary type – solar cell – dye sensitized solar cell.

MODULE IV FUEL CELLS 8

Difference between batteries and fuel cells - chemistry of fuel cells - types of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC) and solid oxide fuel cells (SOFC).

L:30 periods

PRACTICALS

1. Free radical polymerization of styrene.
2. Free radical polymerization of PMMA.
3. Preparation of phenol-formaldehyde.
4. Preparation of urea-formaldehyde.
5. Synthesis of epoxy resin.
6. Demonstration of mechanical properties of insulating materials using UTM
7. Demonstration of electrical properties of insulating materials
8. Construction of batteries using natural resources
9. Measurement of EMF for different batteries.

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2013.
2. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
3. H.F. Mark and N. Gaylord, Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV Interscience, 2nd Ed. 1988.
4. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.
5. R.K. Rajput, A Textbook of Electrical Engineering Materials, Firewall Media, 2004
6. Vladimir S. Bagotsky, Fuel Cells: Problems and Solutions, 2nd Edition, John Wiley and Sons, 2012.
7. B. Viswanathan and M. AuliceScibioh, Fuel Cells: Principles and Applications, Taylor and Francis Group, 2007.

OUTCOMES

The student will be able to

- summarise the preparation, properties and applications of plastics used in electrical and electronic applications
- enumerate the properties and uses of electrical engineering materials
- illustrate various types of batteries with the aid of a diagram
- classify the fuel cells and elaborate the different types of fuel cells.

CHCX04 ENGINEERING MATERIALS L T P C

2 0 2 3

OBJECTIVES

To make the student conversant with

- properties and uses of different types of refractories and abrasives
- adhesives, cements and lime, setting of cements and their chemical behaviors.
- types, properties and uses of lubricants.
- various types of composite materials.

MODULE I REFRACTORIES AND ABRASIVES 8

Introduction refractory: -classification - based on chemical nature- characteristic and selection of good refractory - general manufacture of refractory- preparation properties and uses of: silica refractory - magnesite refractory - zirconia refractory, properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability, Cermets - super refractory.

Abrasives : introduction - Moh's scale - natural abrasives: diamond – corundum – emery - garnet and quartz, synthetic abrasives: preparation properties and uses: carborundum (silicon carbide)– alundum - boron (norbide) carbide

MODULE II ADHESIVES AND BINDING MATERIALS 8

Introduction - classification of adhesives –advantage –limitation of adhesive bonding –development of adhesive- factors influencing adhesive action: chemical and physical, application techniques of adhesive – Lime: classification – manufacture - setting and hardening, Gypsum: -Manufacture and properties and uses - Cement : chemical composition- Manufacture – setting and hardening – concrete – weathering of cement and concrete and its prevention- special cements: high alumina cement - sorel cement - white portland cement – water proof cement.

MODULE III LUBRICANTS 7

Introduction –functions of lubricant- mechanism of lubrication - classification of lubricant – liquid lubricant: vegetable and animal oils – mineral oils, semisolid: grease(calcium, lithium, aluminium) – petroleum jelly, solid lubricant: graphite - molybdenum disulphide, Properties of lubricant: viscosity - viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue.

MODULE IV COMPOSITE MATERIALS **7**

Introduction – advantageous characteristics of composites, applications of composites, main constituent of composites, types and applications of composites: RCC fibre-reinforced plastics (glass , carbon and aramid) - particulate composite - metal matrix composite - layered composites - failures in fibre-reinforced composites, ceramic matrix composites (CMC) – properties and applications.

L:30periods

PRACTICALS

1. Preparation of refractory bricks
2. Preparation of abrasive papers/cloth
3. Preparation of simple adhesives
4. Estimation of alkalinity in cements
5. Determination of cloud point and pour point
6. Determination of flash point and fire point
7. Preparation of fibre-reinforced composite

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. B.Sivasnakar, "Engineering Chemistry", Tata McGrow-Hill Publication Limited, New Delhi, second reprint 2008.
3. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
4. S SUmare& S S Dara, A text Book of Engineering Chemistry, S. Chand& Company Ltd, New Delhi, 2014.

OUTCOMES

The student will be able to

- classify and describe the manufacture the refractories and enumerate the properties and uses of abrasive materials.
- elaborate the manufacture, properties and uses of various adhesives and binding materials.
- classify lubricants and describe the properties and uses of them
- enumerate the properties and uses of various composite materials.

CHCX05 FUELS AND COMBUSTION L T P C
2 0 2 3

OBJECTIVES

To make the students conversant with the

- three types of fuels available and the different processes involved in it.
- analysis of fuel characteristics and manufacture of fuels
- calculations involved in calorific values and minimum air requirement for complete combustion.
- classification, functions, mechanism and properties of lubricants.

MODULE I SOLID FUELS 7

Characteristics of good fuel. Solid fuel – Wood, Coal – Ranking of coal – selection of coal. Analysis of coal – Proximate analysis. Pulverized coal – Metallurgical coke – Carbonization of coal – types. Manufacture of metallurgical coke – Beehive oven and Otto Hoffman's by-product oven methods.

MODULE II LIQUID AND GASEOUS FUELS 8

Liquid fuel: Petroleum: Refining of petroleum, Liquid fuels derived from petroleum – Cracking: Thermal (Liquid and Vapour phase) – Catalytic (fixed bed and moving bed cracking – Synthetic petrol: Fischer-Tropsch method– Knocking in petrol and diesel engine: octane number and antiknocking – cetane number and improvement of cetane number – biodiesel (trans-esterification) – Gaseous fuels: Compressed natural gas (CNG) – LPG – oil gas – producer gas – water (blue) gas – biogas.

MODULE III COMBUSTION 8

Calorific value: Gross and net caloric value – Bomb Calorimeter, Gas calorimeter - Definition of combustion – calculation of minimum requirement of air (problems) – theoretical calculation of calorific values (Dulong's formula), Gross and net calorific values ((problems) – Analysis of flue gas: Orsat's gas analysis method, explosive range, Ignition temperature. Introduction to air pollution from IC (Internal combustion) engines, photochemical smog, primary and secondary pollutants.

MODULE IV LUBRICANTS 7

Friction and wear – lubricants: definition, functions and mechanism of lubrication (thick film and thin film) –classification: liquid lubricants: animal and vegetable origin, mineral oil, blended oils, lubricating emulsions and silicones – properties of lubricating oils: viscosity and viscosity index; Flash and fire-point, Cloud and pour point, oiliness, emulsification number, volatility, carbon residue, aniline point – semisolid lubricant: greases and waxes – solid lubricant: graphite and molybdenum disulphide –nanolubricants.

L:30 periods

PRACTICALS

1. Testing of fuels - proximate analysis (moisture, volatile matter, ash content and fixed carbon present in coal, coke, charcoal etc)
2. Ash content and carbon residue test
3. Biodiesel synthesis by trans-esterification method (from coconut, groundnut, mustard oil, palm oil)
4. Determination of calorific value of a solid fuel using Bomb calorimeter (coal, charcoal, coke etc)
5. Determination of calorific value of a liquid fuel using Bomb calorimeter (petrol, diesel, biodiesel etc)
6. Determination of cloud point and pour point of a lubricant
7. Determination of flash and fire point of diesel.
8. Aniline Point of diesel
9. Viscosity Index of lubricants and Fuels by Viscometer
10. Flue gas analysis by Orsat’s gas analysis method – Demonstration
11. Working of internal combustion engine - Demonstration

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi, 2001.
2. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
3. John Griswold, Fuels Combustion and Furnaces, Mc-Graw Hill Book Company Inc. University of Michigan, 1946.
4. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1989.
5. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.

OUTCOMES

The students will be able to

- compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels.
- analyse the fuel properties such as moisture, votalite matter, ash content, calorific value etc
- calculate minimum air required for complete combustion and calorific values of fuels.
- categorize different lubricants into three types, explain the preparation and determine their properties.

CHCX06 FUNDAMENTALS OF PHYSICAL CHEMISTRY L T P C
2 0 2 3

OBJECTIVES

To make the student conversant with the

- various thermodynamic terms and relate the laws of thermodynamics in chemical processes
- molecularity and order of reaction and derive the rate constant for different order of reactions
- basics of adsorption of different materials and propose mechanisms and surface area measurement
- conditions for equilibrium and learn different components at equilibrium

MODULE I BASIC THERMODYNAMICS 8

Introduction - Thermodynamic terms - Thermodynamic equilibrium and processes - 1st law of thermodynamics: internal energy, enthalpy, heat capacity, isothermal and adiabatic expansion, Joule-Thomson effect - Zeroth law of thermodynamics: absolute temperature - 2nd law of thermodynamics: - spontaneous and cyclic process, Entropy in isothermal, isobaric and isochoric processes, work and free energy function, Maxwell's relation - 3rd law of thermodynamics

MODULE II CHEMICAL KINETICS 8

Rate of chemical reaction - order and molecularity of a reaction - Rate constant - kinetics of opposing, parallel and consecutive and chain reactions - isotope effects - effect of temperature on reaction rate - collision theory - absolute reaction rate theory - kinetics in enzyme catalysis

MODULE III SURFACE SCIENCE AND CATALYSIS 8

Adsorption - adsorption isotherms - uni and bimolecular adsorption reactions - parahydrogen conversion - factors affecting adsorption – Langmuir adsorption isotherm - Hinshelwood mechanism and *Eley-Rideal*mechanism with example - adsorption of gases on solids and surface area measurement by BET method - Terms in catalysis - homogeneous and heterogeneous and enzyme catalysis with example

MODULE IV PHASE RULE 6

Terms involved - Conditions for equilibrium - application of phase rule to water, lead-silver system, freezing mixtures, thermal analysis: cooling curves.

L:30 periods

PRACTICALS

1. Determination of the heat capacity of benzoic acid, internal energy of combustion of camphor using Bomb calorimeter. Calculation of enthalpy of combustion and formation for camphor.
2. Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal.
3. *Kineticsoffirst and second order reactions.*
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichloro benzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzenzene and p-nitro toluene.

P:30 periods

Total: 60 periods

REFERENCES

1. Rajaram J. and Kuriacose J.C., Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson Education, India, 2013.
2. Samuel Glasstone, Thermodynamics for Chemists, Read Books, United Kingdom, 2007.
3. James E. House, Principles of Chemical Kinetics, 2nd Edition, Academic Press, United States of America, 2007.
4. Keith J. Laidler, Chemical Kinetics, Pearson Education, India, 1987.
5. Douglas M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, 1984.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th Edition, Vishal Publishing Co. India, 2016.

OUTCOMES

The student will be able to

- calculate entropy, enthalpy and free energy change for different chemical processes
- calculate the rate constant for any chemical and biochemical processes
- differentiate the adsorption processes and calculate the surface area and predict the suitability of catalysts for different chemical processes
- predict the equilibrium conditions for water, alloys, freezing mixtures and draw the thermal curves for phase transition

CHCX07 **GREEN TECHNOLOGY** **L T P C**
2 0 2 3

OBJECTIVES

To make students conversant with the

- basic principles of green chemistry and green technology.
- wastes that causes hazards to human health
- chemicals that harms our environment
- need for green processes in various industries

MODULE I GREEN CHEMISTRY PROTOCOL 7

Need – Significance – 12 Principles with examples – R4 model – Life cycle analysis – sustainable and cleaner production - Green Technology: definition, examples: CFC free refrigerants, green building, energy, 3D printers, nanotechnology – Awards for Green chemistry – organization promoting green chemistry.

MODULE II WASTE & WASTE MINIMISATION 8

Source of wastes: domestic, industrial, medical, nuclear, e-waste; problems; prevention – economy of waste disposal – Waste minimization techniques: general waste treatment and recycling – alternate waste water treatment technologies: hybrid process – Green computing: goals, green cloud, green ICT - Pollution statistics from various industries (Industrial case studies).

MODULE III GREEN SYNTHESIS 7

Introduction - Solvent free reactions - green reagents, green solvents in synthesis - microwave and ultrasound assisted reactions – supercritical fluid extraction – green oxidation and photochemical reactions – catalyst and biocatalysts.

MODULE IV GREEN INDUSTRIAL PROCESSES 8

Polymer industry: biodegradable polymer - textile industry: greener approaches of dyeing, waste disposal – ecofriendly agrochemicals: biofertilizers, biopesticides – Pharmaceutical industry: atom economy, reduction of toxicity, use of biocatalyst, zero waste disposal – Leather industry: greener process in tanning, crusting, surface coating – ecofriendly batteries & fuel cells.

L:30 periods

PRACTICALS

1. Synthesis of an ionic liquids (Ex: imidazolium) and testing the solubility of organic chemicals.
2. Green bromination of stilbene (using pyridine hydrobromide).
3. Green synthesis: Photocatalytic reactions, solvent-free organic reaction – Aldol; green oxidation, green reduction.
4. Microwave assisted chemical reaction. (synthesis of aspirin, pinacol-pinacolone reaction, etc).
5. Comparison of conventional reaction with microwave assisted reactions (atom economy, solvent, etc) [Ex: aldehyde and ketones with hydrazines to give hydrazones].
6. Diels-Alder reaction in eucalyptus oil (green process).

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
3. Paul Anastas, John C.Warner, John Warner Joint; Green Chemistry: Theory & Practice New Ed Edition; Oxford University press, USA, 2000.
4. Rashmi Sanghi, M. M. Srivastava, Green chemistry, Narosa publishers, New Delhi, 2003.

OUTCOMES

The students will be able to

- outline the principles and implications of green chemistry.
- comprehend the potential risks of waste generated and analyse the threats to human and environment.
- integrate information into design of molecules to avoid/eliminate toxic solvents & reagents or reduce toxic products.
- identify various alternate greener technologies for various industries.

CHCX08 ORGANIC CHEMISTRY OF BIOMOLECULES

L	T	P	C
2	0	2	3

OBJECTIVES

To make students conversant with the

- basic concepts in organic chemistry
- types and structure of carbohydrates and lipids
- formation of different structures of proteins from amino acid
- structure of nucleic acids

MODULE I BASIC CONCEPTS IN ORGANIC CHEMISTRY 8

Classification and IUPAC nomenclature of organic compounds – stereochemistry – optical, stereo and geometrical isomerism – types of reagents: electrophiles and nucleophiles – types of reactions: addition, substitution, elimination and rearrangement reactions.

MODULE II CARBOHYDRATES, LIPIDS AND VITAMINS 7

Structure and functions of carbohydrates: mono, di, oligo and polysaccharides – lipids: phospholipids, glycolipids, sphingolipids – cholesterol – steroids – Structure, functions and deficiency disorders of fat soluble vitamins: A, D, E & K - Water soluble vitamins B & C: Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.

MODULE III AMINO ACIDS, PEPTIDES AND PROTEINS 7

Aminoacids: classification, properties - peptides – polypeptides – proteins: primary, secondary, tertiary and quaternary structure – glycoproteins – lipoproteins – Enzymes: classification and functions

MODULE IV NUCLEIC ACIDS 8

Nucleic acids – importance - structure of purines and pyrimidines – nucleotides – polynucleotides - RNA – types & structure - DNA – phosphodiester bonds – chemical, helical structure and functions – DNA replication – gene modification.

L: 30 periods

PRACTICALS

1. Qualitative tests to identify carbohydrates.
2. Quantitative estimation of carbohydrates.
3. Separation of sugars – TLC and/or paper chromatography.

4. Quantitative estimation of lipids.
5. Separation of amino acids – TLC and/or paper chromatography.
6. Quantitative estimation of proteins by Lowry's method.

P:30 periods

Total: 60 periods

REFERENCES

1. V. K. Ahluwalia, Organic Reaction Mechanism, Narosa Publishers, New Delhi, 2002.
2. Johnson Arthur T., Biology for Engineers, CRC Press, Finland, 2011.
3. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
4. David L. Nelson, Michael M. Cox, Lehninger Principles of biochemistry, Macmillan press, London, 2010

OUTCOMES

The students will be able to

- classify organic compounds and explain the mechanism of various organic reactions.
- draw the structures and enumerate the functions of carbohydrate, lipids and vitamins.
- correlate the relationship among amino acids, peptides and proteins.
- recognize the role of nucleic acid in the formation of RNA & DNA and differentiate DNA & RNA using their structure and function.

CHCX09 POLYMER SCIENCE AND TECHNOLOGY **L T P C**
2 0 2 3

OBJECTIVES

To make the student conversant with the

- basic concepts of polymers, classification, types of polymerization and molecular weight & its distribution
- preparation, properties and applications of thermoplastics and introduction to biodegradable polymers
- properties and applications of thermosets, elastomers and FRP
- different types ofmoulding techniques

MODULE I BASIC CONCEPTS OF POLYMERS 8

Definitions**:** monomer, polymer, functionality, degree of polymerization – classification of polymers**:** source, structure, application, thermal processing behavior (thermoplastics and thermosets), composition and structure (addition and condensation), mechanism (chain growth and step-wise growth) – copolymer: types – Definition –nomenclature of polymers – tacticity – types of polymerization : free radical, cationic and anionic polymerization (concepts only) – average molecular weight of polymer**:** number, weight – molecular weight distribution (problems)

MODULE II THERMOPLASTICS AND BIODEGRADABLE POLYMERS 8

Preparation, properties and applications **:** LDPE, HDPE, polypropylene, PVC, PTFE, PET, polyamides (Nylon-6 and Nylon 6,6) and polycarbonates – polymerblends and alloys – basics of biodegradablepolymers.

MODULE III THERMOSET RESINS, ELASTOMERS AND FRP 7

Thermosetresins **:**phenolicresins, aminoresins (urea and melamineformaldehyde), epoxyresins, unsaturated polyesters – polyurethanes – elastomers**:** vulcanization of naturalrubber, dienebasedelastomers –fibre reinforcedplastics**:** glass, aramid and carbon.

MODULE IV MOULDING TECHNIQUES 7

Moulding constituents**:** functions – moulding techniques**:** compression, injection, extrusion (single screw), blow moulding, thermoforming, (mechanical and vacuum forming), lamination.

L: 30 periods

PRACTICALS

1. Determination of molecular weight and degree of polymerization using Oswald's viscometer.
2. Free radical polymerization of styrene.
3. Free radical polymerization of PMMA.
4. Preparation of phenol-formaldehyde.
5. Preparation of urea-formaldehyde.
6. Synthesis of epoxy resin.
7. Synthesis of unsaturated polyester.
8. Preparation of FRP laminates.
9. Demonstration of injection moulding, compression moulding and blow moulding.

P:30 periods

Total: 60 periods

REFERENCES

1. Billmeyer F.N., Text Book of Polymer Science, 3rd Edition, John Wiley and Sons, New York, 1994.
2. George Odian, Principles of Polymerisation, 3rd Edition, McGraw Hill Book Company, New York, 1991.
3. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
4. Jacqueline I., Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, New York, 1998.
5. Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV, H.F. Mark and N. Gaylord, Interscience, 2nd Ed. 1988.
6. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.

OUTCOMES

The student will be able to

- classify various polymers, name the polymers and types of polymerization reactions, calculate molecular weight of polymers,
- summarise preparation, properties and applications of thermoplastics and give examples of biodegradable polymers
- elaborate the properties and applications of thermosets, elastomers and FRP
- select the appropriate moulding technique for a given polymer, based on the application

Humanities Elective I

(To be offered in III Semester)

SSCXO1	FUNDAMENTALS OF ECONOMICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain and discuss the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and public finance.
- To apprise the students about Indian economy and the role of engineers in economic development.

MODULE I DEMAND AND SUPPLY ANALYSIS 8

Classification of economy – open and closed economy, Demand - Types of demand - Determinants of demand – Law of Demand - Demand elasticity - Supply - Determinants of Supply – Law of Supply - Supply elasticity - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 7

Concepts of National income and measurement – Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – meaning of inflation- types - causes and preventive measures

MODULE III MONEY, BANKING AND PUBLIC FINANCE 9

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and Expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) .

MODULE IV INDIAN ECONOMY AND THE ROLE OF ENGINEERS 6

Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Engineers' contributions to the economic growth.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
- Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

- Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
- Mell Andrew and Walker Oliver (2014), "*The Rough Guide to Economics*", Rough Guide Ltd.

OUTCOMES:

On successful completion of this course,

- Students will have had exposure to the basic concepts of demand, supply and various pricing strategies.
- Students will have understood the macroeconomic concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and public finance in their real life situations.
- Students will have an overview of the economic reforms introduced in Indian economy.

SSCXO2	PRINCIPLES OF SOCIOLOGY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquaint the students with Concepts and perspectives of Sociology
- To explain the reflection of society in Individuals and vice versa
- To describe the hierarchical arrangement of individuals and groups in society
- To explicate the dimensions, forms and factors of Social change.
- To examine the context, impact and agencies of Globalization

MODULE I THE FOUNDATIONAL CANON 8

Sociology-Definition, scope and importance; Major theoretical perspectives-Functionalism, Conflict Theorising and Interactionism; Elements of social formation-Society, Community, Groups and Association; Associative Social Process- Co-operation, Accommodation and Assimilation; Dissociative Social Process-Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 7

Culture-definition, characteristics, functions, types, cultural lag and civilization, Socialization – definition, process, stages, agencies and anticipatory socialization; Social Control- definition, characteristics, importance, types & agencies.

MODULE III SOCIAL INEQUALITY AND STRATIFICATION 7

Concepts- inequality, hierarchy, differentiation, Social Exclusion, and Social Stratification. Forms of Social Stratification- Caste, Class and Estate. Gender and Social Stratification- sex and gender, patriarchy, factors perpetuating gender stratification; Globalization and gender inequality

MODULE IV SOCIAL CHANGE AND GLOBALIZATION 8

Social Change-definition, nature, direction; Forms- evolution, development, progress and transformation; Factors of social change- demography, economy, technology, polity and culture. Globalization- definition, characteristics, historical and social context and Impact, agencies of globalization- IGOs, INGOs, Nation-State, MNEs and Media

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Giddens A. 1989. “Sociology” Cambridge: Polity Press.
2. Heald Haralambos, R.M(2014) . ‘‘Sociology Themes and Perspectives”, Oxford, New Delhi-92
3. Bhushan Vidya and D.R. Sachdeva (2012). ‘‘Fundamental of Sociology”, Pearson, Delhi.

REFERENCES:

1. Das Gupta, Samir and PaulomiSaha (2012), ‘‘An Introduction to Sociology”, Pearson, Delhi
2. Bottomore, T.B. 1972. *Sociology- A Guide to Literature and Problems*, New Delhi,

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals tenets of Sociology.
- Students will be trained to understand social reality with sociological perspective.
- Students will be oriented to constructively analyze human interactions, social relationship and social issues
- Students will gain exposure to the dynamics of human society with special reference to the contemporary trends of globalization.

SSCXO3	SOCIOLOGY OF INDIAN SOCIETY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To present a portrayal of the components of the Indian Social structure
- To describe the nature and contemporary structure of Indian social Institutions.
- To examine the causality and magnitude of social problem facing the contemporary India.
- To elucidate the processes forms and impact of change and development in Indian society

MODULE I INDIAN SOCIAL STRUCTURE 7

Unity and Diversity; Concepts of unity and diversity- racial, religious, ethnic and linguistic composition of India. Types of communities-rural, urban and tribal; Social backwardness- OBC, SC and ST; Indian minorities- religious, ethnic, linguistic and LGBT

MODULE II INDIAN SOCIAL INSTITUTIONS 7

Family- definition, types, characteristics, functions of family; Joint Family- definition features, utility, changes; Marriage- definition, characteristics, marriage as sacrament or contract. Caste- definition, principles, contemporary changes, dominant caste, caste -class interface.

MODULE III SOCIAL PROBLEMS IN INDIA 8

Social Problem-definition, nature, social disorganization; Population explosion-causes, effects, relationship with development; Child Labour- causes, magnitude and consequences; Unemployment-nature , types, causes and effects; Gender issues-social status of women, violence against women and women in work place; Contemporary issues- communalism, terrorism and corruption.

MODULE IV SOCIAL CHANGE AND DEVELOPMENT IN INDIA 8

Socio-cultural Change- Sanskritization, Westernization, Secularization, Modernization;

Processes of Social change- Industrialization, Urbanization, Globalization; Development- definition, elements, role of government, industry and corporate sector. Technology and change- invention and innovation, impact of technology on social institutions, technology and development.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
2. Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
3. Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
4. Ahuja Ram. 2014. *Society in India,*, Rawat Publication: New Delhi.

REFERENCES:

1. Jayapalan, N.(2001), **"**Indian Society and Social Institutions" Atlantic Publishers &Distri,
2. Atal, yogesh (2006), "Changing Indian Society" Rawat Publications, Jaipur

OUTCOMES:

On successful completion of this course,

- Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
- Students will be sensitized to the various categories ,Inequalities and their challenges
- Students will be exposed to the social problems encountered in contemporary India.
- Students will gain knowledge about the various forms and trends of the social change.
- Students will become aware about the challenges in the path of progress of Indian society and realize relevance of their role in bringing about development

Humanities Elective II
(To be offered in IV Semester)

SSCXO4	ECONOMICS OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To have an increased awareness on the concept and components of sustainable development.
- To develop the ability to demonstrate the need of sustainable development and international responses to environmental challenges.
- To have an insight into global environmental issues and sustainable globalization.
- To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal.International responses to environmental challenges - Global policy such as Kyoto Protocol, Montreal Protocol, Basel Convention.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 8

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability, Globalization and Global Governance.Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 7

Principles of environmental policy for achieving sustainable development: precautionary principle and polluter pays principle – Business Charter for Sustainable Development.Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Anderson, David A (2010), "*Environmental Economics and Natural Resource Management*", Routledge, 3rd edition.
2. Karpagam M (1999), "*Environmental Economics: A Textbook*", Sterling Publishers Pvt. Ltd, New Delhi.

REFERENCES:

1. Karpagam M and Jaikumar Geetha (2010), "*Green Management Theory and Applications*", Ane Books Pvt. Ltd, New Delhi.
2. Sengupta Ramprasad (2004), "*Ecology and Economics: An Approach to Sustainable Development*", Oxford University Press, New Delhi.

OUTCOMES:

On successful completion of this course,

- The students will have understood the concepts and components of sustainable development.
- The students will have a holistic overview on the challenges of sustainable development and International responses to environmental challenges.
- The students will have gained knowledge on the global environment issues and demonstrate responsible globalization through global governance.
- The students will have developed awareness of the ethical, economic, social and political dimensions that influence sustainable development.

SSCXO5	INDUSTRIAL SOCIOLOGY	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.
- To explain the structure and functions of industrial organizations.
- To elucidate the dynamics of organizational behavior, leadership and communication.
- To inculcate professional ethics and values to equip students to work in organizational settings.

MODULE I INTRODUCTION 8

Industrial Sociology- definition, scope and importance; Theoretical approaches- scientific management, human relations approach, theory of bureaucracy, Fordism and post-fordism; Production system- concept and characteristics of factory system, automation and rationalization; Industrial conflict- strike , lockout and trade unions.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility; Informal organization- definition, characteristics, types and relevance; Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction;
Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 8

Group dynamics- Definition, Group behaviour model, Group decision making process, group cohesiveness; Leadership- definitions, style and effective supervision; Communication- concepts, types, model barriers; Job satisfaction- nature, employee compensation and job satisfaction.

MODULE IV PROFESSIONAL ETHICS AND VALUES 7

Concepts- values- morals, and ethics, Integrity, work ethics , service learning - Civic Virtue - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - commitment - empathy - Self-Confidence - Environmental Ethics, Cyber issues - computer ethics, cyber crimes, plagiarism Ethical living-concept of harmony in life.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Gisbert Pascal, Fundamentals of Industrial Sociology, Tata Mc. Graw Hill Publishing Co., New Delhi, 1972
3. Schneider Engeno. V, Industrial Sociology 2nd Edition, Mc. Graw Hill Publishing Co., New Delhi, 1979.

REFERENCES:

1. Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1st Edition,1985
2. DevisKeith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1st Edition, 1984

OUTCOMES:

On successful completion of this course,

- Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
- Students will be familiar with structure of authority, roles and responsibility in organizational settings.
- Students will imbibe leadership, communication and behavioral acumen to govern organization
- Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCXO6	LAW FOR ENGINEERS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand the Constitution and Governance of our country.
- To apprise the students of human rights - local and international and redressal mechanism.
- To have an insight into the industrial, corporate and labour laws of our country.
- To establish a clear understanding about the importance of intellectual property related laws.

MODULE I INDIAN CONSTITUTION AND GOVERNANCE 8

Constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Directive principles, Union executive, Legislature – Union – State and union territories – Election Commission – Election for parliament and state legislature, Judiciary- basic functioning of the Supreme Court and High Courts, Right to information Act 2005 – evolution – concept – practice.

MODULE II HUMAN RIGHTS 7

Human rights – meaning and significance, Covenant on civil and political rights, Covenant on Economic, Social and Cultural rights, UN mechanism and agencies, The Protection of Human Rights Act, 1993 – watch on human rights and enforcement.

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS 8

Corporate laws – meaning and scope, Companies Act 1956 – Indian Contract Act 1872 - Principles of Arbitration - Industrial Employment (Standing Orders) Act 1946 - Industrial Disputes Act 1947 - Workmen's Compensation Act 1923 - The Factories Act, 1948.

MODULE IV LAWS RELATED TO IPR 7

IPR – meaning and scope, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. M.P. Jain (2005) *Indian Constitutional Law*, Wadhwa & Co.
2. H. D, Agarwal (2008), *International Law and Human Rights,* Central Law Publications,
3. Rao, Meena (2006), *Fundamental Concepts in Law of Contract*, 3rd edn., Professional offset.
4. Ramappa (2010), *Intellectual Property Rights Law in India*, Asia Law House.
5. Singh, Avtar (2007), *Company Law*, Eastern Book Co.
6. R.F, Rustamji (1967), *Introduction to the Law of Industrial Disputes*, Asia Publishing House.

REFERENCES:

1. Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act., 1946

OUTCOMES:

On successful completion of this course,

- Students will `be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
- Students will have gained knowledge in human rights, cultural, social and political rights.
- Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
- Students will have an overview of IPRs and laws related to Intellectual Property Rights.

General Elective Courses
Group I courses
(To be offered in V Semester)

GECX101	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of various environmental hazards and its management measures.
- To give exposure on the natural disasters causes and prevention strategies.
- To give exposure on various man-made disasters causes and prevention strategies.
- To make them understand the different segments of disaster management.
- To introduce the concept of different relief measures to be adopted in the time of disaster.
- To give exposure to various environmental policies & programs in India for disaster management

MODULE I ENVIRONMENTAL HAZARDS 7

Environmental hazards, Environmental Disasters and Environmental stress- Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL DISASTERS 7

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

MODULE III MAN-MADE DISASTERS 7

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion

MODULE IV DISASTER MANAGEMENT 8

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT 8

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

Total Hours –45

REFERENCES:

1. Satender, “Disaster Management in Hills”, Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), “Environmental Geography”, Heritage Publishers, New Delhi,1990.
3. Savinder Singh, “Environmental Geography”, PrayagPustak Bhawan,1997.
4. Kates, B.I. and White, G.F., “The Environment as Hazards”, Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), “Disaster Management”, University Press, India, 2003.
6. Singh, R.B.,“Space Technology for Disaster Mitigation in India (INCED)”, University of Tokyo, 1994.
7. Bhandani, R.K., “An overview on Natural & Manmade Disaster & their Reduction”, IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., “Manuals on Natural Disaster management in India”, National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

OUTCOMES:

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

- Describe the origin, changes and management of environmental hazards.
- Develop the knowledge on natural disasters.
- Develop the knowledge on man-made disasters.
- Discuss the different segments of disaster management.
- Explain the concept of different disaster relief measures.
- Achieve sufficient knowledge on the National Policy on Disaster Management.

GECX102 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

MODULE I INTRODUCTION 8

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs- Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE II TQM PRINCIPLES 7

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

MODULE III TQM IMPROVEMENT PROCESS 8

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE V TQM TOOLS 7

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss

Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS 7

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System– Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

Total Hours –45

TEXT BOOKS:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans& William M.Lidsay, "The Management and Control of Quality", 5th Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S., "Total Quality Management", Butterworth HcinemannLtd.,Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., "Quality Management – Concepts and Tasks", New Age International, 1996.
5. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- Apply the various statistical tools and approaches for Quality control.
- Achieve continuous process improvement through TQM.

GECX103 ENERGY STUDIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENERGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

L – 45; Total Hours –45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, "Energy Technology", 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. "Principles of Energy Conservation", McGraw Hill, 1991.
3. D Patrick and S W Fardo, "Energy Management and Conservation", PHI,1990
4. P. O'Callaghan: "Energy Management", McGraw - Hill Book Company, 1993.
5. Kenney, W. F., "Energy Conservation in Process Industries", Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GECX104 ROBOTICS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To learn about the robots, various components, of Robots, programming and their applications.

MODULE I **8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL **8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS **8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES **7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS **7**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

L – 45; Total Hours –45

REFERENCES:

1. Yoram Koren,” Robotics for Engineers”, Mc Graw-Hill, 1987.
2. Kozyrey, Yu, “Industrial Robots”, MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. “Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al,”Expert Systems and Robotics”, Springer – Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GECX105	TRANSPORT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

MODULE I INTRODUCTION 7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE II ORGANISATION AND MANAGEMENT 7

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

MODULE III TRANSPORT SYSTEMS 9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE IV SCHEDULING AND FARE STRUCTURE 8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

MODULE V MOTOR VEHICLE ACT 7

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MODULE VI MAINTENANCE 7

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

L – 45; Total Hours –45

TEXT BOOKS:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCES:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date, 2019

OUTCOMES:

Upon completion of the course, students will

- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

GECX106 **CONTROL SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS 6

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

L – 45; Total Hours –45

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath& M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

GECX107 INTRODUCTION TO VLSI DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- Basic concepts of HDL.
- Verilog language and its syntax constructs.
- Programmable Logic Devices and FPGAs
- MOS devices theory
- CMOS based combinational and sequential circuits

PREREQUISITES:

Fundamentals of Electronics
Basics knowledge in Digital Electronics.

MODULE I REVIEW OF BASIC DIGITAL SYSTEMS 7

Boolean algebra, Building blocks of combinational logic design-Adders, multiplexer, encoder, decoder, comparator, Latches & flip-flops, counters, shift registers.

MODULE II LOGIC DESIGN USING VERILOG HDL 8

Overview of Digital Design with Verilog HDL, Levels of Design Description, Concurrency, Hierarchical Modeling Concepts, Modules and Ports, Component instantiation Data flow and RTL, structural, gate level, switch level modeling and Behavioral Modeling.

MODULE III LANGUAGE CONSTRUCTS OF VERILOG HDL 7

Identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments, conditional statements Variable types, arrays and tables, Tasks and functions, Test bench.

MODULE IV BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS 8

HDL Design -Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements. Programmable logic elements and AND-OR arrays, FPGAs programming methods.

MODULE V TRANSISTOR THEORY 7

Introduction to MOS Transistors-NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters.

MODULE VI BASICS OF DIGITAL CMOS DESIGN 8

NMOS & PMOS Logic Gate, CMOS Logic Gate, Basic layout design of simple gate-stick diagram, CMOS Logic Structures-full adder, multiplexers.

Total Hours –45

TEXT BOOKS:

1. M.Morris Mano "Digital Design", 3rd Edition, Prentice Hall of India Pvt. Ltd New Delhi, 2003

REFERENCES:

1. Michael D. Ciletti“Advanced Digital Design with the Verilog HDL" (2nd Edition) Hardcover – January 31, 2010
2. J.Bhasker: Verilog HDL primer, BS publication, 2001.
3. J. P. Uyemura, "Introduction to VLSI Circuits and System", Wiley, 2002
4. Neil Weste and K. Eshragian, “Principles of CMOS VLSI Design: A System Perspective,” 2nd edition, Pearson Education (Asia) Pvt.Ltd., 2000
5. Douglas A Pucknell& Kamran Eshragian , “Basic VLSI Design” PHI 3rd Edition (original edition – 1994)

OUTCOMES:

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

- Create basic Register Transfer Level (RTL) models for combinational circuits & Sequential circuits using Verilog HDL.
- Create basic behavioral models for combinational circuits & Sequential circuits using Verilog HDL.
- Describe the usage of Programmable Logic Devices and FPGAs.
- Describe MOS devices theory and inverter circuit DC characteristics
- Design the basic digital building blocks using MOS circuit.
- • Apply VLSI design concepts based on the requirements to conduct experiments or projects

GECX 108 PLANT ENGINEERING

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 7

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

MODULE II ELEMENTS OF PLANT 8

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

MODULE III DETAIL ENGINEERING 10

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation (Hook ups) , Control Philosophy – Detail Engineering.

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture.

MODULE V INSTALLATION AND COMMISSIONING 7

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

MODULE VI CASE STUDIES 5

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc

L – 45; Total Hours –45

REFERENCES:

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto,2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001.
3. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004
4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

OUTCOMES:

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

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GECX109	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be able to

- Discuss the basic concepts of computer security, model and attacks
- Examine the major types of threats and the associated attacks
- Identify the encryption techniques in real time applications
- Understand the special requirements for wireless security and how authentication is implemented in wireless systems
- Understand the functions of Network Security Device Firewall and its types
- Interpret the various network intrusion such as computer viruses, network worms etc

MODULE I INTRODUCTION 6

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Standards – classical encryption techniques.

MODULE II SYMMETRIC ENCRYPTION AND MESSAGE CONFIDENTIALITY 7

Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III PUBLIC KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION 8

Approaches to Message Authentication - Secure Hash Functions - Message Authentication Codes - Public-Key Cryptography Principles - Public-Key Cryptography Algorithms - Digital Signatures

MODULE IV KEY DISTRIBUTION ,USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY 8

Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key

Infrastructure -Federated Identity Management - Web Security Considerations - Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC MAIL SECURITY AND IP SECURITY 8

IEEE 802.11 Wireless LAN Overview -IEEE 802.11i Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-to-End Security - Pretty Good Privacy - S/MIME – Domain Keys Identified Mail- IP Security Overview -IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Cryptographic Suites

MODULE VI SYSTEM SECURITY 8

Intruders -Intrusion Detection -Password Management - Types of Malicious Software - Viruses Virus Countermeasures – Worms - Distributed Denial of Service Attacks- The Need for Firewalls - Firewall Characteristics - Types of Firewalls - Firewall Basing - Firewall Location and Configurations

L – 45; Total Hours –45

REFERENCES:

1. William Stallings,”Network security Essentials:Applications and standards“, Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013
2. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson, ISBN-13:978-0-273-79335-9,2013
3. Behrouz Forouzan, DebdeepMukhopadhyay,Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016
4. Wikipedia, “Network Security and Management” , https://en.wikipedia.org/wiki/Book:Network Security and Management, 2014.
5. Nitesh Dhanjani, Justin Clarke, “Network Security Tools”, O'Reilly Media, ISBN-13: 9780596007942, 2005.

OUTCOMES:

Students who complete this course will be able to

- Recognize the computer security concepts, architecture attacks and model
- Distinguish the symmetric and asymmetric encryption techniques

- Apply the cryptographic algorithms in different applications
- Express the network security designs using available secure solutions such as PGP,SSL, IPSec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats.

GECX110 KNOWLEDGE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

L – 45; Total Hours –45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, “Knowledge Management”, Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, “Handbooks on Knowledge Management”, 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, ”Knowledge Management: Systems and Processes”, 2010.

OUTCOMES:

Students who complete this course will be able to

- Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- Critically evaluate current trends in knowledge management and apply it for e-learning

GECX111	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cybersecurity.
- TounderstandCyberFraudsandAbuseanditsSecurityMeasures.
- To know the technological aspects of CyberSecurity.

MODULE I FUNDAMENTALS OF CYBER SECURITY 7

Securityproblemincomputing–CryptographyBasics–HistoryofEncryption– Modern Methods – Legitimate versus Fraudulent Encryption methods– EncryptionusedinInternet.

MODULE II CYBERCRIME AND CYBEROFFENSES 8

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

MODULE III CYBERCRIME: MOBILE AND WIRELESS DEVICES 8

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

MODULE IV TOOLS AND METHODS USED IN CYBERCRIME 8

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

MODULE V SECURITY POLICIES 7

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control Developmental Policies Standards, Guidelines and Procedures – Basics of assessing a system

MODULE VI COMPUTER FORENSICS 7

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

L – 45; Total Hours –45

TEXT BOOKS:

1. Nina Godbole, SunitBelapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 2011.
2. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education,2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”,3rdEdition, Pearson Education,2003.
2. WilliamStallings,“CryptographyandNetworkSecurity–Principlesand Practices”, 3rdEdition, Pearson Education,2003.
3. AtulKahate,“CryptographyandNetworkSecurity”,TataMcGrawHill,2000.

OUTCOMES:

Uponcompletionofthiscourse, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

GECX112	GENETIC ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

- The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

MODULE V PRINCIPLES OF PLANT BREEDING 9

Objectives, Selfing and crossing techniques, Male sterility,Incompatability, Hybrid vigour.

MODULE VI HUMAN GENOME PROJECT 9

Genetic diseases in humans, Genetics and society

L – 45; T – 15; Total Hours –60

REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart, Freeman and Company, 8^{th} Edition, 2004
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House, 5^{th} Edition, 2012
3. Concepts of Genetics, Klug & Cummings, Prientice Hall, 12^{th} Edition, 2003
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory, 4^{th} Edition, 2014

OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic materialDescribe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

GECX113 FUNDAMENTALS OF PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/ SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

MODULE IV PROJECT HR MANAGEMENT 5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

MODULE V COMMUNICATION MANAGEMENT 5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management-Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE VI PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

L – 45; Total Hours –45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in a project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

GECX114 OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge and training in optimization techniques.
- To get knowledge about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations

MODULE I LINEAR PROGRAMMING PROBLEM 8

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ARTIFICIAL VARIABLE AND TWO PHASE METHOD, DUALITY 6

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships - rules of constructing the dual from primal.

MODULE III TRANSPORTATION PROBLEM & ASSIGNMENT PROBLE 8

Transportation problems – Initial basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models, Assignment problem – Minimization and Maximization type of problems by Hungarian method.

MODULE IV NETWORK AND SEQUENCING PROBLEMS 8

PERT and CPM – Network diagram – Fulkerson's rule - CPM Probability of achieving completion date – Crash time – Cost analysis. Sequencing N jobs through 2 machines and 3 machines.

MODULE V QUEUING THEORY & SIMULATION 7

Poisson arrivals and exponential service times – characteristics of Queuing models – single channel – Introduction to multi channel models – Random number generation – Monte Carlo Simulation.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS AND GAME THEORY 8

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:

1. HamdyATaha, "Operations Research an introduction", 8th edition, Phil Pearson, 2007.
2. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, "Operations Research applications and algorithms", 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, "Operations Research concepts and cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.

A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.

3. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

OUTCOMES:

At the end of the course students will be able to

- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

GECX115	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hari Singh Nalwa, "Handbook of Nanostructured Materials and Nanotechnology", Academic Press, 2000.
2. Guozhong Cao, "Nanostructures and Nano materials-Synthesis, Properties and Applications", Imperial College Press (2011).
3. Zhong Lin Wang, "Handbook of Nanophase and Nanomaterials (Vol 1 and II)", Springer, 2002.
4. Mick Wilson, KamaliKannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.

REFERENCES:

1. A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, KamaliKannangara, Michells Simmons and Burkhard Raguse, "Nano Technology – Basic Science and Emerging Technologies", 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, "Nanoscience and Nanotechnology: Fundamentals to Frontiers", Wiley, 2013.

OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GECX116	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart **carefully maintaining their vehicle and can increase driving safety.**

MODULE I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 7

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 8

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 7

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL MAINTENANCE 7

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

MODULE VI AUTO ELECTRICAL AND AIR CONDITIOING MAINTENANCE 8

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection-AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

L – 45; Total Hours –45

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by JigarA.DoshiDhruU.Panchal,JayeshP.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course student should be able to

- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- Analyze the causes and remedies for fault in transmission and drive line systems.
- Analyze the causes and remedies of steering and suspension systems.
- Analyze the causes and remedies of brake system.
- Demonstrate the procedure for wheel alignment and wheel balanced.

GECX117 FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Describe and explain basic principles of digital image processing
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems

PRE-REQUISITES:

- Basic knowledge of transforms in Mathematics

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Elements of Image Processing System, Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray Level Resolution.

MODULE II COLOR IMAGE PROCESSING 8

Fundamental of color image processing, color models- RGB, CMY, HIS, Pseudo color image processing

MODULE III IMAGE ENHANCEMENT 7

Basic gray level Transformations, Histogram Processing, Spatial Filtering

MODULE IV IMAGE TRANSFORMS 7

2D-DFT, DCT, HaarTransform,Fundamentals of 2D-wavelet transform, sub-band coding

MODULE V IMAGE SEGMENTATION AND RESTORATION 8

Point, line and edge detection methods ,Image Segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter.

MODULE VI IMAGE COMPRESSION 7

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, JPEG and MPEG Compression standards.

TOTAL HOURS : 45

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

REFERENCES

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.
- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

Group II courses
(To be offered in VII Semester)

GECX201	**GREEN DESIGN AND SUSTAINABILITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the concepts of sustainable development and fundamentals of socio economic systems.
- To understand the basics of green building and frame work for the attainment of sustainability.
- To enhance the student's interest in the design of green building and energy efficient measures in a buildings.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development-Environment and development linkages - Globalisation and environment-Population, poverty and pollution- global, regional and local environment issues-Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 8

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth-Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN 8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

Total Hours –45

TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 1995.

REFERENCES:

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- explain the objective, need for the sustainability and also the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Recommend relevant energy conservation measures in a building
- describe the elements in green building design and suggest ideas for attainting sustainability in building.

GECX202	APPROPRIATE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of appropriate technology and expose the students to the basics of financial analysis and energy fundamentals.
- To create awareness on the appropriate technology with relevant to building design, water, sanitation and waste management.
- To enhance student's interest in energy efficient techniques and impart knowledge on relevant policies.

MODULE I BASICS CONCEPTS 7

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis- discounted cash flow, and energy fundamentals.

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 7

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 7

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 8

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

MODULE V ENERGY EFFICIENT TECHNIQUES 8

Green building concepts-renewable energy sources- Solar – Steam and wind- Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 8

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

Total Hours –45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, “Appropriate Technology: Tools Choices and Implications”, Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, “Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology”, Stanford, 1986.

REFERENCES:

1. Richard Heeks, “Technology and Developing Countries: Practical Applications Theoretical Issues”, 1995.
2. John Pickford, “The Worth of Water : Technical Briefs on Health, Water and Sanitation”, Intermediate Technology Publications, 1998.

OUTCOMES:

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

- describe about the tools, choices of appropriate technology along with concepts of energy fundamentals
- conceptualize the techniques to be adopted in building design for saving energy and water.
- acquire knowledge about the techniques for water, health and sanitation management
- explain the classification, collection dispose and recycling systems adopted in waste management.
- elucidate the concepts of green building and renewable energy sources.
- express the polices relevant to technology and recommend an appropriate technology for an sustainable development.

GECX203	ENGINEERING SYSTEM MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION 6

Systems – Modelling – types – systems components – Steps in model building-Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES 7

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS 7

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS 9

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES 10

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES 6

Case Study using simulation languages

L – 45; Total Hours –45

REFERENCES:

1. Law, A.M., & W.D. Kelton, “Simulation Modelling and Analysis”, McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., “System Improvement Using Simulation”, 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, “Simulation Made Easy, A Manager’s Guide”, IIE Press, 1995.
4. Geoffrey Gordon, “Systems Simulation”, Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, “Simulation with Arena”, Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GECX204	VALUE ANALYSIS AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS 8

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES 8

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Mudge, Arthur E. “Value Engineering- A systematic approach”, McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), “Value Engineering”, Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, “Value Engineering: A Plan for Invention”, St.Lucie Press, New York, 1999.
2. Lawrence, D.M., “Techniques of Value Analysis and Engineering”, McGraw Hill 1988.
3. George, E.D., “Engineering Design: a Material and Processing Approach”, McGraw Hill, 1991.
4. Heller, D.E., “Value Management, Value Engineering and Cost Reduction”, Addison Wesley, 1988.

OUTCOMES:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.
- Apply the concept to industrial development
- Help in the product marketing

GECX205 INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT 7

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING 7

Safety in metal working-Machine guarding -Safety in welding and gas cutting -Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION 8

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY 8

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING 8

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and

maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.
Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

L – 45; Total Hours –45

REFERENCES:

1. Krishnan N.V, “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Blake R.B., “Industrial Safety”, Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., “Construction Safety, Security, and Loss Prevention”, John Wiley and Sons, 1979.
4. Fordham Cooper W., “Electrical Safety Engineering”, Butterworths, London, 1986.
5. Alexandrov M.P., “Material Handling Equipment”, Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GECX206 ADVANCED OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming – Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning-practical genetic algorithms.

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations – Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

L – 45; Total Hours –45

REFERENCES:

1. Singiresu S. Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc. 1995.
4. Kalymanoy Deb, “Optimization for Engineering Design”, PHI, 2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

At the end of the course student will be able to

- Formulate a real life situation as an optimization the problem.
- Identify the appropriate solution methodology and provide a solution

GECX 207	MATLAB SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION MATLAB DATA PRESENTATION 7

Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

MODULE II MATLAB PLOT FUNCTION 7

Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

MODULE III ROOT FINDING AND COMPUTER REPRESENTATION OF NUMBERS 7

Linearization and solving non-linear systems of equations- The Newton-Rapson method- Integers and rational numbers in different bases- Floating point numbers- Round off and errors in basic arithmetic-Significant digits when reporting results

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 8

Numerical integration and solving 1st order, ordinary differential equations (Euler’s method and Runge-Kutta)- Use of ODE function in MATLAB

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8

Converting 2nd order and higher ODEs to systems of 1st order ODEs- Solving systems of ODEs via Euler’s method and Runge-Kutta)- Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations

MODULE VI INTRODUCTION OF SIMULINK 8

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- Modeling the solution of three equations with three unknowns- Representing a model as a subsystem-Simulink demos.

L – 45; Total Hours –45

REFERENCES:

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB. CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab's capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
- Make use of Maltab visual capabilities for all engineering applications.
- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GECX208	EMBEDDED SYSTEMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

MODULE I EMBEDDED SYSTEMS OVERVIEW 8

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples-Embedded System design process.

MODULE II EMBEDDED COMPUTING PLATFORM 8

Overview of Processors and hardware units in an embedded system-CPU buses – Memory devices –Memory types- I/O devices – Designing with computing platforms-Consumer electronics architecture-Design example: Alarm clock.

MODULE III REAL TIME EMBEDDED SYSTEMS 8

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

MODULE IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS and TOOLS 8

Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

MODULE V PROGRAM MODELING IN EMBEDDED SYSTEMS 8

Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.

MODULE VI EMBEDDED SYSTEMS APPLICATION 5

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

Total Hours –45

TEXT BOOKS:

1. Marilyn Wolf , "Computers as components", Elsevier 2012.
2. Shibu. K.V, “Introduction to Embedded Systems”, Tata Mcgraw Hill,2009.
3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons,2002.

REFERENCES:

1. Sriram V Iyer and PankajGupta ,”Embedded Realtime Systems Programming ”TataMcGraw-Hill,2008
2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems",CMPBooks, 2003
3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

OUTCOMES:

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

- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.
- Analyze different domain specific applications in embedded systems.

GECX209	USABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION 6

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES 8

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN 8

Process of Interaction Design - Establishing Requirements – Design,Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING 8

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS 8

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards.

MODULE VI USER INTERFACES 7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human - Computer Interaction", John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface: Strategies for Effective Human Interaction", Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, "Usability Engineering: Process, Products, and Examples", Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GECX210 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 7

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 7

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 8

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN 8

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

MODULE V SOURCING AND TRANSPORTATION 8

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE VI INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 7

Information technology in a supply chain – CRM, ISCM, SRM in supply chain - Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

L – 45; Total Hours –45

REFERENCES:

1. Sunil Chopra and Peter Meindl, "Supply Chain Management-Strategy Planning and Operation", Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah "Supply Chain Management – Text and Cases" Pearson Education, 2008.
3. Altekar Rahul V, "Supply Chain Management-Concept and Cases", Prentice Hall India, 2005.
4. Monczka et al., "Purchasing and Supply Chain Management", Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GECX211	SYSTEMS ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

MODULE I FUNDAMENTALS OF SYSTEM DEVELOPMENT 8

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

MODULE II AUTOMATED TOOLS FOR SYSTEMS DEVELOPMENT 7

What is requirements determination? Fact finding techniques, Tools for documenting procedure and decision-CASE Tools-Need for CASE tools-Reverse engineering and reengineering- phases of the software life cycle-Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

MODULE III SYSTEM ANALYSIS 8

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

MODULE IV SYSTEM DESIGN 8

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System

Maintenance.

MODULE V USABILITY AND MEASURING USER SATISFACTION 7

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

MODULE VI SAD IN E-COMMERCE 7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-El electronic data interchange: EDI standards - virtual private networks - XML and EDI

L – 45; Total Hours –45

REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, “Modern Systems Analysis and Design”,Fifth Edition, Prentice Hall,March 2007.
2. Ned Kock, “Systems Analysis & Design Fundamentals” Sage South Asia, May 2008.
3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, “Essentials Of System Analysis And Design” Prentice Hall , August 2005.
4. Rumbaugh et al, “Succeeding with Booch and Rambaugh Methods”, Addisson Wesley, second Edition, 1998.
5. Larman, C.,” Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design”. Prentice-Hall PTR, 2002.

OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.
- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

GECX212	ADVANCED MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

MODULE I **8**

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect-Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

MODULE II **8**

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro &Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)-Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

MODULE III **8**

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers-Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

MODULE IV **7**

Nano Materials- The nanosize range- classification of nanomaterials-processing of nanomaterials-properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

MODULE V **7**

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

MODULE VI **7**

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys,Cobalt based alloys, titanium based alloys, polymers

L – 45; Total Hours –45

REFERENCES:

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6^{th} ed., Eastern Economy edition,Prentice Hall of India,2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7^{th} ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

OUTCOMES:

Students will be able to know

- significance of dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

GECX213	NATIONAL SERVICE SCHEME	L	T	P	C
		2	0	0	2

OBJECTIVES:

Primary Objective: Personality development through community service.
To achieve the above objective, the following should be adhered:

- To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- To develop certain basic skills for personality development through community development.
- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving and
- Practice national integration and social harmony.

MODULE I INTRODUCTION TO NSS 8

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme- The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

MODULE II PERSONALITY AND COMMUNITY DEVELOPMENT SKILLS 8

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

MODULE III UNDERSTANDING YOUTH 7

Definition and Profiles of youth categories, Youth Issues, Challenges and Opportunities for Youth, Youth as agent of social change & Community Mobilization Role of Youth in Nation Building. National Youth Policy.

MODULE IV SOCIAL HARMONY AND NATIONAL INTEGRATION 7

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution-Globalization and its Economic Social Political and

Cultural impacts.

L – 30; Total Hours –30

TEXT BOOKS:

- National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
- National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
- Social Problems in India, *Ram Ahuja,* 3rd Edition, 2014.

REFERENCES:

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

OUTCOMES:

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- Students will be trained to skills for personality development through community development.
- Students will gain knowledge about national integration and social harmony.
- Students will be exposed to the role of youths in Nation building Students will gain

GECX214	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have a fair knowledge in automotive pollution control.
- To understand the concept of formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engine will be taught to the students.
- To know about the instruments for measurement of pollutants
- To get introduced about emission standards

MODULE I EMISSION FROM AUTOMOBILES 8

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of ollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

MODULE II SI ENGINE EMISSIONS AND CONTROL 9

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor

MODULE III CI ENGINE EMISSION AND CONTROL 8

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE IV NOISE POLLUTION FROM AUTOMOBILES 8

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE V TEST PROCEDURES 6

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

MODULE VI EMISSION MEASUREMENTS 6

Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:

1. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, ‘Automotive Emission Control’, McGraw Hill company., Newyork 1993.

REFERENCES:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2. D.J.Patterson and N.A.Henin, ‘Emission from Combustion Engine and their control’, Anna Arbor Science Publication,1985.
3. L.Lberanek, ‘Noise Reduction’, Mcgrawhill Company., Newyork1993.
4. C.Duerson, ‘Noise Abatment’, Butterworths ltd., London1990.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, ‘Road traffic noise’,
6. Applied science publisher ltd., London,1987.

OUTCOMES:

On completion of the course student should be able to

- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.
- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

GECX215	**MOTOR VEHICLE ACT, INSURANCE AND POLICY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn arbour various types of motor vehicle polices and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE 8

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

MODULE II LICENSING OF DRIVERS OF MOTOR VEHICLES 8

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner’s licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of driving licence in certain cases- suspension or cancellation of driving licence on convection- Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE 7

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership- Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

MODULE IV INSURANCE OF MOTOR VEHICLE 8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance-Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

MODULE V CONTROL OF TRANSPORT VEHICLES 7

Power to State Government to control road transport- Transport authorities-General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles-Temporary permits

MODULE VI OFFENCES AND PUNISHMENT 7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be used by other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle

Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

L – 45; Total Hours –45

TEXT BOOKS:

1. The motor vehicle act 1988, Universal law publishing co.cpvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

REFERENCES:

1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications & Table of Offences and Punishments Asia Law House; 15th edition (2014)
2. Assessment of Compensation in Accidents under Motor Vehicles Act by Karkara Delhi Law House (2013)

OUTCOMES:

On completion of the course students should be able to

- Explain the analysis of rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze the procedure for obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

GECX216	PRINCIPLES OF COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the analog and digital modulation techniques.
- To elaborate the working of communication receivers in the presence of noise.
- To give an overview of various communication systems.

MODULE I LINEAR MODULATION 8

Baseband signals, Amplitude Modulation – Modulation Index, Power Transmitted, Double Side Band and Single Side Band AM, AM Modulators and AM Receivers, AM Radio systems, Frequency Division Multiplexing.

MODULE II ANGLE MODULATION 8

Frequency Modulation and Phase Modulation, Frequency deviation and modulation index, Bandwidth of FM, FM Modulators and FM receivers, FM Radio and FM Stereo Systems

MODULE III SAMPLING AND PULSE MODULATION 7

Sampling, Nyquist's Sampling Theorem, Pulse Modulations - PAM, PPM and PWM, Time Division Multiplexing, Bandwidth of TDM systems.

MODULE IV DIGITAL COMMUNICATION 7

Digital baseband data,Digital Modulations – ASK, FSK, PSK and QPSK. Digital Communication Transmitters and Receivers.

MODULE V NOISE 8

Sources of Noise, Thermal Noise, shot noise, White noise, Narrow band Noise, Effect of noise in communication, SNR, Receiver Noise Temperature and Noise Equivalent Bandwidth.

MODULE VI COMMUNICATION SYSTEMS & NETWORK 7

FM Radio Systems, Cellular Mobile network, Satellite Communications, Optical Fiber Communication.

L – 45; T – 0; Total Hours – 45

TEXT BOOKS:

1. A.Bruce Carlson, Paul B. Crilly, "Communication Systems", 5th Edition, McGraw Hill Int., 2011.
2. B.P. Lathi, Zhi Ding, Hari M. Gupta, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2017.

REFERENCES:

1. Herbert Taub, Donald L. Schilling, Goutam Saha, "Principles of Communication Systems" 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, "An Introduction To Analog And Digital Communications", 1st Edition, Wiley India, 2010.
3. Simon Haykin , "Communications Systems" 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, "Analog and Digital Communications" 3rd Edition,

OUTCOMES:

On completion of the course students will be able to

- Identify various communication systems and the corresponding modulation schemes.
- Predict the characteristics of various analog and digital modulation schemes.
- Interpret the effect of noise and bandwidth in a communication systems
- Apply the Nyquist criteria for a given baseband signals.
- Evaluate the performance of communication receivers.
- Demonstrate the applications of common communication systems.

GECX 217	LEAN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of the Course to make the student know about

- The basics of leanproductionmanagement,
- How Lean principles are applied to the Construction industry to improve the operation management and product development.

MODULE I **7**

Lean production – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

MODULE II **8**

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

MODULE III **7**

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

MODULE IV **8**

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools -. Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - . Cellular systems. - . Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality improvement. Standards. - . Leveling. - . Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing Poka-yoke and pull systems material handling reduction and facilities planning

MODULE V **8**

Managing change in the lean organization Human resource management and the lean enterprise Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

MODULE VI **7**

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

Total Hours –45

TEXT BOOKS:

1. The Toyota Way Field book, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

REFERENCES:

1. Readings athttp://www.leanconstruction.org/readings.htm
2. Hopp,W.J.,andSpearman,M.L.(2011).FactoryPhysics,ThirdEdition, WavelandPress,LongGrove,Il. 720pp.

OUTCOMES:

The student will be able to

- Describe the manufacturing approaches employed and the background and philosophy of lean production.
- Illustrate the concept of waste reduction
- Apply evaluation techniques that can be used in preparation for and use in learn production activities.
- Select the tools that can be used implementing lean production in production operations.
- Discuss the importance of workplace organization, pull production, cellular arrangement and employee involvement, need for employee creativity
- Describe about the Methods for promoting success in implementing lean transformations

GECX218	SPATIAL DATA MODELING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the fundamental representation and analysis of geospatial phenomena and provides the various methods and algorithms used in GIS analysis.
- To focus in terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape processes (water, sediment). The course includes analysis from lidar data, coastal change assessment and 3D visualization.

MODULE I INTRODUCTION TO GEOSPATIAL DATA 7

Mapping natural phenomena –Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

MODULE II DATA DISPLAY AND VISUALIZATION 7

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer)

MODULE III GEOSPATIAL ANALYSIS 7

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least cost path – spatial interpolation and approximation (gridding)

MODULE IV TERRAIN MODELING AND ANALYSIS 9

terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple return lidar data – spatial interpolation of elevation data and topographic analysis, line of sight, view shed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

MODULE V FLOW TRACING, WATERSHED ANALYSIS AND LANDFORMS 8

Methods for flow routing and flow accumulation – Extraction of stream networks – Extraction of watershed boundaries and building watershed hierarchies – feature extraction, types of landforms.

MODULE VI MODELING OF GEOSPATIAL PROCESSES 7

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.

Total Hours –45

TEXT BOOKS:

1. Hassan A, Karimi (2017), Geospatial Data Science Techniques and Applications, CRS Press & Co.
2. Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand (2014), Hierarchical Modeling and Analysis for Spatial Data, CRS Press & Co.

REFERENCES:

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI Press (G70.212 .G584 2005)
2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California

OUTCOMES:

On successful completion of this course, students will be able to

- apply the basic concepts of Conceptualize models as representations of real life systems with inputs, outputs, and processes.
- employ the spatial tools to make simulations and predictions of real life phenomena.
- integrate and develop models with geospatial data through GIS.
- evaluate models in terms of accuracy, sensitivity, and uncertainty.
- perform a system-based approach for problem solving, with an emphasis on sustainability.
- execute the hydrological, erosion and environmental modeling through GIS.

GECX 219	ADVANCED ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop an entrepreneurial mindset.
- To learn the tools and methods for achieving sustainable growth.
- To explore various funds for a business and to get know about importance of a good team.
- To select public image branding and examine all channel types.
- To identify technology needs and establish key metrics to measure progress the business.
- To know about legal issues, regulations of starting and operating a venture and capstone presentation on practice venture.

Course Pre-requisites Completion of Social Entrepreneurship CourseAccess to Learnwise Platform

MODULE I ENTREPRENEURSHIP BASICS & REFINING BUSINESS MODEL 8

EntrepreneurshipBasics - Recap of Key Concepts, Introduction to First Venture, Recap of idea selection and Lean Canvas, Revisit product/service, Business model, Team formation**. Refining Business Model –**Pivoting, Types of Business Model, Refining Business Models, Evaluate business model, Identify additional customer segments, Analyze Business Model of Competitors, Importance of Product Management.

MODULE II BUSINESS PLANNING & REVENUE 8

Business Planning – Introduction to Business Plan, Make a Sales Plan, Hiring Sales Team, Make a People Plan for Venture, Financial Planning and Forecasting Template, Revisit Business Model, Create a Procurement Plan, Negotiation. **Revenue** –Exploring ways to Increase Revenue, Understanding Primary Revenue Source, Customer Lifecycle for Growing Customers, Exploring Secondary Sources of Revenue.

MODULE III FUNDING GROWTH & BUILDING A-TEAM 7

Funding Growth – Funding Options for an Entrepreneur, Explore the Right Funding Options, Exploring crowd funding platforms, Create Your Funding Plan, Pitch Practice. **Building A-Team** – Intro to Building an A-Team, Defining roles and responsibilities, Pitching to Attract Talent, Setting Your Team Up for Success, Defining Role of a New Hire

.

MODULE IV BRANDING AND CHANNEL STRATEGY 7

Branding and Channel Strategy– Intro to Branding, Draw your Venture's Golden Circle, Define Your Values, Positioning Statements, Selecting Brand Name, Social Media Handle, Logo and Mobile app names forYour Venture, Creating online public profiles, Bulls Eye Framework and other traditional channel types, Identify your Right Channel using Bulls Eye Framework.

MODULE V LEVERAGING TECHNOLOGIES AND AVAILABLE PLATFORMS & MEASURING PROGRESS 8

Leveraging Technologies and Available Platforms – Leaping Ahead with Technology, Digital Marketing for Your Startup, Plan a Social Media Campaign, Digital Collaboration, Store Your Documents Online, Other Platforms, Make Your Tech Plan and Platform Wish List. Measuring Progress – Metrics for Customer Retention and Satisfaction, Find your CAC, CLV, and ARPU, Key Financial Metrics, How to Communicate Your Metrics, Find New Revenue Streams based on Your Key Financial Metrics, Re-forecast your Financial Plan to Increase Margin.

MODULE VI LEGAL MATTERS & SEEKING SUPPORT & FINAL PROJECT 7

Legal Matters – Identify the Professional Help and Legal and Compliance Requirements for Your Venture, Conduct a Trademark Search for Your Company/Brand Name. **Seeking Support** – How Mentors Help to Create Successful Startups, Identify Mentors and Advisors, Scout for Board of Directors.**Final Project –** Capstone Project Presentation.

Total Periods- 45

TEXT BOOKS

1. Learn wise platform - Wadhwani Foundation, 2018.
2. All Lessons are delivered as Online videos accessible using Wadhwani Foundation's Learnwise Platform - https://lms.learnwise.wfglobal.org

OUTCOMES:

On completion of the course, students will be able to

- Achieve sustainable growth by pivoting, refining business models, expand customer segments, and business planning for developing early customer traction into a repeatable business.
- Develop strategies to grow revenues and markets.
- Develop an A-Team, brand strategy and create digital presence.
- Develop brand and channel strategy for customer outreach
- Leverage social media to reach new customers cost effectively.
- Explore licensing and franchising for business expansion.

GECX220	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of Electric Vehicles.
- To familiarize the basic energy transfer processes that govern existing and proposed methods of power generation for Electric Vehicles.
- To familiarize with the traditional and non-traditional sources for Electric Vehicles in terms of energy content, accessibility, required processing steps and projected remaining reserves

MODULE I INTRODUCTION 8

A Brief History - Types of Electric Vehicle in Use Today : Battery electric vehicles - The IC engine/electric hybrid vehicle - Fuelled electric vehicles - Electric vehicles using supply lines - Solar powered vehicles - Electric vehicles which use flywheels or super capacitors - Ultra Capacitor – Ultra high Speed Flywheels.

MODULE II BATTERIES 7

Battery Parameters - Lead Acid Batteries - Nickel-based Batteries - Sodium-based Batteries - Lithium Batteries - Metal Air Batteries - Battery Charging - Choice of Battery - Use of Batteries in Hybrid Vehicles - Battery Modeling.

MODULE III FUEL CELLS 8

Hydrogen Fuel Cells - Fuel Cell Thermodynamics - Connecting Cells in Series - Water Management in the PEM Fuel Cell - Thermal Management of the PEM Fuel Cell - A Complete Fuel Cell System - Hydrogen Supply - Fuel Reforming - Hydrogen Storage.

MODULE IV ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS 7

Tractive Effort - Modeling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency - Electric Vehicle Chassis and Body Design - General Issues in Design.

MODULE V DESIGN OF ANCILLARY SYSTEMS 7

Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging and Refueling Systems.

MODULE VI ENVIRONMENTAL IMPACT AND ENERGY STORAGE 8

Vehicle Pollution - The Effects - A Quantitative Analysis - Vehicle Pollution in Context - Alternative and Sustainable Energy Used via the Grid Hybridization of Energy Storages - Energy Consumption in Braking - Brake System of EVs and HEVs - Antilock Brake System.

Total Hours – 45

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained",John Wiley & Sons Ltd, 2nd edition, 2015.
2. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 3rd Edition,2018.
3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
4. Tom Denton, "Electric and Hybrid Vehicles" Routledge Publishers, 1st edition, March 2016.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Identify and quantify the important energy transfer for Batteries and fuel cell schemes.
- Identify the opportunities and challenges of advances in Electric Vehicles.
- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on Resources
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
- Choose proper energy storage systems for vehicles
- Identify the current industry activities by car makers, electricity utilities, parts, suppliers (motors and batteries), including joint ventures, product announcements and pilot projects.

GECX 221	ARTIFICIAL INTELLIGENCE AND EVOLUTIONARY COMPUTING USING MATLAB	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems.
- To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and its application to real time systems.
- To expose the ideas of GA and EP in optimization and control.

MODULE I FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS 9

Objectives,history, biologicalinspiration, neuron model, McCulloch-Pitts neuron model, single-input neuron, multi-input neuron, network architectures, perceptron architecture, single-neuron perceptron, multi-neuron perceptron, perceptron learning rule, constructing learning rules, training multiple-neuron perceptron

MODULE II ASSOCIATIVE NETWORKS 9

Simple associative networks, auto-associative and hetero-associative nets, learning in neural nets, supervised and unsupervised learning, unsupervised Hebb rule, Kohonen rule, ADALINE and MADALINE network, back propagation neural networks,Hopfield networks, adaptive networks, applications using Neural Network toolbox in Matlab.

MODULE III FUZZY SET THEORY 6

Fuzzy versus crisp, crisp sets, fuzzy sets, operations and properties, membership function, crisp relations, fuzzyrelations.

MODULE IV FUZZY SYSTEMS 6

Crisp logic – fuzzy logic – fuzzy rule-based system- defuzzification methods – applications – Greg Viot’s fuzzy cruise controller - fuzzy logic control using FIS in Matlab

MODULE V FUNDAMENTALS OF GENETIC ALGORITHMS 7

Genetic algorithms, history, basic concepts, working principle, encoding, fitness function, reproduction

MODULE VI GENETIC MODELING AND APPLICATIONS 8

Genetic operators, cross over types, mutation operator, coding steps of GA, convergence characteristics, applications of AI techniques in various domains using GATOOL in matlab

Total Hours –45

REFERENCES:

1. Laurance Fausett, Englewood cliffs, N.J., ‘Fundamentals of Neural Networks’,Pearson Education, 1992.
2. Timothy J. Ross, ‘Fuzzy Logic with Engineering Applications’, Tata McGraw Hill,1997.
3. David Goldberg, “Genetic Algorithms and Machine learning”, PHI
4. Wassermann, P. D. "Neural Computing" Van Reinhold, 1988.
5. Zimmermann, H. J., 'Fuzzy Set Theory and Its Applications', 2nd Edition,Kluwer Academic Publishers.
6. Martin T. Hogan, Howard B.Demuth. M,’Neural network design’4th edition
7. Zureda, J.M.,’Introduction to Artificial Neural Systems’, Jaico publishing house Bombay, 1994.
8. Bose N.K, Liang P. 'Neural Network Fundamentals with graphs, Algorithms and applications', TMH Pub. Co. Ltd, 2001.
9. S.Rajasekaran, G.A.Vijayalaksmi Pai , Neural Networks, Fuzzy logic and Genetic algorithms Synthesis and Applications , PHI private learning Ltd.,.New Delhi, 2011.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge andachieve skills on the following:

- Enumerate the theoretical basis of soft computing.
- Discuss the neural networks and supervised and unsupervised learning networks
- Design suitable neural networks, fuzzy systems, genetic representations with appropriate fitness functions for simple problems
- Apply the most appropriate soft computing algorithm for a given situation
- Know the key issues in using these techniques for search of difficult search-spaces
- Be aware of the different approaches and different applications in the field.