B. Tech. (Biotechnology)

2015 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai
Approved by AICTE - Accredited by NBA New Delhi, NAAC with 'A' Grade and ISO 9001:2008 Certified)

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REGULATIONS 2015

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2015 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2015 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2015-2016 for Regular admission (Academic year 2016-2017 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

- Higher Secondary Examination (10 +2) of Curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / Directorate of Technical Education (DoTE), Chennai as equivalent thereto.

(or)

- Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for Lateral Entry admission to the third semester of B.E. / B.Tech. Programmes in the branch of study as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time.

(or)

1.2.2 The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for Lateral Entry admission to the third semester of B.E./B.Tech. Programmes, as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

i. Aeronautical Engineering
ii. Agricultural Engineering
iii. Automobile Engineering
iv. Civil Engineering
v. Computer Science and Engineering
vi. Electrical and Electronics Engineering
vii. Electronics and Communication Engineering
viii. Electronics and Instrumentation Engineering
ix. Mechanical Engineering
x. Mechatronics

B. Tech. Programmes

i. Biotechnology
ii. Fashion Technology
iii. Information Technology
iv. Textile Technology
v. Food Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, mini-project, life-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

(i) **Basic Science** courses including Mathematics, Physics, Chemistry and further specialization in these subjects

(ii) **Basic Engineering c**ourses including Engineering Graphics, Workshop Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science c**ourses including Language Courses, Management Courses, Life Skills and Professional Ethics.

(iv) **Professional Courses** include Discipline Core Courses, Professional Electives, Core Electives and Open Electives.

(v) **Employability Enhancement Courses (EEC)** include Project Work and /or Internship, Seminar, Industrial /Practical Training, Value Added and Certificate Courses.

The assortment of different courses shall be designed that the student, at the end of the programme, would be able to be trained not only in his / her relevant professional field but also as a socially mindful human being.

The medium of instruction is English for all the Courses, Examinations, Seminar Presentation, Projects and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits, with 1 credit per lecture period per week, 1 credit for 2 periods of tutorial, 1 credit for 2 periods of laboratory courses, and 1 credit for 2 periods of seminar/project work per week.

3.3 A Diagnostic Test will be administered to all the B.E. / B.Tech. students after the admission to assess the proficiency in English and based on the score they will be brought under two streams namely, Stream A and Stream B. Students under Stream A will study **Communicative English I** and Stream B will study **Basic English I** under Language Elective I in the First Semester. In the Second Semester, Stream A will be further divided into two categories based on their English language proficiency assessed in the Continuous Assessment, while the upper segment can enroll and study **German / Japanese / French / Chinese / Hindi** and the remaining students of that Stream will study **Communicative English II**. The students under Stream B will study **Basic English II** or may opt for **Communicative English II** based on the assessment carried out at the end of the semester I.

3.4 Every student shall be required to opt for **Nine** electives from the list of electives. Students can opt for the electives (Core / Professional / Open Elective) from any branch of B.E/B.Tech. Programmes, besides his / her own discipline courses, during V to VIII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of three electives as open electives from the list of open electives of the branch / branches other than his / her branch of specialisation. There shall be no pre-requisite course(s) for such open electives.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hour duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VII as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other Departments, provided the student has fulfilled the necessary pre-requisites or the courses that may not require any pre-requisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any Department / Centre and a maximum batch size for a given course shall not exceed 40. In the case of disciplines with multiple divisions (intake more than 60) different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, Credits will be indicated in the Grade Sheet, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the Electives (other than open elective) of the Semester VIII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VIII Semester, following the equivalence norm, that **one regular elective (**in the **VIII Semester)** is equivalent to **three one-credit courses** completed by the student during the previous semesters, IV to VII. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However one credit courses completed during I to III semesters shall be maintained in the Grade sheet as “Additional credits earned” (not considered for the computation of GPA/CGPA).

3.7 Fast Track System shall enable students to undergo a semester-long Internship or Special Training during Semester VIII. A student who secures a minimum CGPA of 8.50 in Semester IV with no current arrears, as on that date and maintains the CGPA of 8.50 till VI Semester without any arrears shall be eligible to opt for Fast Track System and such student is required to complete three elective courses satisfactorily, while completion of Semester VII, as additional Credits during the semesters V to VII.

3.8 Every student shall be required to carry out a Project Work in the Department / Industry or by exercising Fast track during VIII Semester in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the VIII Semester for the valuation.

3.9 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not be considered for computing the CGPA.

3.10 A Student may be permitted to credit online courses with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. Such students may be exempted from attending the classes, if such course(s) are offered in the semester. Summary of such on-line courses, taken by the students, along with the offering agency shall be presented to the Academic Council for information and further suggestions. However, those students need to obtain certification from the agency / agencies offering the course, to become eligible for writing or seeking exemption (core elective course) from the End Semester Examination. In case of credits earned through online mode, from the other Institute / University, the credits may also be transferred directly after due approval from the Departmental Consultative

Committee and the Office of the Controller of Examinations. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Discipline elective or Open elective).

4. VALUE ADDED COURSES / ADD-ON COURSES

A Student can opt for the Value Added Courses / Add-on Courses offered by the various Department / Centres for which the batch size will not exceed 40 per course from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 Semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 90 working days or 450 periods of 60 minutes each or equivalent. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified

(Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a Faculty Advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum in** the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In the case, if a student fails to register in the course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

6.4.1 A student has to earn the total number of credits specified in the Curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one- credit courses, self study electives or additional courses.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. Total number of credits of such courses cannot exceed 6 in a given Semester. However the maximum number of credits that a student can register in a particular semester shall not exceed 30 credits (regardless to the reappearance credits). In such cases, the attendance requirement as stated Clause 7 is mandatory.

6.4.3 The minimum number of credits that a student can register in a particular semester shall not be less than 18 credits (except VII / VIII semester).

6.4.4 The student shall register for the project work in the VIII semester only.

6.5 Reappearance Registration

6.5.1 If a student fails in a theory course, the student shall do reappearance registration (Examination) for that course in the subsequent semesters or when it is offered next.

6.5.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any Laboratory Course/ Project work / Seminar or any other EEC courses (Specified in Clause 3.1) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance (Physical presence) course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/ International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 In the case of reappearance registration for a course (vide Clause 6.5), the student has to register for examination in that course by paying the prescribed fee.

7.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a Faculty member of the Department who shall function as Faculty Advisor for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester.

First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of one credit courses / certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and practical including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.

10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2. Supplementary Examinations may also be conducted, at such times, for the benefit of the students as decided by the Controller of Examinations.

10.4 For the End Semester examinations, both theory and practical courses including project work, the internal and external examiners (from Academia or Industry) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination and Evaluation Board of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 A student who secures not less than 50% of total marks prescribed for a course, vide Clause 16, comprising a minimum of 50% of the marks prescribed for the End Semester Examination, shall be declared to have passed the course successfully and earned the prescribed credits for that course, applicable for all registered courses.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall register and reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

11.1.2 Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester Examinations.

11.2 The minimum number of total credits to be earned by a student to qualify for the award of Degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	Minimum Credits	
	Regular Admission	Lateral Entry
B.E. Programmes		
Aeronautical Engineering	178	134
Agricultural Engineering	177	133
Automobile Engineering	179	134
Civil Engineering	176	131
Computer Science and Engineering	176	131
Electrical and Electronics Engineering	176	132
Electronics and Communication Engineering	177	132
Electronics and Instrumentation Engineering	177	133
Mechanical Engineering	179	135
Mechatronics	177	133
B.Tech. Programmes		
Biotechnology	175	131
Fashion Technology	176	132
Information Technology	176	131
Textile Technology	175	131
Food Technology	175	131

11.2.1 Student Migration and Credit Transfer: Normalization of the Credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of Institution, if a student migrates from other institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.3 A student shall be declared to have qualified for award of B.E/B.Tech. Degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and number credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.3), while the Letter Grade is an index of the performance of a student in a said course.

12.3 The performance of a student will be reported using Letter Grades, each carrying certain points as detailed below:

Range of Total Marks (as specified in Clause 16) / Specific Reason	Grade Points	Letter Grade
91 to 100	10	O (Outstanding)
81 to 90	9	A + (Excellent)
71 to 80	8	A (Very Good)
61 to 70	7	B + (Good)
50 to 60	6	B (Above average)
0 to 49	0	RA (Reappearance Registration)
Incomplete	0	I
Withdrawal	0	W
Absent	0	AB
Shortage of Attendance	0	SA

‘RA’ ---Reappearance registration is required for that particular course

‘I’ --- Continuous evaluation is required for that particular course in the subsequent examinations.

‘SA’ --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.4 After completion of the evaluation process, Grade Point Average (GPA), and the Cumulative Grade Point Average (CGPA) is calculated using the formula:

$$GPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of GPA and all the semesters, under consideration, in the case CGPA.

12.5 A student who does not appear for the End Semester Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.6 For the non credit courses Grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of GPA/CGPA.

12.7 **Photocopy / Revaluation:** A student, who seeks the re-valuation of the answer script is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s), within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the Department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless to the period of Break-of-study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 **First Class with Distinction**: A student who qualifies for the award of the Degree having passed all the courses of study of all the Eight Semesters (six semesters for lateral entry students) at the first opportunity, after the commencement of his / her study and securing a CGPA not less than 8.50 (vide clause 12.3) shall be declared to have passed with **First Class with Distinction**.

13.2 **First Class**: A student who qualifies for the award of the Degree having passed all the courses of study of all the eight semesters (six semesters for lateral entry students) after the commencement of his / her study and securing a CGPA not less than 6.50 shall be declared to have passed with **First Class** (not exceeded the total duration as specified in the Clause 5).

13.3 **Second Class**: All other students who qualify for the award of the Degree shall be declared to have passed in **Second Class.**

13.4 Course Completion Certificate shall be given to a student, provided he / she should have registered all the courses and also registered for the examinations in those courses (subject to Clause 6.0 and 7.0).

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if such request for withdrawal is made prior to the submission of the Continuous Assessment marks of the course(s) with the recommendations from the Head of the Department.

14.3 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break-of-study (for one academic semester or 6 months, whichever is earlier). However, a student detained for want of minimum attendance requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to rejoin the programme after the break shall be governed by the rules and regulations of DoTE and the Curriculum and Regulations in force at the time of rejoining, subject to the Clause 11.2.1.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of Degree (vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break-of-study may be granted by the Head of the Institution for a period not more than one year (total duration or two semesters whichever is earlier) in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended Break of Study, the name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Test I (15)	
	Test II (15)	
	Open book test (10)	
	Library - Seminars / Assignments (Two) (10)	
	End Semester Examination	**50**
	Total Marks	**100**

II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Test I (10)	
	Test II (10)	
	Conduct of Experiment	
	Preparation(5)	
	Experiment and Results (5)	
	Record Note#	
	Final Lab Examination (20)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**

III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (5)	
	ii. Experiment and Results (10)	
	iii. Record / Observation# (5)	
	Test – Cycle I (15)	
	Test – Cycle II (15)	
	End Semester Examination	
	Experiments & Results (40)	**50**
	Viva Voce – (10)	
	Total Marks	**100**

Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department

IV	**TECHNICAL SEMINAR**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Presentation I (25)	
	Presentation II (25)	
	End Semester Examination	
	Report# (20) *Presentation (20)* *Viva voce (10)*	**50**
	Total Marks	**100**
V	**PROJECT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Literature survey (10)	
	Problem Identification (5)	
	Methodology (10)	
	Review II	
	Continuation in Methodology (10)	
	Results / Progress (15)	
	End Semester Examination	
	Report# (20) *Presentation (20)* *Viva voce (10)*	**50**
	Total Marks	**100**
VI	**LANGUAGE ELECTIVE (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test 1	
	Listening (10) *Speaking (5)* *Reading (5)* *Writing (5)*	**25**
	Test 2	
	Listening (10) *Speaking (5)* *Reading (5)* *Writing (5)*	**25**
	Oral Exam	**50**
	Total Marks	**100**

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VII	**ONE-CREDIT COURSE**	**Marks**
	Test	**30**
	Quiz	**20**
	Final Examination	**50**
	Total Marks	**100**
VIII	**MINI-PROJECT**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Review I	**25**
	Review II	**25**
	Project Evaluation	
	Report (25)[#]	**50**
	Presentation&Viva Voce (25)	
	Total Marks	**100**
IX	**LIFE SKILLS**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory/Not Satisfactory)	
X	**VALUE ADDED / CERTIFICATE COURSES**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory / Not Satisfactory)	
XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Class work (based on attendance) (5)	
	Assignments (Minimum 8 Assignments) (20)	
	Model Examination (25)	
	End Semester Examination	**50**
	Total Marks	**100**

[#] *Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department*

Optional Test: *A student becomes eligible to appear for the one optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.*

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

Heads of Departments, in order to provide the experiential learning to the students, shall take efforts to arrange at least two industrial visits / field visits in a semester. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

18. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year, failing which he/she shall not be permitted to appear for the End Semester examinations of semester II and there onwards. Such students are permitted to appear for the End Semester examinations of semester II and there onwards only after completing satisfactorily the requirements.

The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

19. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

The Question Paper pattern (Theory Examination) for UG Programme is given below:

	PART A	
Objective Type Questions: 20	**(20X1 = 20 Marks)**	**20**
	PART B	
Short Answer Questions: 10	**(10X2 = 20 Marks)**	**20**
	PART C	
Long Answer Questions: 5	**(5X12 = 60 Marks)**	**60**

	Total	**100**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Utilize their high standards of professional ethics, team spirit and technical excellence to pursue higher education and research in national and international institutes of repute

II. Serve as an interface between process, product and technology, contribute to the core domain and allied areas

III. Exhibit the professional responsibility in various fields of Biotechnology for sustainable development of the society

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

a. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **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.

c. **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.

d. **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.

e. **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.

f. **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.

g. **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.

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

i. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **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.

k. **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.

l. **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.

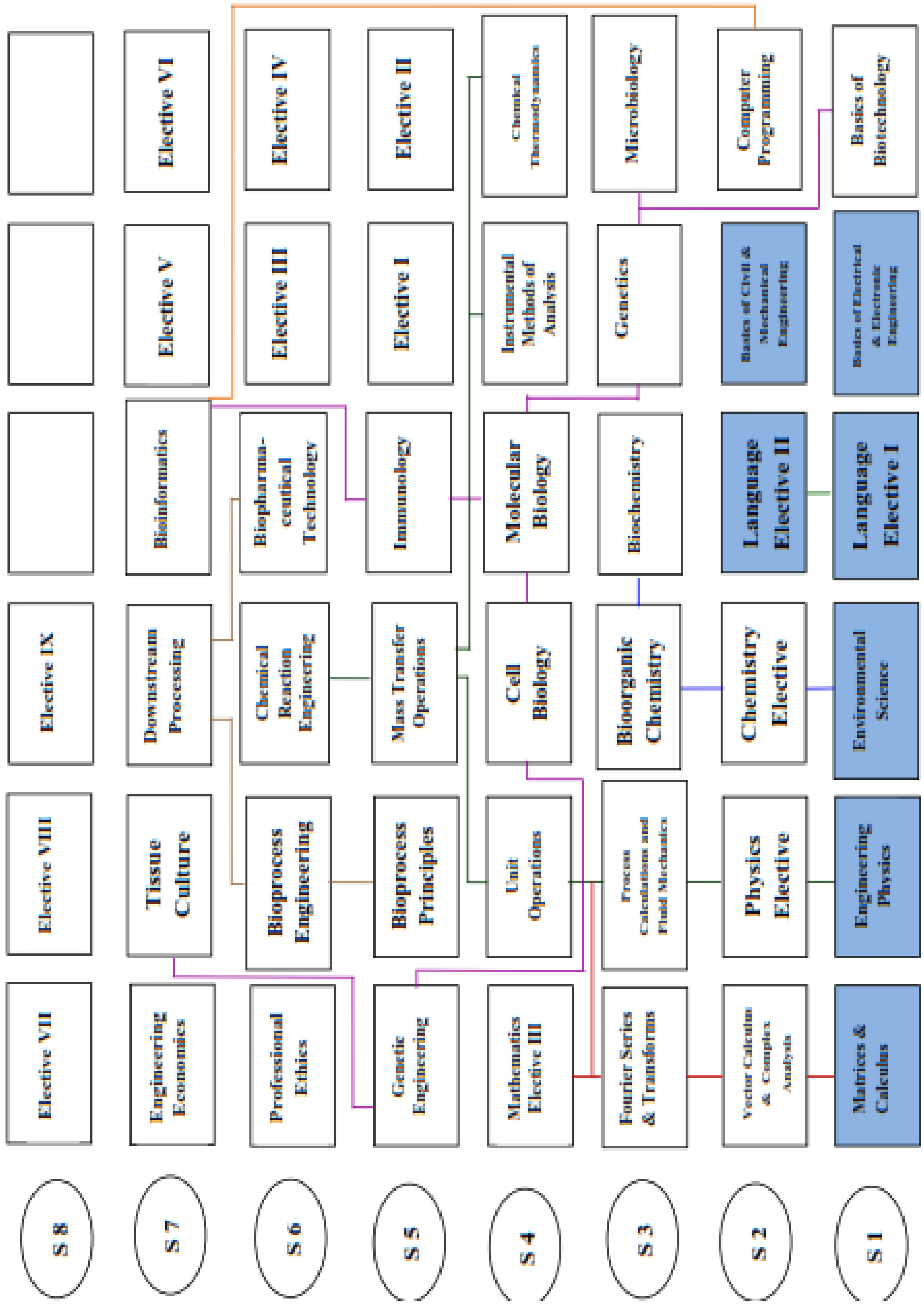
Program Specific Outcome (PSOs)

1. Use the analytical instruments and techniques to separate, purify and characterize biological compounds
2. Design and synthesis of the novel biomolecule for the agriculture and healthcare sectors
3. Conceive, Plan and Deploy societal projects for environmental protection using Bioresources.

Mapping of PEOs and POs

POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO1	X	X	X		X	X				X	X	
PEO2		X	X	X		X		X		X	X	X
PEO3						X	X		X		X	X

DEPATMENT OF BIOTECHNOLOGY - CONNECTIVITY CHART



B.Tech - BIOTECHNOLOGY
Minimum Credits to be Earned : 175

First Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA101	MATRICES AND CALCULUS*	I,II,III	a,b	3	2	0	4	50	50	100	BS
15PH102	ENGINEERING PHYSICS*	I,II,III	a	2	0	2	3	50	50	100	BS
15CH103	ENVIRONMENTAL SCIENCE*	I,II,III	g	2	0	2	3	50	50	100	HSS
	LANGUAGE ELECTIVE I#	-	-	-	-	-	3	100	-	100	HSS
15GE105	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING∆	I,II	a	2	0	2	3	50	50	100	ES
15BT106	BASICS OF BIOTECHNOLOGY	I,II,III	a, b, c	3	0	0	3	50	50	100	ES
15GE107	WORKSHOP PRACTICEΩ	I,II	a, e	0	0	2	1	50	50	100	ES
Total				**12**	**2**	**8**	**20**	**400**	**300**	**700**	

Second Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA201	VECTOR CALCULUS AND COMPLEX ANALYSIS*	I,II,III	a, b	3	2	0	4	50	50	100	BS
	PHYSICS ELECTIVE*	-	-	-	-	-	4	50	50	100	BS
	CHEMISTRY ELECTIVE*	-	-	-	-	-	4	50	50	100	BS
	LANGUAGE ELECTIVE II#	-	-	-	-	-	3	100	-	100	HSS
15GE205	BASICS OF CIVIL AND MECHANICAL ENGINEERING⊕	II	a	3	0	0	3	50	50	100	ES
15GE206	COMPUTER PROGRAMMINGΨ	II	g	3	0	2	4	50	50	100	ES
15GE207	ENGINEERING GRAPHICSλ	I,II,III	a, b, d, e	0	0	4	2	50	50	100	ES
Total				**9**	**2**	**6**	**24**	**400**	**300**	**700**	

* Common to all branches of B.E./B.Tech
# Common to all branches of B.E./B.Tech (Continuous Assessment)
∆ Common to AE,AG,AU,CE,ME,MTRS,BT,TT,FD (I Semester) and to CSE,FT,IT (II Semester)
Ω Common to AE,AG,AU,ME,MTRS,BT,FT,TT,FD (I Semester) and to CE,CSE,ECE,EEE,EIE,IT (II Semester)
⊕ Common to CSE,ECE,EEE,EIE,FT,IT (I Semester) and to MTRS, BT,TT, FD (II Semester)
Ψ Common to CE (I Semester) and to AE,AG,AU,ME,MTRS,BT,FT,TT,FD (II Semester)
λ Common to CE,CSE,ECE,EEE,EIE,IT (I Semester) and to AE, AG,AU,ME,MTRS,BT,FT,TT,FD (II Semester)

Third Semester											
Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA301	FOURIER SERIES AND TRANSFORMS[α]	I,II,III	a, b	3	2	0	4	50	50	100	BS
15BT302	PROCESS CALCULATIONS AND FLUID MECHANICS	I,II	a,b	3	2	0	4	50	50	100	ES
15BT303	BIOORGANIC CHEMISTRY	I,II,III	a,b,g,i,k	3	0	0	3	50	50	100	PC
15BT304	BIOCHEMISTRY	I,II,III	a,b,c,g,i,j,k	3	0	0	3	50	50	100	PC
15BT305	GENETICS	I,II,III	a,b,c,d	3	0	0	3	50	50	100	PC
15BT306	MICROBIOLOGY	I,II,III	a,b,c,g,i	3	0	0	3	50	50	100	ES
15BT307	BIOCHEMISTRY AND BIOORGANIC CHEMISTRY LABORATORY	I,II	b,c,d,e,g,i	0	0	2	1	50	50	100	PC
15BT308	MICROBIOLOGY LABORATORY	I,II	b,c,d,e	0	0	2	1	50	50	100	PC
15BT309	MINI PROJECT I	I, III	a-l	0	0	2	1	100	-	100	EEC
15GE310	LIFE SKILLS: BUSINESS ENGLISH[Φ]	III	j	0	0	2	-	100	-	100	EEC
Total				**18**	**4**	**8**	**23**	**600**	**400**	**1000**	

Fourth Semester											
Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA401	NUMERICAL METHODS AND STATISTICS[β]	I,II,III	a, b	2	2	0	3	50	50	100	BS
15BT402	UNIT OPERATIONS	I,II,III	a,b,c	3	0	0	3	50	50	100	ES
15BT403	CELL BIOLOGY	I,II	a,b,d	3	0	0	3	50	50	100	PC
15BT404	MOLECULAR BIOLOGY	I,II,III	a,b,g,i	3	0	0	3	50	50	100	PC
15BT405	INSTRUMENTAL METHODS OF ANALYSIS	I,II,III	a,b,c,d,g,i,k	2	2	0	3	50	50	100	PC
15BT406	CHEMICAL THERMODYNAMICS	I,II,III	a,b,g,i	3	2	0	4	50	50	100	ES
15BT407	CELL AND MOLECULAR BIOLOGY LABORATORY	I,II	b,d,e	0	0	2	1	50	50	100	PC
15BT408	CHEMICAL ENGINEERING LABORATORY	I,II	a,b,c,d	0	0	2	1	50	50	100	ES
15BT409	MINI PROJECT II	I, III	a-l	0	0	2	1	100	-	100	EEC
15GE410	LIFE SKILLS: VERBAL ABILITY[Φ]	III	j	0	0	2	-	100	-	100	EEC
Total				**16**	**6**	**8**	**22**	**600**	**400**	**1000**	

[α] Common to all branches of B.E./B.Tech. except CSE
[Φ] Common to all branches of B.E./B.Tech (Non-Credit Course)

[β] Common to AG,AU,ME,MTRS,EEE,EIE,BT,TT,FT,FD

Fifth Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15BT501	GENETIC ENGINEERING	I,II,III	a,b,c,g,i	3	0	0	3	50	50	100	PC
15BT502	BIOPROCESS PRINCIPLES	I,II,III	a,b,c	3	0	0	3	50	50	100	PC
15BT503	MASS TRANSFER OPERATIONS	I,II,III	b,c,d,g,i,j	3	2	0	4	50	50	100	PC
15BT504	IMMUNOLOGY	I,II,III	a,b,c,e	2	0	2	3	50	50	100	PC
	ELECTIVE I	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE II	-	-	-	-	-	3	50	50	100	PE
15BT507	BIOPROCESS LABORATORY-I	I,II	a,b,d,e	0	0	2	1	50	50	100	PC
15BT508	GENETIC ENGINEERING LABORATORY	I,II	b,d,e	0	0	2	1	50	50	100	PC
15BT509	TECHNICAL SEMINAR I	I	i,j	0	0	2	1	50	50	100	EEC
15BT510	MINI PROJECT III	I, III	a-l	0	0	2	1	100	-	100	EEC
15GE511	LIFE SKILLS: APTITUDE I$^{\Phi}$	III	a,b	0	0	2	-	100	-	100	EEC
Total				**11**	**2**	**12**	**23**	**650**	**450**	**1100**	

Sixth Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15GE601	PROFESSIONAL ETHICS^{+}	I,II	f,g,h	2	0	0	2	50	50	100	HSS
15BT602	BIOPROCESS ENGINEERING	I,II,III	a,b,c,d,e,f, g,i,j,k	3	2	0	4	50	50	100	PC
15BT603	CHEMICAL REACTION ENGINEERING	I,II,III	b,c,e,i,j,k	3	2	0	4	50	50	100	PC
15BT604	BIOPHARMACEUTICAL TECHNOLOGY	I,II	a,i,j,k	3	0	0	3	50	50	100	PC
	ELECTIVE III	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IV	-	-	-	-	-	3	50	50	100	PE
15BT607	BIOPROCESS LABORATORY-II	I,II	a,b,c,d,e,f, g,i,j,k	0	0	2	1	50	50	100	PC
15BT608	BIOPHARMACEUTICAL TECHNOLOGY LAB	I,II	b,c,e,h	0	0	2	1	50	50	100	PC
15BT609	TECHNICAL SEMINAR II	I	i,j	0	0	2	1	50	50	100	EEC
15BT610	MINI PROJECT IV	I,III	a-l	0	0	2	1	100	-	100	EEC
15GE611	LIFE SKILLS: APTITUDE II$^{\Phi}$	III	a,b	0	0	2	-	100	-	100	EEC
Total				**11**	**4**	**10**	**23**	**650**	**450**	**1100**	

$^{\Phi}$ Common to all branches of B.E./B.Tech (Non-Credit Course)

$^{+}$ Common to AE, AU,CE,ME,MTRS,BT,FT,TT, FD (VI Semester) and to CSE,ECE,EEE,EIE,IT (VII Semester)

Seventh Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15GE701	ENGINEERING ECONOMICS[$]	I,II	a,f,g,k,l	3	0	0	3	50	50	100	HSS
15BT702	TISSUE CULTURE	I,II,III	a,c,i,k	3	0	0	3	50	50	100	PC
15BT703	DOWNSTREAM PROCESSING	I,II,III	a,b,c,d,i	3	2	0	4	50	50	100	PC
15BT704	BIOINFORMATICS	I,II	a,b,d,e	2	0	2	3	50	50	100	PC
	ELECTIVE V	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VI	-	-	-	-	-	3	50	50	100	PE
15BT707	TISSUE CULTURE LABORATORY	I,II	b,d	0	0	2	1	50	50	100	PC
15BT708	DOWNSTREAM PROCESSING LABORATORY	I,II,III	a,b,c,d,g,i,j	0	0	2	1	50	50	100	PC
15BT709	MINI PROJECT V	I, III	a-l	0	0	2	1	100	-	100	EEC
15GE710	LIFE SKILLS : COMPETITIVE EXAMS[Φ]	III	a,b,l	0	0	2	-	100	-	100	EEC
			Total	**11**	**2**	**10**	**22**	**600**	**400**	**1000**	

Eight Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
	ELECTIVE VII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VIII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IX	-	-	-	-	-	3	50	50	100	PE
15BT804	PROJECT WORK	I,II,III	a-l	-	-	-	9	50	50	100	EEC
			Total	**-**	**-**	**-**	**18**	**200**	**200**	**400**	

[$] Common to CSE,ECE,EEE,EIE,IT (VI Semester) and to AE, AG,AU,CE,ME,MTRS,BT,FT,TT, FD (VII Semester)
[Φ] Common to all branches of B.E./B.Tech (Non-Credit Course)

Electives							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
LANGUAGE ELECTIVES							
15LE101	BASIC ENGLISH I	III	j	3	0	0	3
15LE102	COMMUNICATIVE ENGLISH I	III	j	3	0	0	3
15LE201	BASIC ENGLISH II	III	j	3	0	0	3
15LE202	COMMUNICATIVE ENGLISH II	III	j	3	0	0	3
15LC203	CHINESE	III	j	3	0	0	3
15LF203	FRENCH	III	j	3	0	0	3
15LG203	GERMAN	III	j	3	0	0	3
15LH203	HINDI	III	j	3	0	0	3
15LJ203	JAPANESE	III	j	3	0	0	3
PHYSICS ELECTIVES							
15PH201	PHYSICS OF MATERIALS	I	a	3	0	2	4
15PH202	APPLIED PHYSICS	I	a	3	0	2	4
15PH203	MATERIALS SCIENCE	I	a	3	0	2	4
15PH204	PHYSICS OF ENGINEERING MATERIALS	I	a	3	0	2	4
15PH205	SOLID STATE PHYSICS	I	a	3	0	2	4
CHEMISTRY ELECTIVES							
15CH201	ENGINEERING CHEMISTRY	I	a	3	0	2	4
15CH202	APPLIED CHEMISTRY	I	a	3	0	2	4
15CH203	APPLIED ELECTROCHEMISTRY	I	a	3	0	2	4
15CH204	INDUSTRIAL CHEMISTRY	I	a	3	0	2	4
15CH205	WATER TECHNOLOGY AND GREEN CHEMISTRY	I	a	3	0	2	4
DISCIPLINE ELECTIVES							
15BT001	FOOD BIOTECHNOLOGY	I,II	a,b,c,d,e,j,k	3	0	0	3
15BT002	VACCINE TECHNOLOGY	I,II	c,h,k	3	0	0	3
15BT003	AGRO INDUSTRIAL BIOTECHNOLOGY	I,II	a,b,c,d,f,i	3	0	0	3
15BT004	STEM CELL TECHNOLOGY	I,II	a,b,c,d,e,f,g,h,j,k	3	0	0	3
15BT005	ENVIRONMENTAL BIOTECHNOLOGY	I,II	a,b,c,e,g,j	3	0	0	3
15BT006	BIOMASS AND BIOENERGY	I,II	a,b,d,h,i,k	3	0	0	3
15BT007	BIOPOLYMERS	I,II	a,b,c,i	3	0	0	3
15BT008	TISSUE ENGINEERING AND BIOMATERIALS	I,II	a,b,c,d,e,f,g,h,i,k	3	0	0	3

15BT009	BIOSENSORS	I,II	b,c,i,k	3	0	0	3
15BT010	CANCER BIOLOGY	I,II	a,b,c,d,e,f,g,h	3	0	0	3
15BT011	MOLECULAR MODELING	I,II	a,b,d,g,i,k	3	0	0	3
15BT012	BIOPHYSICS	I,II	a,b,g,i	3	0	0	3
15BT013	MOLECULAR PATHOGENESIS AND DISEASE DIAGNOSIS	I,II	b,c,i	3	0	0	3
15BT014	BIOETHICS,BIOSAFETY AND IPR	I,II	b,c,d,e,h,i,j,k	3	0	0	3
15BT015	SYSTEMS AND SYNTHETIC BIOLOGY	I,II	e,g,h,i	3	0	0	3
15BT016	METABOLIC ENGINEERING	I,II	a,b,g,i	3	0	0	3
15BT017	NANOBIOTECHNOLOGY	I,II	a,b,c,d,e,h,i	3	0	0	3
15BT018	PROTEOMICS AND GENOMICS	I,II	e,h,i	3	0	0	3
15BT019	ENZYME AND PROTEIN ENGINEERING	I,II	a,b,c,d,g,h,i,k	3	0	0	3
15BT020	BIOENTREPRENEURSHIP	I,II	b,c,j	3	0	0	3
15BT021	MARINE BIOTECHNOLOGY	I,II	a, b, c, i	3	0	0	3
ENTREPRENEURSHIP ELECTIVES							
15GE001	ENTREPRENEURSHIP DEVELOPMENT I	II	b,c,d, e, f & k	3	0	0	3
15GE002	ENTREPRENEURSHIP DEVELOPMENT II	II	b,c, h, i, j & k	3	0	0	3
PHYSICAL SCIENCE ELECTIVES							
15GE0P1	NANOMATERIALS SCIENCE	I,II	a	3	0	0	3
15GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	I,II	a	3	0	0	3
15GE0P3	APPLIED LASER SCIENCE	I,II	a	3	0	0	3
15GE0C1	CORROSION SCIENCE	I,II	a	3	0	0	3
15GE0C2	ENERGY STORING DEVICES AND FUEL CELLS	I,II	a	3	0	0	3
15GE0C3	POLYMER CHEMISTRY AND PROCESSING	I,II	a	3	0	0	3
OPEN ELECTIVES							
15BT0YA	WASTE MANAGEMENT AND UTILIZATION	I,II	c,d,i	3	0	0	3
15BT0YB	FOOD PROCESS ENGINEERING	I,II	a,e,i	3	0	0	3
15BT0YC	BIOFUELS	I,II	a,c,g	3	0	0	3
15BT0YD	MUSHROOM CULTIVATION TECHNOLOGY	I,II	a,b,c,d,i,j	3	0	0	3
15BT0YE	FORENSIC TECHNOLOGY	I,II	a,c,g	3	0	0	3
ONE CREDIT COURSES							
15BT0XA	MOLECULAR MARKER TECHNOLOGIES	I,II	a,i,k	-	-	-	1
15BT0XB	TRANSLATIONAL RESEARCH AND TECHNOLOGY TRANSFER	I,II	a,i	-	-	-	1
15BT0XC	MARINE FOOD TECHNOLOGY	I,II	a,i	-	-	-	1
15BT0XD	BEVERAGE, BAKING AND CONFECTIONERY TECHNOLOGY	I,II	a,i	-	-	-	1
15BT0XE	APPLIED BIOLOGICAL MODELLING	I,II	a,i,k	-	-	-	1

15BT0XF	HPLC FUNDAMENTALS IN BIOTECH INDUSTRY	I,II	a,i	-	-	-	1
15BT0XG	PROCESS VALIDATION AND QUALITY ASSURANCE FOR BIOPRODUCTS	I,II	a,i	-	-	-	1
ADDITIONAL ONE CREDIT COURSES (I to III Semesters)							
15GE0XA	HEALTH & FITNESS	-	-	-	1		
15GE0XB	FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY	-	-	-	1		
15GE0XC	VEDIC MATHEMATICS	-	-	-	1		
15GE0XD	INTRODUCTION TO ALGORITHMS	-	-	-	1		
15GE0XE	ETYMOLOGY	-	-	-	1		
15GE0XF	HINDUSTANI MUSIC	-	-	-	1		
15GE0XG	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	-	1		
15GE0XH	AGRICULTURE FOR ENGINEERS	-	-	-	1		
15GE0XI	INTRODUCTION TO DATA ANALYSIS USING SOFTWARE	-	-	-	1		
15GE0XJ	ANALYSIS USING PIVOT TABLE	-	-	-	1		
BRIDGE COURSES							
15BTB01	FUNDAMENTALS OF BIOTECHNOLOGY						
15BTB02	ENGINEERING DRAWING & GRAPHICS						
VALUE ADDED COURSES							
15BTV01	PHARMACEUTICAL MICROBIOLOGY						

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	7	12	4	3	-	-	-	-	26	15%	15%	20%
2	ES	9	7	7	8	-	-	-	-	31	18%	15%	20%
3	HSS	6	3	-	-	-	2	3	-	14	8%	5%	10%
4	PC	-	-	11	10	15	13	12	-	61	35%	30%	40%
5	PE	-	-	-	-	6	6	6	9	27	14%	10%	15%
6	EEC	-	-	1	1	2	2	1	9	16	10%	10%	15%
Total		22	22	23	22	23	23	22	18	175	100%	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course

CA - Continuous Assessment
ES - End Semester Examination

15MA101 MATRICES AND CALCULUS 3 2 0 4

(Common to all Branches)

Course Objectives

- Interpret the introductory concepts of Matrices and Calculus, which will enable them to model and analyze physical phenomena involving continuous changes of variables
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Matrices and Calculus.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Course Outcomes (COs)

1. Analyze the characteristics of a linear system with Eigen values and vectors.
2. Identify and model the real time problem using first order linear differential equations.
3. Recognize and solve the higher order ordinary differential equations.
4. Characterize the functions and get the solutions of the same.
5. Integrate the functions for evaluating the surface area and volume.

UNIT I **9 Hours**

MATRICES

Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values-Stretching of elastic membranes. Cayley - Hamilton Theorem - Quadratic form: Reduction of a quadratic form to a canonical form.

UNIT II **8 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER

Leibnitz's Equations - Modelling and solutions using Newtons law of cooling of bodies - solutions to R-L and R-C electric circuits.

UNIT III **11 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

Linear differential equations of second and higher order with constant coefficients. Linear differential equations of higher order with variable coefficients: Cauchys linear differential equation - Method of variation of parameters for second order differential equations.

UNIT IV **9 Hours**

MULTIVARIABLE CALCULUS

Functions of Two Variables and their solutions- Total Differential - Derivative of implicit functions-Jacobians Unconstrained maxima and minima.

UNIT V **8 Hours**

MULTIPLE INTEGRALS

Double integration with constant and variable limits-Region of integration -Change the order of integration -Area as double integral in cartesian coordinates. Triple integral in Cartesian coordinates.

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order

Total: 45+30=75 Hours

Reference(s)

1. C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015.
3. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012.
4. B.S. Grewal, Higher Engineering Mathematics, Forty Third Edition, Khanna Publications, New Delhi 2014.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.
6. T.Veerarajan, Engineering mathematics for First Year,Tata McGraw-Hill Publishing company Limited, New Delhi, 2014.

Assessment Pattern

UNIT/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6					6			6											20
2	2					2				4					4				6						18
3		2			2						6			6					6						22
4		2					6				8				6										22
5	2						4			6									6						18
																								Total	100

Assessment Questions
Remember

1. Define spectral values of a matrix.
2. State Cayley - Hamilton theorem.
3. List out five natures of a quadratic form.
4. Reproduce the solution for the first order linear differential equation $\frac{dy}{dx} + Py = Q$
5. State Newton's Law of cooling in ordinary differential equation.
6. Define Jacobian in three dimensions
7. State Wronskian determinant.
8. List two sufficient conditions for extreme of a function $z = f(x, y)$ at (a,b) .
9. Define Jacobian of u and v with respect to x and y.
10. Recall any two properties of Jacobians.

Understand

1. Identify whether there exist a square matrix without eigenvalues. Give reason
2. Indicate the matrix which has real eigenvalues and real eigenvectors.
3. Identify in which cases can we expect orthogonal eigenvectors.
4. Compare second and higher order ordinary differential equation

5. A condenser of capacity C discharged through an inductance L and resistance R in series and the charge q at the time t satisfies the equation $L\frac{d^2q}{dt^2}+R\frac{dq}{dt}+\frac{q}{c}=0$.given that L=0.25 henries,R=250 ohms,C=2×10^{-6} farads,and that when t=0,charge q is 0.002 coulombs and the current $\frac{dq}{dt}=0$,obtain the value of q in terms of t.
6. Represent the area bounded by the parabolas $y^2=4-x$ and $y^2=4-4x$ as a double integral.
7. Formulate Leibnitz's equation where R=100 ohms L=0.05 henry E=100 Cos300t volts.
8. A condenser of capacity C discharged through an inductance L and resistance R in series and the charge q at the time t satisfies the equation $L\frac{d^2q}{dt^2}+R\frac{dq}{dt}+\frac{q}{c}=0$.the circuit consists of an inductor of 1H,a resistor of 12Ω,capacitor of 0.01 F,and a generator having voltage given by E(t)=24 sin10t.find the charge q and the current I at time t,if q=0 and i=0 at t=0 where i=$\frac{dq}{dt}$.
9. Formulate the area between the curves $y^2=4x$ and $x^2=4y$.
10. Indicate and change the order of integration for $\int_0^1\int_{x^2}^{2-x} xydydx$

Apply

1. Carry-out the three engineering applications of eigen value of a matrix.
2. Find the Eigen values and Eigen vectors of the matrix A = $\begin{pmatrix}11 & -4 & -7\\ 7 & -2 & -5\\ 10 & -4 & -6\end{pmatrix}$ and hence find the Eigen values of A^2, 5A and A^{-1} using properties.
3. Use Cayley Hamilton theorem to find inverse of A =$\begin{pmatrix}1 & 3 & 7\\ 4 & 2 & 3\\ 1 & 2 & 1\end{pmatrix}$.
4. Find the points of the function $f(x,y)=x^2y+xy^2-axy$ where f is a maximum or minimum.
5. A body originally at 80^0C cools down to 60^0C in 20 minutes, the temperature of the air being 40^0C. what will be the temperature of the body after 40 minutes from the original?
6. If the temperature of a cake is 300^0F when it leaves the oven and is 200^0F 10 minutes later, when will it be practically equal to the room temperature of 60^0F, say, when will it be 61^0F? Use Newton's law of cooling.
7. In an L-C-R circuit, the change q on a plate of a condenser is given by $L\frac{d^2q}{dt^2}+R\frac{dq}{dt}\ \frac{q}{c}$=Esinpt, where i=$\frac{dq}{dt}$.the circuit is tuned to resonance so that $p^2=1/LC$. If initially the current I and the charge q be zero. Showthat, for small values of R/L, the current in the circuit at time t is given by (Et/2L) sinpt.

8. Construct the solution for the equation $(D^3 - D)y = xe^x$
9. Use the method of variation of parameters to solve $(D^2 + 4)y = \cot 2x$.
10. Construct the equation $x^2y'' + xy' = x$ into a linear differential equation with constant coefficients.

Analyze

1. Justify whether the matrix B = $\begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$ is orthogonal or not?
2. Suppose that in winter the day time temperature in a certain office building is maintained at 70°F, The heating is shut off at 10 P.M. and turned on again at 6 A.M. On a certain day the temperature inside the building at 2 A.M. was found to be 65°F. The outside temperature was 50°F at 10 P.M. and had dropped to 40°F by 6 A.M. Find the temperature inside the building when the heat was turned on at 6 A.M.? .
3. Experiment show that the radioactive substance decomposes at a rate proportional to the amount present. Starting with 2grms at time t=0 find the amount available at a later time.
4. Differentiate RL and RC electric circuit.
5. Transform the equation $x^2y'' + xy' = x$ into a linear differential equation with constant coefficients.
6. If the voltage in the RC circuit is $E = E_0 \cos \omega t$, find the charge and the current at time t.
7. Solve $(x^2D^2-2xD+2)y = (3x^2-6x+6)e^x$, $y(1) = 2 + 3e$, $y'(1) = 3e$
8. In a circuit the resistance is 12Ω and the inductance is 4 H. The battery gives a constant voltage of 60 V and the switch is closed when t = 0, so the current starts with I(0) = 0. (a) Find I(t) (b) Find what happens to the current after a long time justify the current after 1 s.
9. If $g(x,y) = \psi(u,v)$ where $u = x^2 - y^2$, $v = 2xy$ prove that $\frac{\partial^2 g}{\partial x^2} + \frac{\partial^2 g}{\partial y^2} = 4(x^2+y^2)\left(\frac{\partial^2 \psi}{\partial u^2} + \frac{\partial^2 \psi}{\partial v^2}\right)$
10. Solve $\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-x^2-y^2}} x\,dx\,dy\,dz$.

Evaluate:

1. Use Cayley-Hamilton theorem to find the value of $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$ if the matrix A = $\begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$
2. Determine the nature, index, rank and signature by reducing the quadratic form $2x^2+2y^2+2z^2+2yz$ to canonical form by an orthogonal transformation.
3. Determine the value of y from the equation $\frac{dy}{dx} = \frac{x^2+y^2+1}{2xy}$
4. Determine the solution of y of the equation $\sqrt{1-y^2}\,dx = (\sin^{-1}x - x)dy$.
5. Determine the value of y from the equation $\frac{dy}{dx} - \frac{\tan y}{1+x} = (1+x)\, e^x \sec y$.

6. Determine the complete solution for y from the equation $\frac{d^2y}{dx^2} + \frac{1}{x}\frac{dy}{dx} = \frac{12\log x}{x^2}$.
7. Determine the complete solution for y of $(x^2D^2 - xD + 4)y = x^2\sin(\log x)$.
8. Determine the solution of the initial value problem $y'' + y' - 6y$ =0 with the initial conditions y(0)=10 and $y'(0)$ =0.
9. Evaluate $\iiint (x^2 + y^2 + z^2)\, dxdydz$ taken over the region of space defined by $x^2 + y^2 \le 1$ and $0 \le x \le 1$.
10. Evaluate $\int_0^a \int_y^a \frac{x}{x^2+y^2} dxdy$ by changing into polar coordinates

15PH102 ENGINEERING PHYSICS 2 0 2 3

(Common to all branches)

Course Objectives

- To impart knowledge in properties of matter, crystallography and ultrasonics
- To understand the applications of lasers and fiber optics
- To implement the principles of quantum physics in the respective engineering fields

Course Outcomes (COs)

1. Realize the concept of properties of matter and apply the same for practical applications
2. Identify the suitable laser source for fiber optic communication applications
3. Determine the velocity of ultrasonic waves and apply the same for day today applications
4. Classify the different types of crystal structures and analyze their properties
5. Comprehend the efficacy of quantum equations in modern areas

UNIT I **8 Hours**

PROPERTIES OF MATTER

Elasticity: elastic and plastic materials - Hooke's law - elastic behavior of a material -stress -strain diagram- factors affecting elasticity. Three moduli of elasticity- Poisson's ratio-torsional pendulum- twisting couple on a cylinder. Young's modulus- uniform bending -non- uniform bending. Viscosity: coefficient of viscosity -streamline and turbulent flow -experimental determination of viscosity of a liquid -Poiseuille's method.

UNIT II **6 Hours**

APPLIED OPTICS

Interference: air wedge- theory- uses- testing of flat surfaces- thickness of a thin wire. Laser: introduction- principle of laser- characteristics of laser- types: CO2 laser -semiconductor laser (homo junction). Fiber optics: principle of light transmission through fiber- expression for acceptance angle and numerical aperture- types of optical fibers (refractive index profile and mode)- fiber optic communication system (block diagram only).

UNIT III **5 Hours**

ULTRASONICS

Ultrasonics: introduction- properties of ultrasonic waves-generation of ultrasonic waves-magnetostriction- piezo electric methods- detection of ultrasonic waves. Determination of velocity of ultrasonic waves (acoustic grating). Applications of ultrasonic waves: SONAR- measurement of velocity of blood flow -study of movement of internal organs.

UNIT IV **5 Hours**

SOLID STATE PHYSICS

Crystal Physics: lattice -unit cell -crystal systems- Bravais lattices- Miller indices- 'd' spacing in cubic lattice- calculation of number of atoms per unit cell, atomic radius, coordination number and packing density for SC, BCC, FCC and HCP structures- X-ray diffraction: Laue's method - powder crystal method.

UNIT V **6 Hours**

QUANTUM MECHANICS

Quantum Physics: development of quantum theory- de Broglie wavelength -Schrodinger's wave equation-time dependent and time independent wave equations- physical significance. Application: particle in a box (1d)- degenerate and non-degenerate states. Photoelectric effect: quantum theory of light work function- problems.

FOR FURTHER READING

Neutrions - expanding universe

2 Hours

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

4 Hours

EXPERIMENT 1

Determine the moment of inertia of the disc and calculate the rigidity modulus of a given wire using torsion pendulum (symmetrical masses method).

4 Hours

EXPERIMENT 2

Find the elevation of the given wooden beam at the midpoint by loading at the ends and hence calculate the Youngs modulus of the material.

4 Hours

EXPERIMENT 3

Find the depression at the midpoint of the given wooden beam for 50g, 100 g, 150 g, 200 g and 250 g subjected to non-uniform bending and determine the Youngs modulus of the material of the beam.

4 Hours

EXPERIMENT 4

Determine the coefficient of viscosity of the given liquid by Poiseulles method.

4 Hours

EXPERIMENT 5

Form the interference fringes from the air wedge setup and calculate the thickness of the given wire.

4 Hours

EXPERIMENT 6

By applying the principle of diffraction, determine the wavelength of given laser and the average particle size of lycopodium powder using laser source.

4 Hours

EXPERIMENT 7
Determine the
(i) wavelength of ultrasonics in a liquid medium,
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using ultrasonic interferometer.

Total: 60 Hours

Reference(s)

1. D. S. Mathur, Elements of Properties of Matter, 5th edition, S Chand & Company Ltd., New Delhi, 2012.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2012.
3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. B. K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
5. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
6. Ian Morison, Introduction to Astronomy and Cosmology, John Wiley and Sons, Ltd., 2013.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				4	2				6				4				4						24
2		2				2	6			2	4			4											20
3		4				4	2			4				4											18
4	2	2				4					5			5											18
5	2	2				4	4			4					4										20
																								Total	100

Assessment Questions
Remember
1. Reproduce Hooke's law
2. Name the three types of moduli of elasticity
3. List the two applications of air wedge
4. Recall the two conditions required for achieving total internal reflection
5. Define magnetostriction effect
6. Recognize the four applications of ultrasonics in medical field
7. Write the Bragg's condition necessary for obtaining X-ray diffraction in crystals
8. Retrieve the seven types of crystal system
9. Recall four physical significance of wave function
10. Define photoelectric effect

Understand
1. Explain the procedure adopted for determining the Young's modulus of the given material by non-uniform bending method
2. Illustrate the effect of temperature on elasticity of a material
3. Classify the fiber optics based on refractive index profile
4. Indicate the role of optical resonators in the production of laser
5. Compare the merits of magnetostriction and piezo-electric oscillators

6. Summarize the four applications of ultrasonic waves in day-today life
7. Identify the closely packed cubic crystal structure with an example
8. Compare Laue method and powder crystal method used in X-ray diffraction
9. Infer the significance of photoelectric effect
10. Represent the two assumptions involved in solving the Schrödinger time dependent wave equation

Apply

1. Show that when a cylinder is twisted the torsional couple depends on torsional rigidity
2. Using torsional pendulum, explain the rigidity modulus of the wire
3. Design an experimental setup used for determining the thickness of a thin material
4. A silica optical fiber has a core refractive index of 1.50 and a cladding refractive index of 1.47. Find the numerical aperture for the fiber.
5. Construct the piezo electric oscillator circuit and explain the generation of ultrasonic waves
6. Find the depth of submerged submarine if an ultrasonic wave is received after 0.33 s from the time of transmission.(given v=1400 m/s)
7. Show that the axial ratio for an ideal HCP structure is 1.633
8. Sketch the planes having Miller indices (100) and (111).
9. Assess the various energy levels of an electron enclosed in a one dimensional potential well of finite width ‘a’
10. Compute the relation between de Broglie wavelength and velocity of a particle

Analyse

1. Differentiate uniform bending from non-uniform bending
2. Straight lined fringes are formed only in flat glass plates. Justify.
3. Conclude that the thickness of thin wire is influenced by band width of a material
4. Outline the merits and demerits of magnetostriction oscillator method.
5. Five fold symmetry is not possible in crystal structures. Justify your answer.Â
6. Compare the degenerate state with non-degenerate state

Evaluate

1. Determine the viscosity of a given liquid using Poiseuille’s method (Given: water, burette, stop clock, capillary tube, stand and travelling microscope)
2. When ultrasonic waves are passed through liquids, cavitations are produced. Criticize the statement
3. Check the packing factor for a simple cubic structure is 0.52
4. Evaluate the expression for time dependent Schroedinger’s wave equation

15CH103 ENVIRONMENTAL SCIENCE 2 0 2 3

(Common to all branches)

Course Objectives

- Realize the interdisciplinary and holistic nature of the environment
- To understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development
- Recognize the socio-economic, political and ethical issues in environmental science

Course Outcomes (COs)

1. Assess the importance of interdisciplinary nature of environment, its purpose, design and exploitation of natural resources
2. Analyze the fundamental physical and biological principles that govern natural processes and role of professionals in protecting the environment from degradation.
3. Identify the existing environmental challenges related to pollution and its management
4. Select suitable strategies and methods for sustainable management of environmental systems
5. Determine the impact of human activities on environment

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification) - water logging - salinity - case studies. Energy resources: renewable(solar, wind, tidal, geothermal and hydroelectric power) - non renewable energy sources

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: forest ecosystem - desert ecosystem - ecological succession. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity - field study

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - marine pollution - thermal pollution - noise pollution. Disaster management: causes - effects - control measures of floods - earthquake - cyclone - landslides

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - urban problems related to energy. Environmental ethics - issues and possible solutions - solid waste management - causes - effects - 3R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. Environment protection act: Air (Prevention and control of pollution) act - wildlife protection act

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - women and child welfare programmes - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights:E - waste and biomedical waste -Identification of adulterants in food materials

2 Hours

EXPERIMENT 1

Preparation of N/10 Oxalic acid and M/10 Sodium carbonate solution

4 Hours

EXPERIMENT 2

Estimation of dissolved oxygen in a water sample/sewage by Winklers method

4 Hours

EXPERIMENT 3

Estimation of chloride content in water by argentometric method

4 Hours

EXPERIMENT 4

Estimation of calcium in lime by complexometric method

4 Hours

EXPERIMENT 5

Estimation of chromium in leather tannery effluents

4 Hours

EXPERIMENT 6

Determination of percentage purity of sodium carbonate

4 Hours

EXPERIMENT 7

Estimation of heavy metals in the given solution by EDTA method

4 Hours

EXPERIMENT 8

Determination of concentration of unknown colored solution using spectrophotometer

Total: 60 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. A. Ravikrishnan, Environmental Science and Engineering, 5th revised Edition, Sri Krishna Hitech Publishing company (P) Ltd, Chennai, 2010
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. E. Bharucha, Textbook of Environmental studies, second Edition, Universities Press Pvt. Ltd., New Delhi, 2013
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	2			4	4				1			1	3				1				1			20
2	4	1			4	7							1	2				1							20
3	3				4	6	2		1	1			1	1				1							20
4	1	2			3	8	1			4			2	4											25
5	1	2			2	5				1			1	3							1				15
																								Total	100

Assessment Questions

Remember

1. Define the term bio-magnification.
2. List any four major gaseous responsible for air pollution.
3. Name any four gases responsible for Air Pollution.
4. State environmental ethics.
5. List any two impacts of water pollution.
6. Mention the two objectives of value education.
7. List any four consequences of air pollution on human health.
8. Recall any two endangered and endemic species of India.
9. List any two disadvantages of nuclear energy production.

Understand

1. Summarize the structural and functional attributes of an ecosystem.
2. With the help of neat flow chart explain waste water treatment process using activated sludge process.
3. Explain the modern method of rain water harvesting technique diagrammatically and discuss the various strategies adopted for water conservation.
4. Summarize the abstracts of Wildlife (protection) Act, 1972.
5. Indicate the three consequences of noise pollution.
6. Classify the ecosystems on the basis of energy sources
7. Infer two types of photochemical reactions involved in formation and destruction of ozone in the stratosphere.
8. Explain how the impacts of natural disasters can be minimized on human communities with on representative example.
9. Summarize four major effects caused on forests and tribal people due to big dam construction.

10. Infer the any two conflicts over water, confining to our nation.
11. Identify three major threats to Indian biodiversity
12. Relate the concept of food chain and food web with tropic level and mention their three significances.

Apply

1. Identify any seven impacts caused if ground water is used enormously.
2. Select the proper disaster management techiques that can be implemented to manage. a) Earthquake b) Floods
3. Summarize the concept age-structure pyramids as a tool to achieve stabilized population in our nation.
4. Predict the significances of child welfare programmes in India.
5. Implement the 3R approach to manage solid waste.
6. Assess the four adverse effects of solid waste.
7. Assess how climate change affects human health.

Analyse

1. Differentiate between confined and unconfined aquifers.
2. Distinguish between critical and strategic minerals with two examples for each.
3. Outline variations in population growth among nations with necessary diagram.
4. "Day by day our atmosphere gets prone to serious effects" and "deterioration of environment affects human health". Justify these two statements.
5. Compare the major two advantages and limitations of major greenhouse pollutant CO2.

Evaluate

1. Choose any one suitable method to minimize the impact of acid rain on environment.
2. Determine the doubling time of population, if annual growth rate of a nation is 25 years.

15GE105 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING 2 0 2 3

(Common to AE,AG,AU,CE,ME,MTRS, BT,TT,FD (I Semester) and to CSE,FT,IT (II Semester))

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of communication systems.

Course Outcomes (COs)

1. Understand the basic concepts of electric and magnetic circuits.
2. Summarize the types of DC machines.
3. Classify the static and dynamic AC machines and explain their operation.
4. Interpret the operation of AC and DC drives
5. Illustrate the characteristics of semiconductor devices and communication systems.

UNIT I **7 Hours**

ELECTRIC CIRCUITS

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchoffs Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

UNIT II **5 Hours**

DC MACHINES

Introduction of magnetic circuits - Law of Electromagnetic induction, Flemings Right & Left hand rule- Types of induced emf - Definition of Self and Mutual Inductance - DC Motor- Contruction - Working Principle- Applications.

UNIT III **6 Hours**

AC MACHINES

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Contruction - Working Principle - Applications.

UNIT IV **5 Hours**

ELECTRICAL DRIVES

Speed control of dc shunt motor and series motor - Armature voltage control - Flux control - Construction and operation of DC servo motor - Construction and operation of DC servo motor stepper motor.

UNIT V **7 Hours**

ELECTRON DEVICES AND COMMUNICATION

Characteristics of PN Junction diode and Zener diode - Half wave and Full wave Rectifiers - Bipolar Junction Transistor - Operation of NPN and PNP transistors - Logic gates - Introduction to communication systems.

FOR FURTHER READING

Voltage Regulator - Stepper motor - Energy meter - SMPS, Satellite and Optical communication.

4 Hours

EXPERIMENT 1

Analyze the VI characteristics of a fixed resistor and a lamp by varying its temperature.

4 Hours

EXPERIMENT 2

Apply the voltage division and current division techniques for series and parallel connections of lamp loads.

4 Hours

EXPERIMENT 3

Understand the concept of electromagnetic induction using copper coil.

4 Hours

EXPERIMENT 4

Understand the construction and working principle of DC machines.

6 Hours

EXPERIMENT 5

Determine the VI Characteristics of PN Junction diode and plot the input and output wave shapes of a half wave rectifier.

4 Hours

EXPERIMENT 6
Realize the working of transistor as an electronic switch through experiments.

4 Hours

EXPERIMENT 7
Lighting applications using logic gates principle.

Total: 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010
3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013

Assessment Pattern

UNIT/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					6				4				6						20
2	4					4				2				6					4						20
3	2				10					4					4										20
4	4					6				4					6										20
5	4					4				6														6	20
																								Total	100

Assessment Questions
Remember
1. State Kirchhoff's current law.
2. State Ohm's law.
3. State Kirchhoff's voltage law.
4. State Faraday's law of electromagnetic induction.
5. Give the properties of flux lines.
6. Define reluctance.
7. Define magnetic flux.
8. State the operating principle of a transformer.
9. State the operating principle of DC generator.
10. What is back emf?
11. State the operating principle of DC Motor.
12. State Fleming's Left hand rule.
13. State Fleming's Right hand rule.
14. Sketch the V-I characteristics of zener diode.
15. What is junction barrier?
16. What is BJT?
17. List the applications of optical fibre communication.
18. Define aspect ratio.

Understand

1. Define average value.
2. Compare series and parallel circuits.
3. Why domestic appliances connected in parallel?
4. Classify the magnetic circuits.
5. Describe the concepts of self and mutually induced emf.
6. What is leakage coefficient?
7. Interpret the laws of electromagnetic induction.
8. Elucidate the working principle of a transformer.
9. What is DC generator?
10. List the applications of DC motors.
11. Illustrate the construction and working principle of three phase induction motor.
12. Outline the applications of DC generators.
13. Demonstrate the action of diode in forward and reverse biasing.
14. Explain the operation of NPN transistor.
15. Draw symbol of diode and zener diode.
16. Illustrate the input and output characteristics of CE configuration.
17. Exemplify the need for modulation.
18. Summarize the advantages of FM over AM.
19. State the need for modulation.
20. Discuss the principle of frequency modulation.

Apply

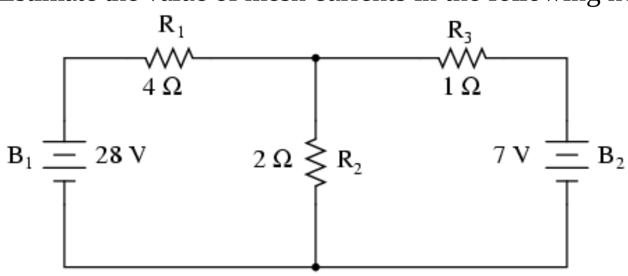
1. Three resistors are connected in series across a 12V battery. The first resistance has a value of 2 Ω, second has a voltage drop of 4V and third has power dissipation of 12 W. Calculate the value of the current in the circuit.
2. A 25 Ω resistor is connected in parallel with a 50 Ω resistor. The current in 50 Ω resistor is 8A. What is the value of third resistance to be added in parallel to make the total line current as 15A?
3. The self - inductance of a coil of 500turns is 0.25H.If 60% of the flux is linked with a second coil of 10500 turns. Calculate a) the mutual inductance between the two coils and b) emf induced in the second coil when current in the first coil changes at the rate of 100A/sec.
4. An air cored toroidal coil has 480 turns, a mean length of 30cm and a cross-sectional area of 5 cm^2.Calculate a)the inductance of the coil and b) the average induced emf, if a current of 4 A is reversed in 60 milliseconds
5. A toroidal air cored coil with 2000 turns has a mean radius of 25cm, diameter of each turn being 6cm. If the current in the coil is 10A, find mmf, flux, reluctance, flux density and magnetizing force.
6. Construct the circuit of voltage regulator.
7. Outline the applications of DC motors.
8. Develop the block diagram of the television and explain each block.
9. Build the circuit of full wave bridge rectifier.
10. Develop the block diagram of the optical fibre communication and explain each block.
11. Construct the circuit of half wave rectifier.

Analyse

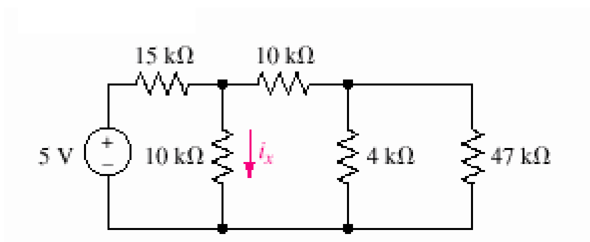
1. Analyze the voltage, current and power in a resistor supplied with an alternating voltage.
2. Obtain the equations for the equivalent star network resistances for a given delta network.
3. Derive the expression for RMS, average value, peak and form factor of sinusoidal voltage.
4. Analyze the voltage, current and power relationship in three phase star connected system.
5. Derive the expressions for self -inductance and mutual inductance.
6. Analyze the series and parallel magnetic circuit and derive the total mmf required.
7. Compare electric and magnetic circuits.
8. Derive the emf equation of DC Generator.
9. Obtain the expression for current amplification factor.
10. Derive the expression of ripple factor, efficiency of full wave bridge rectifier.

Evaluate

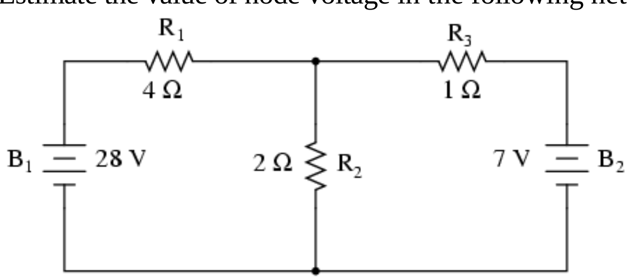
1. Estimate the value of mesh currents in the following network.



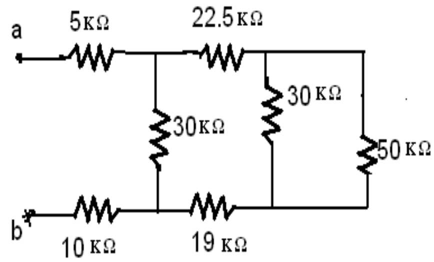
2. For the circuit in Fig. determine i_X and compute the power dissipated by the 15-kΩ resistor.



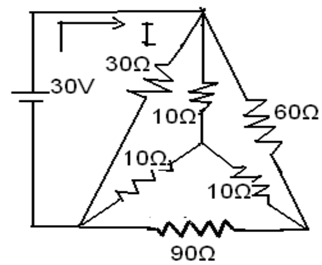
3. Estimate the value of node voltage in the following network.



4. An iron rod of 1cm radius is bent to a ring of mean diameter 30cm and wound with 250 turns of wire. Assume the relative permeability of iron as 800. An air gap of 0.1cm is cut across the bent ring. Calculate the current required to produce a useful flux of 20,000 lines if leakage is neglected.
5. The effective resistance of two resistors connected in series is 100 Ω. When connected in parallel, then effective value in 24 ohm's. Determine the value of two resistors.
6. Determine the equivalent resistance of the following circuit



7. Calculate the total resistance $R_{T,}$ and total current I in the following circuits using star delta transformation technique



Create

1. Create the circuit diagram of 5V regulated power supply.
2. Plan the combinational circuit diagram of EX-NOR gate using NOR gate.

15BT106 BASICS OF BIOTECHNOLOGY

3 0 0 3

Course Objectives

- To introduce various streams of Biotechnology
- To expose students to industrial bioproducts/ process
- To create deeper understanding of Biotechnology application in the modern world

Course Outcomes (COs)

1. Acquire in depth knowledge in fermentation, product recovery and its instrumentation.
2. Learn about the production of primary and secondary metabolites
3. Have the basic knowledge about the production of enzymes, vaccines and other recombinant products in biotechnology
4. Know about the genetically modified plants for various applications
5. Exploit microbes for eco-cleanup and biofuel production

UNIT I **9 Hours**

INTRODUCTION TO BIOTECHNOLOGY

Biotechnology - definition and historical development, Biotechnology - an Interdisciplinary and a three component core, product safety, main areas of applications of Biotechnology, substrates for Biotechnology - biomass, natural raw materials, by-products, chemical and petrochemical feedstocks.

UNIT II **9 Hours**

BIOPROCESS / FERMENTATION TECHNOLOGY

Introduction of Bioprocess technology, principles of microbial growth, Bioreactor / fermenter â?? upstream, bioprocess and downstream and scale up, solid substrate fermentation.

UNIT III **9 Hours**

ENZYME TECHNOLOGY

Nature of enzymes, industrial applications of enzymes, genetic engineering of enzymes, technology of enzyme production, immobilized enzymes.

UNIT IV **9 Hours**

AGRICULTURAL AND ENVIRONMENTAL BIOTECHNOLOGY

Transgenic plants for pest and weed resistance, biocontrol agents, genetic engineering of transgenic animals, genetically engineered hormones and vaccines, microbes in wastewater treatment, composting, bioremediation.

UNIT V **9 Hours**

BIOTECHNOLOGY IN FOOD AND ENERGY

Food and beverage fermentations, alcoholic beverages, dairy fermented products, vegetable fermentation-sauerkraut, conversion of biomass to energy, production of ethanol and methane from biomass, safety aspects in Biotechnology.

FOR FURTHER READING

Photosynthesis for energy production, single cell protein - from wastes, agricultural crops and algae, antibiotics, vaccines and monoclonal antibodies, biopharmaceutical products, plant tissue culture techniques-selection and formulation of media, micropropagation, somatic embryogenesis, somoclonal variation.

Total: 45 Hours

Reference(s)

1. John E Smith, Biotechnology, Cambridge University Press, 5th Edition, 2006
2. W.Crueger, and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation, 2003
3. Colin Ratledge and Bjorn Kristiansen, Basic Biotechnology, Cambridge University Press, 2001
4. L.E.Casida, Industrial Microbiology, New Age International (P) Ltd, 2005

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. Draw the schematic overview of biotechnological process.
2. Give examples of application of biotech for welfare of mankind.
3. State the applications of microbes in bioremediation.
4. Show the importance of recombinant DNA technology.
5. Give some functions of cholesterol in the body.
6. List the salient features of immobilized enzymes.
7. Mention the application of immobilization.
8. What methods are adopted for immobilizing the nitrilase enzyme inchemical industry?
9. Write the structure of Penicilin acylase.
10. What is global warming?

Understand

1. Interpret the growth of microorganisms in batch and continuous reactors.
2. Compare solid state fermentation and substrate fermentation
3. How the process of microbial transformation is utilized in bioremediation?
4. Compare aerobic and anaerobic fermentation.
5. Explain the process of fructose preparation from starch.
6. Explicate the energy derivatization from plant source.
7. Show the microbiological origin of methane generation.
8. Name the organism that produce hydrogen without any energy input.
9. Spell out the microbial source used to degrade organic molecules.
10. What are xenobiotics?

Apply

1. How will you prepare Sauerkraut?
2. Identify the potential biotechnological impact at different levels of food chain.
3. State the process of gene transfer in bioremediation.
4. Identify the potential biotechnological impact at different levels of food chain
5. What are the advantages of biodiesel over fossil fuel derived diesel?
6. Depict the microbiological methods of methane generation using flow diagram.
7. List out the economical arguments against methane generation.
8. How the xenobiotics are treated in an eco-friendly approach?
9. Identify the BOD and Sludge treatment for liquid wastes.

Analyse

1. List the salient features of immobilized enzymes.
2. Examine the role of microbes in waste water treatment.
3. Analyze the stability of genetically modified DNA inherited by the offspring.
4. Analyse the various methods of ethanol production from biomass.
5. Explain the flow diagram for ethanol production from feed stocks.
6. Explain the stages in treating complex sewage wastes using anaerobic digestors.
7. Compare the aerobic biological process for liquid waste degradation.
8. Explain the importance of single cell protein.

Evaluate

1. Appraise the salient features of genetically engineering hormones.
2. Interpret the applications of biotechnology in petrochemical industry.
3. Explain the importance of single cell protein.
4. Develop a methodology for immobilization of bromelain.
5. Develop a methodology for isolation and identification of bromelain.
6. Design a reactor for production of vodkha.

Create

1. Propose a methodology for production of fruit based alcoholic beverages.
2. Interpret the applications of biotechnology in petrochemical industry.
3. Appraise the salient features of genetically engineering hormones.

15GE107 WORKSHOP PRACTICE 0 0 2 1

Common to AE,AG,AU,ME,MTRS,BT,FT,TT,FD (I Semester) and to CE,CSE,ECE,EEE,EIE,IT (II Semester)

Course Objectives

- To provide training for fabricating the components using carpentry, sheet metal, fitting and welding equipments/tools.
- To develop the skills for preparing the green sand mould using foundry tools and to make simple electrical & pipe line connections using suitable tools.
- To understand the procedure of dismantling and assembling of home appliances & petrol engine.

Course Outcomes (COs)

1. Fabricate simple components using carpentry, sheet metal, fitting & welding equipments/tools.
2. Prepare green sand mould and make simple electrical & pipe line connection using suitable tools.
3. Dismantle and assemble the essential home appliances and petrol engine.

3 Hours

EXPERIMENT 1

Forming of simple object in sheet metal using suitable tools – (Example: Dust Pan/ SoapBox) (or) making simple object using Metal Spinning Machine. (Example: Aluminum Cup).

3 Hours

EXPERIMENT 2

Prepare 'V' (or) Half round (or) Square(or) Dovetail joint from the given mild Steel flat.

3 Hours

EXPERIMENT 3

Fabrication of a simple component using thin and thick plates. (Example: Book rack)

3 Hours

EXPERIMENT 4
Making a simple component using carpentry power tools. (Example: Electrical switch Box/Toolbox/ Letter box].

3 Hours

EXPERIMENT 5
Construct a household pipe line connections using pipes, Tee joint,Four way joint, elbow,union,bend, Gate way and Taps (or) Construct a pipe connections of house application centrifugal pump usingpipes, bend, gate valve,flanges and foot valve.

3 Hours

EXPERIMENT 6
Prepare a green sand mould using solid pattern/split pattern.

2 Hours

EXPERIMENT 7
Construct a domestic electrical wire connections usingindicator, one way switch with calling bell, two way switch with lamp, one way switch with fan regulator and one way switch with socket.

4 Hours

EXPERIMENT 8
Laboratory safety; Cleaning of glassware; Maintenance of laminar hood; Calculation and preparation of buffer solutions;

6 Hours

EXPERIMENT 9
Preparation of Nutrient broth and agar for microbial growth; Examination and Identification of Cell cycle stages through optical microscope

Total: 30 Hours

15MA201 VECTOR CALCULUS AND COMPLEX ANALYSIS — 3 2 0 4

(Common to all Branches)

Course Objectives

- Implement the Complex Analysis, an elegant method in the study of heat flow, fluid dynamics and electrostatics.
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Calculus viz: Differentiation, Integration and Vectors.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Course Outcomes (COs)

1. Characterize the calculus of vectors.
2. Apply the theoretical aspects of vector integral calculus in their core areas.
3. Recognize the differentiation properties of complex functions.
4. Identify the complex functions and their mapping in certain complex planes.
5. Use the concepts of integration to complex functions in certain regions.

UNIT I **10 Hours**

VECTOR CALCULUS

Gradient -Divergence -Curl - Directional derivative- Solenoidal -Irrotational vector fields -Line Integral - Surface integrals.

UNIT II **9 Hours**

INTEGRAL THEOREMS OF VECTOR CALCULUS

Green's theorem in a plane- Stoke's Theorem- Gauss divergence theorem- Applications involving cubes and parallelepiped.

UNIT III **8 Hours**

ANALYTIC FUNCTIONS

Analytic Functions- Necessary and Sufficient conditions of Analytic Function- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method -Applications to the problems of Potential Flow.

UNIT IV **8 Hours**

MAPPING OF COMPLEX FUNCTIONS

Physical interpretation of mapping- Application of transformation: translation, rotation, magnification and inversion of multi valued functions - Linear fractional Transformation (Bilinear transformation).

UNIT V **10 Hours**

INTEGRATION OF COMPLEX FUNCTIONS

Cauchy's Fundamental Theorem - Cauchy's Integral Formula - Taylor's and Laurent's series- Classification of Singularities - Cauchy's Residue Theorem.

FOR FURTHER READING

Applications to Electrostatic and Fluid Flow.

Total: 45+30=75 Hours

Reference(s)

1. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-HillPublishing Company Ltd, 2003
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015
3. J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill,New Delhi, 2007
4. B. S. Grewal, Higher Engineering Mathematics, Forty third Edition, Khanna Publications , New Delhi 2014
5. Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition ,Cengage Learning India Private Limited, 2012
6. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India,2007

Assessment Pattern

UNIT/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6					8			4			2								22
2	2					4				4					4				6						20
3		2									10								6						18
4	2						4				6				6										18
5	2						4			6				4					6						22
																								Total	100

Assessment Questions
Remember
1. Define gradient of a vector.
2. Define irrotational of a vector.
3. State Green's theorem.
4. State Gauss divergence theorem.
5. Check whether the function is $f(z)=z^3$ analytic.
6. List the necessary condition for a function f(z) to be analytic.
7. Define bilinear transformation.
8. State the condition for the transformation w = f(z) to be conformal at a point.
9. State the formula for finding the residue of a double pole.
10. State Cauchy's integral formula.

Understand
1. If $\vec{F} = x^2\vec{i} + xy^2\vec{j}$ evaluate the line integral $\int \vec{F}.\vec{dr}$ from (0,0) to (1,1) along the path y=x.
2. Identify the unit normal vector to the surface $x^2 + xy + z^2 = 4$ at the point (1,-1, 2).
3. Identify the value of $\nabla x \nabla \Phi$.(F), using Stoke's theorem.
4. Formulate the area of a circle of radius a using Green's theorem.
5. Illustrate the two properties of analytic function.
6. Represent the analyticity of the function w = sin z.
7. Identify fixed points of the transformation $w = z^2$.
8. Identify the image of the triangular region in the z plane bounded by the lines x= 0, y = 0, and x+ y= 1 under the transformation w = 2z.
9. Infer $\int_c \frac{dz}{(z-3)^2}$ where c is the circle $|z| = 1$.
10. Identify the residues of the function $f(z) = \frac{4}{z^3(z-2)}$ at its simple pole.

Apply

1. Find $\int_c \overline{F}.dr$ where $\overline{F} = (2y+3)i + xzj + (yz-x)k$ along the line joining the points (0,0,0) to(2,1,1).
2. If $\vec{F} = 3xy\,\vec{i} - y^2\,\vec{j}$, find $\int_C \vec{F}\cdot d\vec{r}$ where C is the curve in the xy-plane y=2x^2 from (0,0) to (1,0)
3. Apply Green's theorem in the plane to Compute $\int_c (3x^2-8y^2)dx + (4y-6xy)dy$ where C is the boundary of the region defined by x=0, y=0 and x+y=1.
4. Using Gauss divergence theorem,Compute $\iint_s \vec{F}\cdot\hat{n}ds \; where \; \vec{F} = 4xz\vec{i} - y^2\vec{j} + yz\vec{k}$ and S is the surface of the cube bounded by x=0,y=0,z=0,x=1,y=1,z=1.
5. If ω=φ+iψ represent the complex potential for an electric field and $\psi = x^2 - y^2 + \frac{x}{x^2+y^2}$, find the function φ.
6. If $u = \log(x^2+y^2)$, find v and f (z) such that f (z) =u+iv is analytic.
7. Find bilinear transformation which maps the points I,-1,I of the z plane into the points 0,1,∞ of the w plane respectively.
8. Find the image of the circle $|z-1| = 1$ in the complex plane under the transformation w = $\frac{1}{z}$.
9. Find Taylor's series f(z) = cos z about z = $\frac{\pi}{3}$.
10. Find the nature of singularity $z\, e^{\left(\frac{1}{z}\right)^2}$.

Analyze

1. Conclude $div\, grad(r^n) = \nabla^2(r^n) = n(n+1)r^{n-2}$.
2. Demonstrate the irrotational vector and solenoidal vector with an example.
3. Justify stokes's theorem for $\overline{F} = -yi + 2yzj + y^2k,$ where S is the upper half of the sphere $x^2+y^2+z^2=1$.
4. Justify Gauss divergence theorem for $\vec{F} = x^2\,\vec{i} + y^2\,\vec{j} + z^2\,\vec{k}$ where S is the surface of the cuboid formed by the planes x= 0, x= a, y = 0, y = b, z = 0 and z = c.
5. The complex potential f(z)=z^2 describes a flow with constant equipotential lines and streamlines ,Determine the velocity vector.
6. Show that the function $u = x^3 + x^2 - 3xy^2 + 2xy - y^2$ is harmonic and find the corresponding analytic function.
7. Find the image of the rectangle whose vertices are (0,0), (1,0), (1,2), (0,2) by means of linear transformation w = (1+i)z+2-i. Also compare the images.

8. Generate $f(z)=\frac{z}{(z-1)(z-3)}$ as Laurent's series valid in the regions: $1<|z|<3$ and $0<|z-1|<2$

9. Use Cauchy's integral formula Compute $\int_C \frac{e^z\,dz}{(z+2)\,(z+1)^2}$ where C is the circle $|z|=3$.

10. Find $\int_C \frac{z+4}{z^2+2z+5}dz$ where C is $|z+1+i|=2$.

Evaluate

1. Determine $\iint_s (xdydz+2ydzdx+3zdxdy)$, where s is the closed surface of the sphere

$x^2+y^2+z^2=a^2$

2. Prove that $curl(curl\vec{F})=grad(div\vec{F})-\nabla^2\vec{F}$.

3. Check Stokes theorem for $\vec{F}=(x^2+y^2)\vec{i}-2xy\vec{j}$ taken around the rectangle bounded by x=±a,y=0 y=b.

4. Check Green's theorem in the plane to determine $\int_c (3x^2-8y^2)dx+(4y-6xy)dy$ where c is the boundary of the region defined by $(i)\,x=0, y=0, x+y=1 (ii)\, y=\sqrt{x}\ and\ y=x^2$.

5. Determine the analytic function f (z) = P + iQ, if Q = $\frac{\sin x\sinh y}{\cos 2x+\cosh 2y}$, if f(0) = 1.

6. Determine f (z) and the conjugate harmonic v such that w = u + i v is an analytic function of z given that u = $e^{x^2-y^2}\cos 2xy$.

7. Determine the image of the infinite strip $\frac{1}{4}\le y\le\frac{1}{2}$ under the transformation w = $\frac{1}{z}$

8. Determine the Laurent's series expansion $f(z)=\frac{z-1}{(z+2)(z+3)}$ $for\ 2<|z|<3$.

9. Determine $\int_C \frac{z+4}{z^2+2z+5}dz$ where C is $|z+1+i|=2$

10. Using Cauchy's integral formula determine $\int_C \frac{e^z dz}{(z+2)(z+1)^2}$ where C is |Z| =1.

15GE205 BASICS OF CIVIL AND MECHANICAL ENGINEERING

3 0 0 3

Course Objectives

- To impart basic knowledge in the field of Civil Engineering
- To guide students to select the good building materials
- To create awareness on various types of water supply and transportation systems
- To impart basic knowledge in the various engineering materials and manufacturing Processes.
- To understand the working principles of various Internal Combustion Engines, Refrigeration, Boiler and power plants.

Course Outcomes (COs)

1. Understand the fundamental philosophy of Civil Engineering
2. Identify the nature of building components, functions, construction practices and material qualities
3. Understand the fundamental concepts of water supply and transportation systems
4. Recognize the various engineering materials and understand the working principles and operations of manufacturing processes.
5. Understand the working principles and operations of Internal Combustion Engines, Refrigeration, Boiler and power plants.

UNIT I **7 Hours**

INTRODUCTION TO CIVIL ENGINEERING

History, development and scope of Civil Engineering Functions of Civil Engineers. Construction Materials Characteristics of good building materials such as Stones Bricks -Cement - Aggregates and concrete. Surveying: Definition and purpose Classification Basic principles Measurement of length by chains and tapes.

UNIT II **7 Hours**

GENERAL FEATURES RELATING TO BUILDINGS

Selection of site Basic functions of buildings Major components of buildings. Types of foundation Bearing capacity of soils General Principles of Brick masonry Stone masonry Beams Lintels Columns Doors and windows Introduction to Green Building and Interior Design

UNIT III **7 Hours**

WATER SUPPLY AND TRANSPORTATION SYSTEMS

Sources of water Supply Methods of Rain Water Harvesting Flow Diagram of Water treatment Process Modes of Transportation Systems. Classification of Highways-Components of roads Bituminous and cement concrete roads. Importance of railways - Gauges Components of permanent way Types of bridges.

UNIT IV **8 Hours**

ENGINEERING MATERIALS AND MANUFACTURING PROCESSES

Materials classification, mechanical properties of cast iron, steel and high speed steel Casting process-Introduction to green sand moulding, pattern, melting furnace electric furnace Introduction to metal forming process and types Introduction to arc and gas welding Centre lathe, Drilling and Milling machines principal parts, operations.

UNIT V **8 Hours**

INTERNAL COMBUSTION ENGINES AND REFRIGERATION

Internal Combustion (IC) Classification, main components, working principle of a two and four stroke petrol and diesel engines, differences Refrigeration working principle of vapour compression and absorption system Introduction to Air conditioning.

UNIT VI **8 Hours**

ENERGY, BOILERS, TURBINE AND POWER PLANTS

Energy-Solar, Wind, Tidal, Geothermal, Biomass and Ocean Thermal Energy Conversion (OTEC)Boilers classification, Babcock and Wilcox and La-Mont Boilers, differences between fire tube and water tube boiler Steam turbines- working principle of single stage impulse and reaction turbines Power plant classification, Steam, Hydel, Diesel, and Nuclear power plants.

Total: 45 Hours

Reference(s)

1. N. Arunachalam, Bascis of Civil Engineering, Pratheeba Publishers, 2000
2. M. S. Palanichamy, Basic Civil Engineering, TMH, 2009
3. G. Shanmugamand M. S. Palanichamy, Basic Civil and Mechanical Engineering,Tata McGraw Hill Publishing Co., New Delhi, 2009
4. Pravin Kumar, Basic Mechanical Engineering, Pearson Education India, Pearson,2013.
5. G. Shanmugam and S. Ravindran, Basic Mechanical Engineering, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2013.
6. S. R. J. Shantha Kumar, Basic Mechanical Engineering, Hi-tech Publications, Mayiladuthurai, 2015

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	7					6								4											17
2	7					10																			17
3	4					6			4																14
4	7					8									4										19
5	5					10																			15
6	6					7								5											18
																								Total	100

Assessment Questions

Remember

1. Classify Boiler.
2. What are the uses of high carbon steel?
3. Define welding
4. Define soldering.
5. Define Brazing.
6. What do you mean by milling?
7. Classify IC Engines.
8. List the various components of IC Engines.
9. Define Refrigeration.
10. Classify Boiler.
11. What is turbine?
12. Define water tube boiler.

13. Name the main parts of a turbine.
14. Classify power plants.
15. Writedown the scope of Civil Engineering.
16. Define surveying.
17. List the ingredients of concrete.
18. State the basic principles of survey.
19. What is meant by lintel?
20. Write down the components of buildings.
21. List the functions of foundation.
22. What is meant by bearing capacity of soil?
23. What are the factors to be considered in selection of site?
24. Define gauges.
25. Name the components of permanent way.
26. State the importance of railway.
27. List out the types of bridge.
28. Write down the classification of highway.
29. What do you meant by rain water harvesting?
30. What are the factors to be considered in design of green building?

Understand
1. Compare reaction and impulse turbines.
2. What is the difference between renewable and non-renewable sources of energy?
3. What is the function of a hydraulic turbine?
4. What is the function of a surge tank in Hydel power plant?
5. What is the function of a moderator in Nuclear power plant?
6. How to select the boiler?
7. Why air is pre-heated before enter into boiler?
8. How does a fusible plug function in boiler?
9. What is the function of a spark plug in IC engine?
10. What is the function of a fuel injector in diesel engine?
11. Compare and contrast 4 stroke and 2 stroke engine.

Apply
1. Explain in detail about rain water harvesting.
2. Explain the process of water treatment.
3. Enumerate the procedure for construction of water bound macadam road.
4. Describe the characteristics of good building stone.
5. Explain the various functions of Civil Engineer.
6. Discuss in detail about principles of surveying.
7. Describe the characteristics of cement and concrete.
8. Differentiate the English and Flemish bonds brick masonry.
9. What are the points to be observed in the construction of brick masonry?

Analyze
1. Discuss about any four super structure components.
2. Distinguish between shallow and deep foundation.
3. Distinguish between stone and brick masonry.
4. Differentiate bituminous and cement concrete roads.
5. Elucidate the components of permanent way.
6. Describe the cross section of bituminous pavement.
7. Elucidate different sources of water supply.

15GE206 COMPUTER PROGRAMMING

3 0 2 4

Common to CE (I Semester) and to AE,AG,AU,ME,MTRS,BT,FT,TT,FD (II Semester)

Course Objectives

- To learn the basics of computer organisation.
- To study the basics of C primitives, operators and expressions.
- To understand the different primitive and user defined data types.

Course Outcomes (COs)

1. Recognize the basic concepts of computers.
2. Implement programs using operators and expressions.
3. Demonstrate the usage of control structures.
4. Execute programs using Arrays and strings.
5. Summarize the concepts of structures and functions.

UNIT I **8 Hours**

INTRODUCTION TO COMPUTERS

Introduction to computers - Characteristics of Computers - Evolution of Computers - Computer Generations - Basic Computer Organization - Number System - Problem Solving Techniques - Features of a Good Programming Language.

UNIT II **9 Hours**

INTRODUCTION TO C PROGRAMMING

Overview of C-Structure of C program-Keywords-Constants- Variables-Data types-Type conversion Operators and Expressions: Arithmetic-Relational-Logical-Assignment- Increment and Decrement-Conditional-Bitwise -Precedence of operators-Managing I/O operations-Formatted I/O-Unformatted I/O.

UNIT III **10 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement-if else statement-nesting of if else Statement-Switch Statement.Decision Making and Looping: while statement-do while statement-for statement-Nested for statement Jump Statements: goto-break-continue-return statement

UNIT IV **9 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays, multi dimensional arrays. Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNIT V **9 Hours**

STRUCTURES AND FUNCTIONS

Structures and Unions: Introduction-defining a structure- declaring structure variables-accessing structure members- structure initialization-Unions-Enumerated data type
User Defined Functions: Elements of user defined functions -Definition of functions-return values and their types- function calls-function declaration-categories of function -call by value and call by reference-recursion-Preprocessor directives and macros.

FOR FURTHER READING

Creating and manipulating document using word - Mail merge - Creating spread sheet with charts and formula using excel - developing power point presentation with Animations - C graphics using built in functions

3 Hours

EXPERIMENT 1

Write a C program to perform arithmetic operations on integers and floating point numbers.

3 Hours

EXPERIMENT 2

Write a C program to implement ternary operator and relational operators.

3 Hours

EXPERIMENT 3

Write a C program to find the greatest of three numbers using if-else statement.

3 Hours

EXPERIMENT 4

Write a C program to display the roots of a quadratic equation with their types using switch case.

3 Hours

EXPERIMENT 5

Write a C program to generate pyramid of numbers using for loop.

4 Hours

EXPERIMENT 6

Write a C program to perform Matrix Multiplication

3 Hours

EXPERIMENT 7

Write a C program to check whether the given string is Palindrome or not.

4 Hours

EXPERIMENT 8

Write a C program to find the factorial of given number.

4 Hours

EXPERIMENT 9

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student details: rollno, name, branch, year, section, cgpa.

****
NAME:
ROLL NO:
BRANCH:
YEAR:
SECTION:
CGPA:

Total: 75 Hours

Reference(s)

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals, BPB publications, 2008
2. Ashok. N. Kamthane, Computer Programming, Second Edition, Pearson Education, 2012
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
5. Byron Gottfried, Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	6	4				4					6														20
2	6					2					12														20
3	2				2		4				6		6												20
4	6				2		4		4		4														20
5	4				2		2				2						6				4				20
																								Total	100

Assessment Questions

Remember

1. List the characteristics of a computer.
2. List the features of a good programming language.
3. Define a constant.
4. Define associativity.
5. List the three looping statments in C.
6. State the use of switch case statement.
7. Recall arrays.
8. Recall strings.
9. Define a structure.
10. Define a union.

Understand

1. Explain the generations of computers.
2. Exemplify the problem solving techniques.
3. Illustrate the structure of a C program with an example.
4. Summarise the operators in C.
5. Exemplify the decision making statements in C.
6. Classify the looping statements in C.
7. Classify the types of arrays in C.
8. Summarize the string handling functions in C.
9. Exemplify the process of defining a structure.
10. Explain the components of a function.

Apply

1. Predict the reason for calling C as a structured programming language.
2. Demonstrate the concept of number conversions.
3. Execute a C program to find th roots of a quadratic equation.
4. Implement a C program to use the bitwise operators.
5. Implement a C program to generate fibonacci series.

6. Implement a C program to check whethr a number i prime or not.
7. Implement a C program to perform matrix multiplication.
8. Implment a C program to check whether a string is a palindrome or not.
9. Implement a C program to find the size of a union.
10. Implement a C program to swap two numbers using call by value and call by reference.

Analyse

1. Differentiate while and do while statements.
2. Compare structure and union in C.
3. Organize the basic computer organization.
4. Differentiate == and = operators.
5. Differentiate rak and continue statements.

Evaluate

1. Check the value of th expression c=(x*y+(z/x)) with x=10,y=20,z=30.
2. Determine the sum of n numbers using functions.
3. Determine the vowels using switch case statement.
4. Determine the vowels using switch case statement.
5. Differentiate the use of strcpy() and strncpy() functions.

Create

1. Generate a structure to store the following details: Rollno, Name, Mark1, Mark2, Mark3, Total, Average, Result and Class. Write a program to read Rollno, name and 3 subject marks. Find out the total, resultÂ and class as follows:
   a) Total is the addition of 3 subject marks.
   b) Result is "Pass" if all subject marks are greater than or equal to 50 else "Fail".
   c) Class will be awarded for students who have cleared 3 subjects
   i. Class "Distinction" if average >=75
   ii. Class "First" if average lies between 60 to 74 (both inclusive)
   iii. Class "Second" if average lies between 50 & 59 (both inclusive)
   d) Repeat the above program to manipulate 10 students' details and sort the structures as per rank obtained by them.
2. Derive a C++ program that determines whether a given integer is odd or even and displays the number and description on the same line.

15GE207 ENGINEERING GRAPHICS 0 0 4 2

Common to CE,CSE,ECE,EEE,EIE,IT (I Semester) and to AE, AG,AU,ME,MTRS,BT,FT,TT,FD (II Semester)

Course Objectives

- To learn conventions and use of drawing tools in making engineering drawings.
- To understand the engineering drawing methods and procedures to draw two dimensional drawings from three dimensional model and vice versa.
- To provide the practice for converting simple drawing into the computer aided drawing.

Course Outcomes (COs)

1. Recognize the conventions and apply dimensioning concepts while drafting simple objects.
2. Develop the two dimensional drawings from three dimensional model and vice versa.
3. Utilize the visualization skill to convert simple drawing into the computer aided drawing.

UNIT I **12 Hours**

CONVENTIONS AND BASIC DRAWINGS

Importance - conventions - ISO and BIS - drawing tools and drawing sheets - lettering, numbering, dimensioning, lines and symbols-Conic sections-types constructions-ellipse,parabola and hyperbola-eccentricity and parallelogram method.

UNIT II **14 Hours**

PROJECTIONS

Principles-first and third angle projections - Points - first angle projection of points Straight lines - parallel, perpendicular and inclined to one reference plane-Solid - cylinders, pyramids, prisms and cones-perspective projections.

UNIT III **12 Hours**

ORTHOGRAPHIC PROJECTIONS AND SECTION OF SOLIDS

Orthographic Projections - concepts - front view, top view and side view of simple solids -Section of Solids-simple illustrations.

UNIT IV **12 Hours**

ISOMETRIC PROJECTIONS AND DEVELOPMENT OF SURFACES

Importance- orthographic to isometric projection- simple and truncated solids. Development of surfaces - cylinders, pyramids, prisms, cones and simple truncated objects.

UNIT V **10 Hours**

INTRODUCTION TO AUTOCAD

Basics commands of AutoCAD- two dimensional drawing, editing, layering and dimensioning - coordinate systems-Drawing practice - orthographic views of simple solids using AutoCAD.

Total: 60 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, BUREAU OF INDIAN STANDARDS-SP46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V.Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
6. George Omura, Brian C. Benton, Mastering AutoCAD 2015 and AutoCAD LT 2015: Autodesk Official Press, Wiley Publisher, 2015.

15MA301 FOURIER SERIES AND TRANSFORMS 3 2 0 4

(Common to all branches of B.E./B.Tech. except CSE)

Course Objectives

- To understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- To implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- To summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation
- To develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Course Outcomes (COs)

1. Recognize the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.
2. Formulate a function in frequency domain whenever the function is defined in time domain.
3. Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
4. Classify a partial differential equation and able to solve them.
5. Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.

UNIT I **9 Hours**

FOURIER SERIES

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value.

UNIT II **13 Hours**

LAPLACE TRANSFORM

Laplace Transform- Existence Condition -Transforms of Standard Functions - Unit step function, Unit impulse function- Properties- Transforms of Derivatives and Integrals - Initial and Final Value Theorems - Laplace transform of Periodic Functions - Inverse Laplace transforms.

UNIT III **8 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity

UNIT IV **8 Hours**

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of Second Order Quasi Linear Partial Differential Equations - Fourier Series Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation - Steady State Solution of Two-Dimensional Heat Equation - Fourier Series Solutions in Cartesian Coordinates.

UNIT V **7 Hours**

Z -TRANSFORM

Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution Method- Partial fraction method - Solution of Difference Equations using Z-Transform.

FOR FURTHER READING

Solutions of one dimensional wave equation and heat equations using Laplace transforms method.

Total: 45+30=75 Hours

Reference(s)

1. Larry.C.Andrews and Bhimsen.K.Shivamoggi, Integral Transforms for Engineers, First Edition, PHI Learning, New Delhi, 2007
2. Ian.N.Sneddan, The Use of Integral Transforms, 2nd Edition, McGraw Hill companies, 1972.
3. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, Inc, Singapore, 2008.
4. Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012.
5. B.S. Grewal, Higher Engineering Mathematics, Fortieth Edition, Khanna Publications, New Delhi 2007.
6. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003.

Assessment Pattern

UNIT/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					6				6				6						22
2	2					6				6					6				6						26
3		2					2				6							6							16
4		2					6				6				6										20
5	2						2			6									6						16
																								Total	100

Assessment Questions

Remember

1. State the Dirichlet's Conditions.
2. Define even and odd function graphically.
3. List out the complex Fourier transform pair.
4. State convolution theorem in Fourier transforms.
5. Label the condition for the existence of Laplace Transform.
6. Reproduce L (t sin at).
7. State the final value theorem for Laplace Transform.
8. Label the inverse Laplace Transform of $1/(s^2+w^2)^2$.
9. Recognize $z\{f(n+1)\}$ $in terms of$ $\overline{f}(z)$
10. Recall the Z – Transform of $\cos\left(\frac{n\pi}{2}\right)$

Understand

1. Infer the half-range cosine series for the function $f(x) = x, 0 < x < \pi$
2. Interpret the Fourier series of period 2 for the function $f(x) = \begin{cases} \pi x & 0 \le x \le 1 \\ \pi(2-x) & 1 \le x \le 2 \end{cases}$
3. Identify the Fourier transform of $f(x) = \begin{cases} 1-|x| & for\ |x| \le 1 \\ 0 & for\ |x| > 1 \end{cases}$. Hence evaluate $\int_0^\infty \left(\frac{\sin x}{x}\right)^2 dx$ and $\int_0^\infty \left(\frac{\sin x}{x}\right)^4 dx$.
4. Illustrate the Fourier Sine and Cosine transform of e^{-ax} and evaluate $\int_0^\infty \frac{dx}{(a^2+x^2)}$.
5. Exemplify $\int_0^t \sin u \cos(t-u)\,du$ using Laplace Transform .
6. Indicate the inverse Laplace transform of $\frac{z}{(z-1)(z-2)(z-3)}$ by the method of partial fraction.
7. Use convolution theorem to find the inverse Laplace transform of $\frac{8z^2}{(2z-1)(4z+1)}$.
8. Classify the possible solutions of one dimensional wave equation.
9. Formulate $z\{nf(t)\} = -z\frac{dF}{dz}(z)$
10. Summarize Z-transform.

Apply

1. Execute the function $f(x) = |\cos x|\ \ in\ \ (-\pi, \pi)$ to represent as a Fourier series of periodicity 2π.
2. A taut string of length L is fastened at both ends. The midpoint of the string is taken to a height of b and then released from rest in this position. Find the displacement of the string at any time t.
3. Find the Fourier transform of $f(x) = \begin{cases} a-|x| & for\ |x| \le a \\ 0 & for\ |x| > a \end{cases}$. Hence evaluate $\int_0^\infty \left(\frac{\sin x}{x}\right)^2 dx$ and $\int_0^\infty \left(\frac{\sin x}{x}\right)^4 dx$.
4. Find the Fourier transform of $f(x) = \begin{cases} 1, & for\ |x| < a \\ 0, & for\ |x| > a \end{cases}$ hence evaluate $\int_0^\infty \frac{\sin x}{x} dx$ and $\int_0^\infty \left(\frac{\sin^2 x}{x^2}\right) dx$
5. Verify the initial and final value theorem for the function $1 + e^{-2t}$.
6. Find $L\left(\frac{\cos 2t - \cos 3t}{t}\right)$
7. Using Convolution theorem find the inverse Laplace transform of $\frac{1}{s^2(s^2+25)}$.
8. Find $L^{-1}\left(\frac{p^2-p+2}{p(p+2)(p-3)}\right)$ using Partial fraction method.
9. Using Convolution theorem evaluate $z^{-1}\left(\frac{z^2}{(z-1)(z-3)}\right)$.
10. Solve the differential equation
$y(n+3) - 3y(n+1) + 2y(n) = 0\ given\ that\ y(0) = 4,\ y(1) = 0\ and\ y(2) = 8$.

Analyze

1. Organize the sine series for $f(x)=\begin{cases} x \ \ in \ \ 0<x<l/2 \\ l-x \ \ in \ \ l/2<x<l \end{cases}$ in the interval $(0,l)$.
2. A tightly stretched string of length 'ℓ' fastened at both ends. The mid-point of the string taken to a height 'b' and show that the displacement at any time 't' is given by
$$y(x,t)=-\frac{8b}{\pi^2}\left[\frac{1}{1^2}\sin\left(\frac{\pi x}{\ell}\right)\cos\left(\frac{\pi at}{\ell}\right)-\frac{1}{3^3}\sin\left(\frac{3\pi x}{\ell}\right)\cos\left(\frac{3\pi at}{\ell}\right)+........\right].$$
3. Organize the Fourier transform of f(x) given by $f(x)=\begin{cases} a^2-x^2 & for \ |x|\le a \\ 0 & for \ |x|\ge a \end{cases}$. Hence evaluate
$$\int_0^\infty\left[\frac{\sin t-t\cos t}{t^3}\right]dt=\frac{\pi}{4}.$$
4. Integrate $\int_0^\infty \frac{dx}{(x^2+a^2)(x^2+b^2)}$ using transform method.
5. Organize the Fourier sine and cosine transform of $f(x)=\begin{cases} x, \ 0<x<1 \\ 2-x, \ 1<x<2 \\ 0, \ x>2 \end{cases}$.
6. Prove that the Laplace Transform of the triangular wave of period 2π defined by
f (t) = $\begin{cases} t & , 0\le t\le\pi \\ 2\pi-t & , \pi<t<2\pi \end{cases}$ is $\frac{1}{s^2}\tanh\left(\frac{\pi s}{2}\right)$.
7. Organize the inverse Laplace transform of $\frac{s+2}{s^2-4s+13}$ using partial fraction.
8. Solve using Laplace Transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=te^{-t}$; $y(0)=0;\ y'(0)=-1$.
9. Find $z^{-1}\left(\frac{z^2}{(z+2)(z^2+4)}\right)$ by the method of partial fraction.
10. Using Z – Transform solve $y(n)+3y(n-1)-4y(n-2)=0,\ n\ge 2\ given\ that\ y(0)=3\ and\ y(1)=-2$.

Evaluate

1. Determine the Fourier series of the function f(x) of Period 2π given by $f(x)=\begin{cases} 1+\frac{2x}{\pi} & in \ \ -\pi\le x\le 0 \\ 1-\frac{2x}{\pi} & in \ \ 0\le x\le\pi \end{cases}$
2. A string is stretched between two fixed points at a distance 2ℓ apart and the points of the string are given initial velocities 'u' where $u=\begin{cases} \frac{cx}{\ell}, & in \ 0<x<\ell \\ \frac{c}{\ell}(2\ell-x) & in \ \ell<x<2\ell \end{cases}$ x being the distance from one end point.
Find the displacement of the string at any subsequent time.
3. Use transforms method to evaluate $\int_0^\infty \frac{dx}{(x^2+1)(x^2+4)}$

4. Determine the Fourier cosine transform of $e^{-a^2x^2}$. Hence prove $e^{-\frac{x^2}{2}}$ is a self-reciprocal.
5. Choose the Laplace transform of the function f(t) with period $\frac{2\pi}{\omega}$, where

$$f(t) = \begin{cases} \sin \omega t & , \text{ for } 0 < t < \pi/\omega \\ 0 & , \text{ for } \pi/\omega < t < 2\pi/\omega \end{cases}$$

6. Using Laplace transform evaluate $\int_0^\infty te^{-3t} \sin 2t \; dt$
7. Using Convolution theorem find the inverse Laplace transform of $\frac{1}{s^2(s^2+25)}$.
8. Solve using Laplace transforms $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = te^{-t}$; $y(0) = 0;\ y'(0) = -1$.
9. Solve the equation $y_{n+2} - 7y_{n+1} + 12y_n = 2^n$, *given that* $y_0 = y_1 = 0$.
10. Evaluate inverse Z-transform of $\frac{z}{(z-1)(z-2)(z-3)}$ by the method of partial fraction.

15BT302 PROCESS CALCULATIONS AND FLUID MECHANICS 3 2 0 4

Course Objectives

- To provide students the basic knowledge on chemical and biochemical calculations for understanding the thermodynamics, mass transfer operation etc.
- To apply chemical engineering principles to solve problems in process industries
- To understand the role of pumps in industries

Course Outcomes (COs)

1. Acquire in depth knowledge on units and conversions
2. Learn about the fluids and its behavior.
3. Understand the flow measurement and head losses in pipes
4. Understand the pumps and its classifications
5. Perform calculations based on process calculations and fluid mechanics

UNIT I **9 Hours**

BASICS OF CHEMICAL CALCULATION

Stoichiometry &chemical equations; Units, dimensions & conversions; Basic chemical calculations-mole, weight & volume%, Henry's law, Raoult's law & their applications to different systems

UNIT II **9 Hours**

MATERIAL AND ENERGY BALANCE

Material Balance without Chemical reaction-distillation, evaporation, drying & fermenter, recycle, by pass and purging; Energy balance -Sensible heat, latent heat

UNIT III **9 Hours**

FLUID MECHANICS

Nature of fluids, properties of fluids, classification of fluids, hydrostatic equilibrium; Manometers; Continuity equation, Bernoulli equation; friction factor and head losses for various stations

UNIT IV **9 Hours**

FLUID FLOW MEASUREMENT

Measurement of fluid flow-orifice meter, venturimeter, pilot tube and Rota meter. Flow controls-gate valve, globe valve, butterfly valve, globe and ball valve. Fluidization â??mechanism, types, its application. ergun equation

UNIT V **9 Hours**

TRANSPORTATION OF FLUIDS

Pumps- Classification, Principle, Characteristics and working of centrifugal pump and reciprocating pump. Concepts of compressors, fans and blowers

FOR FURTHER READING

Density of gas mixture, Steady state calculations, Flow of incompressible fluids in conduits, Friction factor for packed bed, NPSH and cavitation

Total: 45+30=75 Hours

Reference(s)

1. W. L. McCabe, J. C. Smith and P. Harriott, Unit Operations in Chemical Engineering, Tata McGraw-Hill Professional, 2005.
2. K. A. Gavhane,Introduction to Process Calculations - Stoichiometry,Nirali Prakashan, 2009.
3. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall of India, 2007.
4. N. Anantharaman and V. Venkataramani, Process Calculation, Prentice Hall of India, 2005.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			5				6							20
5	3						3			2									6				6		20
																								Total	100

Assessment Questions

Remember

1. Define Stoichiometry.
2. State Henry's law.
3. Recall Raoult's law.
4. Reproduce the three salient features of valves.
5. Reproduce the gas capacity equation for centrifugal fan or blower.
6. Retrieve the dimension of surface tension.
7. Define relative atomic mass.
8. Define the law of conservation of mass.
9. State two advantages of distillation over evaporation.
10. Define Kinematic Viscosity.

Understand

1. Interpret the theory of Evaporator in milk processing.
2. Indicate the calculation of friction factor.
3. Identify the potential flow impact at different viscosities of fluids.
4. Explain the role of pumps in waste water treatment.
5. Summarise the four salient features of Bernoulli equation with examples.
6. Interpret the applications of continuity equation in brewing industries.
7. Indicate the unit of kinematic viscosity in SI unit.
8. Indicate the general relationship between speed N, head H, power P and discharge Q for a centrifugal pump.
9. Explain how Relative Molecular Mass can be calculated.
10. Explain how the concentration of solute in solution can be described with molarity.

Apply

1. Show how to convert weight percentage to volume percentage.
2. Predict how the process of microbial transformation is utilized in heat transfer.
3. Design a reactor and develop ergun equation for production of yoghurt.
4. Select a methodology for immobilization of bromelain with fluidized bed reactor as model.
5. An air storage vessel contains air at 6.5 bar and 15oC. Air is supplied from the vessel to a machine through a pipe 90 m long and 50 mm diameter. The flow rate is 2.25 m3/min at the pipe inlet. The friction coefficient C is 0.005. Neglecting kinetic energy, find the pressure at the machine assuming isothermal flow.
6. Interpret why some liquids float on water while some others settle down at the bottom.
7. Solve how to determine which reactant in a chemical reaction is the limiting reactant.
8. Solve the maximum number of grams of silver chloride that will precipitate from a solution made by mixing 25.00 mL of 0.050 M MgCl2with an excess of AgNO3 solution?
9. Interpret the difference between between Newtonian and Non Newtonian Flow.
10. Demonstrate the difference between Laminar and Turbulent Boundary Layers.

Analyse

1. Compare fluid flow measurement by Orifice and venture meter.
2. Analyse the stability of manometers for the fluid flow measurement in non Newtonian flow.
3. Compare and contrast reciprocating pump over centrifugal pump.
4. Examine whether there is as a difference between Relative Molecular Mass and Relative Formula Mass.
5. Compare and contrast between an ionic compound and covalent compound.
6. Compare and contrast between homogeneous and heterogeneous mixtures.
7. Compare and contrast between homogeneous and heterogeneous mixtures.

Evaluate

1. A Venturi Meter must pass 300g/s of air. The inlet pressure is 2 bar and the inlet temperature is 120oC. Ignoring the inlet velocity, determine the throat area. Take Cd as 0.97. Take γ=1.4 and R = 287 J/kg K (assume choked flow)
2. Evaluate why air is homogeneous if it consists of different gases in varied quantities? Even a mixture of stone in pulses is called a heterogeneous mixture, then why not air if it contains 21 percent oxygen and 78 percent nitrogen?
3. Justify whether the percent yield can be calculated, given the actual yield and enough information to determine the theoretical yield

Create

1. Derive an equation for production and flow measurement of fruit based alcoholic beverages inside a conduit.
2. Derive Bernoulli's equation for gas.

15BT303 BIOORGANIC CHEMISTRY 3 0 0 3

Course Objectives

- To provide students with a basic understanding of chemistry and stereo chemistry of biomolecules
- To know the structures of protein and nucleic acids and mechanism of enzyme action
- To understand the mechanism of protein folding and unfolding and their biological significances

Course Outcomes (COs)

1. Learn stereochemistry, nucleophilic substitution reactions and types of catalysis to understand the structure, properties and function of biomolecules
2. Understand the enzyme structure and their stereospecificity of action
3. Formulate kinetics and mechanism for enzymatic reaction necessary to understand bioprocess
4. Synthesis amino acids, peptides and nucleotides in the lab, can sequence proteins and nucleic acid and interpret their stability and 3D structures
5. Probe protein folding-unfolding kinetics and know the importance of molecular chaperons

UNIT I **9 Hours**

CONCEPTS IN ORGANIC CHEMISTRY

Stereochemistry R,S notation re-si faces e,z isomerism- conformers- ethane cyclopropane - reactivities- mechanisms of SN1 SN2 reactions and their stereochemistry ester formation and hydrolysis, reaction rates potential energy diagram, Hammond's postulate Hammond effects. Transition state analogues. Classification of Catalysis general acid and base and covalent catalysis-multifunctional catalysis.

UNIT II **9 Hours**

ENZYMES: STRUCTURE, STEREOCHEMISTRY AND MECHANISM

Stereospecific enzymatic reactions - fumarasecatalysed reactions - NAD dependent oxidation and reduction reactions - chiral methyl group .The dehydrogenases - the proteases - lysozyme-ribonucleases.

UNIT III **9 Hours**

ENZYME KINETICS

MichaelisMenton-Kinetics. Derivation of rate equation for equilibrium and non-equilibrium kinetics, Mechanism of enzyme action. Energetics of enzyme catalysedreaction . Significances of H, G, S in enzyme kinetics. Kinetics of multisite co-operative enzymes-sequential (Koshland-Nemethy-Filmer (KNF) and Concerted (Monod - Changeux -Wyman model) models

UNIT IV **9 Hours**

PROTEINS AND NUCLEIC ACIDS

Chemical synthesis of amino acids and proteins different types of secondary structural elements in proteins, stability of proteins - stability and activity trade off. Chemical synthesis of nucleotides and poly nucleotides . Chemical and enzymatic methods for sequencing proteins and nucleic acids

UNIT V **9 Hours**

PROTEIN FOLDING

Protein folding pathways, folding kinetics-basic methods two state kinetics and multistate kinetics, transition states in protein folding 1H-2H exchange studies in protein-Linderstrom-Lang model- folding of peptides- CI2 folding. Molecular chaperons-heat shock proteins-GroEL ?GroES- mechanism of action.

FOR FURTHER READING

Structures of aromatic heterocyclic and polycyclic aromatic compounds, structural levels in proteins and nucleic acids, functions of proteins and nucleic acids, types of DNA and RNA, ribozyme- classification, mechanism of catalysis and uses

Total: 45 Hours

Reference(s)

1. A. Fersht, Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, New York: W. H. Freeman and company, 1999
2. H. Dugas, Bioorganic Chemistry, Springer Verlag, 1999.
3. D. L. Nelson and C. M. M. Lehninger, Principles of Biochemistry, W.H. Freeman & Co., 2005
4. C. K. Mathews, K. E. Van Holde, and K. G. Ahern, Biochemistry, Pearson Education, Indian Reprint, 2003
5. F. Campbell, Biochemistry, Thomson Books, Indian Reprint, 2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
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2	3					6				3				5				3							20
3	3					4				5				5				3							20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. What are stereoisomers?
2. State Hammond?s postulate.
3. List out the characteristics of SN1and SN2 reactions
4. Write the integrated form of MM equation with enzyme deactivation
5. Name the pyrimidine and purine bases in RNA and DNA . Give their structures
6. Define turnover number
7. What are two state and multisate kinetics in protein folding?
8. Mention the amino acids in the active site of lysozyme
9. Define stereospecificity of enzyme action.
10. What is Lineweaver-Burk plot? Represent the plot with slope and intercept.
11. Summarise the differences between enzyme catalyst and chemical catalyst
12. How catalysts are classified ?
13. List out the roles of molecular chaperones
14. How proteases are classified?
15. What are essential and non essential amino acids?

Understand

1. What is prochirality?
2. Define re and si faces.
3. Define phi F value
4. What are allosteric enzymes?

5. Why DNA is hydrolytically more stable than RNA?
6. How H-D exchange in protein folding can be monitored?
7. How MWC model differs from KNF model?
8. Why additions of urea to a protein solution denature protein?
9. How the transition state analogs are useful in predicting the mechanism of enzymatic reactions?
10. Can you use a base to catalyse the esterification reaction? Why?
11. Why the rate of enzyme catalysed reaction is enormously high?
12. What are the merits and demerits of classical models for protein folding?
13. What is hydrophobic collapse model?
14. What is Hammond behaviour in protein folding?

Apply

1. Write the Rand S configuration for serine
2. How protein folding can be monitored using DSC?
3. Monitor the protein folding using fluoresence spectroscopy
4. How to improve the turnover number for an enzyme?
5. Evaluate the specificity of an enzyme for different substrates kinetically
6. Model the kinetics of enzymatic reactions and derive the rate expression
7. Evaluate the MM parameters from kinetic data

Analyse

1. Why protein folding occurs?
2. What are cold and solvent denaturations? why they occur
3. Why more than one alcohol is formed in the hydrolysis of n-butyl bromide?
4. Analyse the sequence of a protein by chemical method
5. MWC model doesnot explain negative co-operativity. Analyse.
6. What is the phsico-chemical basis for the nucleation-condensation mechanism in CI2 folding?
7. Interpret Levinthal's paradox
8. Define molten globule in protein folding
9. Prove that 1H/ 2H exchange at equilibrium can not be used to determine pathways
10. How the transition state in protein folding differes from that in chemical reaction?

Evaluate

1. How the KNF model explains the kinetics of multi co-operative enzymes?
2. How CI2 folding mechanism is evaluated?
3. Calculate the turnover number and catalytic efficiency from Enzyme kinetic data
4. Elucidate the stereospecificity and mechanism of action ofÂ chymptrypsin
5. Why the kinetics in protein folding is non- Arrehenius?

15BT304 BIOCHEMISTRY 3 0 0 3

Course Objectives

- To give an introduction to bio molecules in the biological system
- To study the mechanism and role of enzymes in metabolism
- To understand the metabolic pathways of biomolecules

Course Outcomes (COs)

1. Recognize how fundamental chemical principles and reactions are utilized in biochemical processes.
2. Interpret the structural and functional role of carbohydrates in the energy production process.
3. Relate the structural and metabolic role of lipids in the human system.
4. Compute the functional properties of amino acids and proteins related to structure and their pathway for elimination from system.
5. Understand the structure of nucleotide bases and synthesis and degradation of bases.

UNIT I **9 Hours**

INTRODUCTION

Buffering system and biological buffers; Biomolecules introduction. Metabolism - anabolism, catabolism and amphibolism; Chemistry of metabolism; concepts of bioenergetics.

UNIT II **9 Hours**

CARBOHYDRATES

Nomenclature- structure, classification and functions of carbohydrates. Glycolysis and krebs cycle, Pentose Phosphate Pathway (HMP Shunt), Glycogen synthesis and breakdown, Electron transport chain and oxidative phosphorylation.

UNIT III **9 Hours**

LIPIDS

Classification, structure and functions of lipids, synthesis and degradation of lipids- fatty acids, phospholipids, cholesterol and lipoproteins.

UNIT IV **9 Hours**

AMINO ACIDS AND PROTEINS

Classification, structure and functions of aminoacids. Primary, secondary, tertiary and quaternary structures of proteins, Nitrogen metabolism and urea cycle

UNIT V **9 Hours**

NUCLEIC ACIDS

Structure, functions and types of bases - purines and pyramidines. Biosynthesis of nucleotides - de novo and salvage pathways for purines and pyrimidines. Degradation of nucleotides.

FOR FURTHER READING

Metabolism of Biomolecules, Enzyme nomenclature, DNA Ultrastructure, Protein structure Prediction techniques, Bioenergetics of common metabolic processes

Total: 45 Hours

Reference(s)

1. D. L. Nelson and M. M. Cox, Lehninger?s Principles of Biochemistry, 6 th edition WH Freeman & Co., 2012.
2. J. Tymoczko, J. Berg and L. Stryer, Biochemistry- A Short Course, Freeman and Company, 2009.
3. D. Voet and J. G. Voet, Biochemistry, John Wiley and Sons Inc., 2010.
4. C. K. Mathews, K. E. Van Holde and K. G. Ahern, Biochemistry, Pearson Education Private Ltd., 2000.
5. www.ocw.mit.edu

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
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4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. What are biomolecules?
2. List out the names of biological buffers with example.
3. What are the functions of glucose in the body?
4. Write the structure of triacylglycerol?
5. How will you classify aminoacids based on nutritional importance?
6. List out ketogenic and antiketogenic aminoacids.
7. State the significance of apolipoproteins
8. Name the purines and pyrimidines with their structure.
9. What are enzymatic antioxidants give examples?
10. What are conjugated lipids give examples?

Understand

1. What are conjugated lipids give examples?
2. Give some functions of cholesterol in the body.
3. What are the functions of ACAT and LCAT?
4. What are the two main routes of NADPH production?
5. Give some functions of cholesterol in the body.
6. What is the role of water in the human body?
7. Differentiate glucose and fructose.
8. List out the components of DNA.
9. Why vitamins are important for our body?
10. What are structural polysaccharides?

Apply

1. In what way lipids function in the structure of a cell.
2. What is UDP – Glucose? Give its significance in glycogenesis
3. What is the role of amino acids?
4. How antioxidant controls free radicals?

5. Give some examples of synthetic antioxidants.
6. Classify lipoproteins with example.
7. What are conjugated lipids give examples?
8. What is the functional structure of protein?

Analyze
1. What is the role of biotin carboxylase in fatty acid biosynthesis?
2. Define the function of cartinine in beta oxidation of fatty acids.
3. What is the role of TPP in carbohydrate metabolism?
4. Give the function of carnitine
5. Name two micelle forming lipids.
6. Differentiate reducing sugar and non reducing sugar.
7. What is the functional structure of protein?

Evaluate
1. Write the role of biomolecules in metabolic reaction.
2. How excess amount of glucose utilized and stored in human system?
3. Give some examples of synthetic antioxidants.
4. Name some vitamins which act as cofactors for metabolic reactions.

Create
1. Synthesis of simple peptides of medical importance from amino acids
2. How do you develop an effective nutritive food which control protein defieciency?
3. Synthesis of simple sugar units of medical importance from saccharides

3 0 0 3

15BT305 GENETICS

Course Objectives
- This course aims to impart the principle and pattern of segregation of genes and its characters
- To know the mechanism of crossingover, linkage of genes and identification of genetic material
- To learn mutation, genetic variations and evolutionary effects of life forms

Course Outcomes (COs)
1. Understand the Mendel's experiment and principle and pattern of segregation of genes and its characters
2. Know the Mechanism of sex determination, linkages and crossing over
3. Understand the Identification of genetic material
4. Analyse the mutations and chromosomal Inheritance in life forms
5. Explicate the population and evolutionary Genetics

UNIT I **9 Hours**
MENDELIAN GENETICS
Mendels experiment and principle of segregation, monohybrid crosses dominance and recessiveness; principle of independent assortment dihybrid crosses; multiple alleles ABO blood type, Rh factor alleles

UNIT II **9 Hours**

SEX DETERMINATION, LINKAGE AND CROSSING OVER

Mechanism of sex determination, sex differentiation, sex linked inheritance, linkage and crossing over

UNIT III **9 Hours**

GENETIC MATERIAL AND GENETIC TRANSFER

Identification of genetic material by Hersey & Chase, Avery, Mcleod and Fraenkel - Singer experiments; chromosome structure in prokaryotes and eukaryotes, recombination in bacteria - transformation, transduction and conjugation

UNIT IV **9 Hours**

MUTATION AND CHROMOSOMAL INHERITANCE

Mutations - spontaneous, physical and induced; applications of mutation, organization of DNA in mitochondria and plastids, cytoplasmic male sterility in plants

UNIT V **9 Hours**

POPULATION AND EVOLUTIONARY GENETICS

Genetic variation, random mating and Hardy-Weinberg method, inbreeding, outbreeding and assortative mating, genetic equilibrium, evolutionary genetics

FOR FURTHER READING

Genetics in agriculture and medicine, Reverse Genetics, Genetics basis of cancer.

Total: 45 Hours

Reference(s)

1. M.J. Simmons and. D.P. Snustad, Principles of Genetics, John Wiley, 2012
2. E.J. Gardner, M.J. Simmons and. D.P. Snustad, Principles of Genetics, John Wiley, 2006
3. H.T. Robert, Principles of Genetics, Tata McGraw Hill, 2002
4. L. Daniel, Hartl and W. Elizabeth, Essential Genetics, Jones and Bartlett publishers, Massachusetts, 2002

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
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4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. What do you meant by tetrad data?
2. Expound the discovery of transformation by Griffith.
3. What are the functions of highly repetitive DNA sequences?
4. What is Xeroderma pigmentosum?

5. What is genetic equilibrium? Comment on the balancing selection and mutation based selection balance.
6. Name the cross used to increase the hybrid vigour of the progenies over the parents.
7. What is genetic balance theory?
8. Define rolling circular replication
9. What are cp DNA? Mention its significance
10. List the different types of packaging of eukaryotic chromosomes.

Understand

1. What is genetic equilibrium?
2. Comment on the balancing selection and mutation based selection balance.
3. How gametophytic incompatibility is achieved?
4. How nature selects the species for survival?
5. When abortive transductants are formed?
6. How male sterile plants are produced? Add its significance.
7. At which conditions fragile X syndrome are produced?
8. Differentiate mitosis from meiosis.
9. Why carriers does‘nt express in F1 generation?
10. How lethal gene expression can be suppressed?

Apply

1. Why Mendel has chosen pea plant for his experiment?
2. Describe in detail about the transforming principle of DNA and direct evidence of DNA as genetic material.
3. Explain how mating occurs between HfrH x F- cells. Explain with reference to uninterrupted mating experiment.
4. How genetic recombination of bacteria is achieved by generalized transduction?
5. How male sterile plants are produced? Add its significance.
6. How assortative mating and out breeding leads to heterosis?

Analyse

1. Distinguish homozygous from heterozygous
2. Differentiate phenotype and genotype.
3. Explicate the concept of dominance, recessiveness and lethals with reference to Mendelian monohybrid crosses.
4. Distinguish transformation from recombination.
5. Distinguish spontaneous mutation from Induced mutations with examples.
6. Explain the Muller’s ClB method for detecting sex linked recessive lethal mutations in Drosophila.

Evauate

1. Describe the mechanism of radiation induced mutation in DNA.
2. Distinguish assertive mating and negative assertive mating.

Create

1. Illustrate the phenomenon of crossing over with suitable examples.
2. Sketch the detail account of the patterns of sex linked genes and traits in humans.

15BT306 MICROBIOLOGY 3 0 0 3

Course Objectives

- This course aims to develop skills of the Students in the identification of microbes, structure, metabolism and their industrial applications
- To understand the interaction of host and pathogen
- This will be a prerequisite for all courses offered in Bioprocess Technology

Course Outcomes (COs)

1. Isolate and identification of microorganisms from various sources
2. Know the structure and life cycle of microorganisms
3. Understand nutritional and metabolism of microorganisms
4. Adopt appropriate mechanisms for control of microbes and treatment
5. Exploit microbes for producing bioproducts and biomass

UNIT I **9 Hours**

INTRODUCTION

Classification and nomenclature of microbes; Principle and applications of Microscopy - Light, dark field, phase contrast and fluorescence; principles of staining techniques - Gram, acid fast, capsule, flagella, endospore and Lacto phenol cotton blue.

UNIT II **9 Hours**

STRUCTURE AND MULTIPLICATION OF MICROBES

Colony morphology and arrangement of bacterial cells; Structure and multiplication of bacteria, fungi (Rhizopus) and viruses (TMV); life history of mycoplasma, actinomycetes (Streptomyces), yeast, and bacteriophages.

UNIT III **9 Hours**

MICROBIAL NUTRITION, GROWTH AND METABOLISM

Nutritional requirements and media for bacterial growth; bacterial growth curve, nutritional classification of organisms; methods to quantitate bacterial growth, preservation techniques; Bacterial metabolism - respiration and fermentation (lactic acid and ethanol).

UNIT IV **9 Hours**

MICROBIAL CONTROL AND HOST INTERACTION

Physical and chemical methods of microbial control; antimicrobial drugs - mode of action and drug resistance, antibacterial, antifungal and antiviral agents; mechanisms of pathogenicity - mode of entry, penetration of host defences and damage.

UNIT V **9 Hours**

INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

Biofertilizers, biopesticides, production of alcohol, amoxicillin; bioremediation; leaching of ores by microbes; microbial treatment of wastewater - aerobic and anaerobic methods.

FOR FURTHER READING

Microbial diseases - source, mode of infection and treatment of Candidiasis, Rabies, Chikungunya, Dengue, Malaria and Typhoid.

Total: 45 Hours

Reference(s)

1. L. M. Prescott, J. P. Harley and D. A. Klein, Microbiology, Wm. C. Brown Publishers, 2004.
2. M. J. Pelczar, E. C. S. Chan and N. R. Krein, Microbiology, Tata McGraw-Hill, 2002
3. G. J. Tortora, B. R. Funke and C. L. Case, Microbiology, Addison Wesley Longman, Inc. 2001.
4. R. M. Atlas and Renk, Principles of Microbiology, McGraw-Hill Higher Education, 1995.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
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3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. Define Koch's postulate.
2. What are dimorphic fungi?
3. Give out the special features.
4. What are endospores? Mention its purpose.
5. List the essential nutrients that are required for bacterial growth.
6. What are DTP vaccines? Mention its sources.
7. What is the resolving power of a microscope. Mention for TEM and SEM.
8. Define monomorphic & dimorphic bacteria.
9. What are streptomyces? Add a note on special features.
10. Mention the ways by which antibiotics act on the bacteria.

Understand

1. Explicate the process that serves as a base for the Pasteur effect. Add a historical note.
2. What is prophage? Mention its special features. State the principle and mode of action of tincture.
3. Differentiate rectified spirit and neutral spirit.
4. Exemplify the physical and chemical nutritional requirements of bacteria.
5. How Biopesticide differs from Chemical pesticide in their action?
6. When will you use selective media for bacterial isolation?
7. Why are some antibiotic toxic?

Apply

1. How will you convert a bright field microscope in to a dark field microscope?
2. How microbes evade from the host defence mechanism?
3. How biopesticides are produced and used for pest management?
4. How biopesticide differs from Chemical pesticide in their action?

5. Write about special staining. Mention two types?
6. State the types of essential and non-essential aminoacids.
7. Draw the structure of mitochondria and add its function.

Analyse
1. Differentiate pest and predator with an example.
2. Exemplify the direct and indirect methods for quantitation of bacteria.
3. Differentiate pest and resistance and susceptibility with an example.

Evaluate
1. Compare the structural dissimilarities of gram positive and negative bacteria with a neat sketch.
2. Defend the molecular mechanism of lysogeny and mention how lysogeny can be reverted to lytic phase.

Create
1. Illustrate the biochemical pathway and energy production of fermentation.
2. Restate the mode of action of antimicrobial agents with a neat sketch.
3. Sketch the different methods to abate pollution using microorganisms

15BT307 BIOCHEMISTRY AND BIOORGANIC CHEMISTRY LABORATORY **0 0 2 1**

Course Objectives
- To have a hands on experience in the preparation of various solutions and buffers.
- To build the basic knowledge on the qualitative and quantitative study of biomolecules.
- To learn the synthetic strategies of materials used in food and pharma industries.

Course Outcomes (COs)
1. Gain knowledge on preparation of reagents and chemicals.
2. Analyze the biomolecules quantitatively and qualitatively.
3. Attain synthetic organic chemistry skill to synthesize medicines

3 Hours

EXPERIMENT 1
Preparation of buffers and determination of pKa

3 Hours

EXPERIMENT 2
Qualitative analysis of carbohydrates and aminoacids

3 Hours

EXPERIMENT 3
Preparation and estimation of glucose

3 Hours

EXPERIMENT 4
Estimation of Protein

3 Hours

EXPERIMENT 5
Determination of saponification, acid and iodine number of oil

3 Hours

EXPERIMENT 6
Quantitative analysis of DNA and RNA

3 Hours

EXPERIMENT 7
Synthesis of aspirin and its crystallization

3 Hours

EXPERIMENT 8
Preparation of 5, 10, 15, 20-tetrakisphenyl porphyrin

6 Hours

EXPERIMENT 9
Design oriented experiment

Total: 30 Hours

15BT308 MICROBIOLOGY LABORATORY 0 0 2 1

Course Objectives

- Imparts hands on training in the aseptic techniques and operation of equipment
- Develops skills in the isolation and identification of microbes
- To study the metabolites and its antagonistic effects on other organisms

Course Outcomes (COs)

1. Isolate and identification of microorganisms from various sources
2. Preservation of microorganisms
3. Exploitation of microbes for producing bioproducts and biomass
4. Study the growth characteristics of bacteria
5. Evaluate the microbes present in environmental samples

5 Hours

EXPERIMENT 1
Microscopic observation of microorganisms

5 Hours

EXPERIMENT 2
Culturing of microorganisms - in broth, plates (pour plate and streak plate)and slant

5 Hours

EXPERIMENT 3
Staining techniques - Gram staining and endospore staining

5 Hours

EXPERIMENT 4
Bacterial growth curve

5 Hours

EXPERIMENT 5
Antibiotic sensitivity assay by Kirby-Bauer Test

5 Hours

EXPERIMENT 6
Enumeration of microbial population from soil and water

Total: 30 Hours

Reference(s)

1. Microbiology Laboratory Manual

15BT309 MINI PROJECT I 0 0 2 1

Course Objectives

1. To develop knowledge to formulate a real world problem and project's goals.
2. To identify the various tasks of the project to determine standard procedures.
3. To identify and learn new tools, algorithms and techniques.
4. To understand the various procedures for validation of the product and analysis the cost effectiveness.
5. To understand the guideline to Prepare report for oral demonstrations.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations

15GE310 LIFE SKILLS: BUSINESS ENGLISH 0 0 2 -

Course Objectives

- To acquire command in both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English to the level of becoming independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge English Language Assessment

UNIT 1 **15 Hours**

LISTENING AND READING (RECEPTIVE SKILLS)

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information - Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT 2 **15 Hours**

WRITING AND SPEAKING (PRODUCTIVE SKILLS)

Business Emails - notes - memos to colleagues or friends - Giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading Turn-taking - sustaining interaction - initiating - responding - giving personal information - Talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self-Study Practice Tests with Key, Heinle,a part of Cengage Learning, Delhi, 2003.

15MA401 NUMERICAL METHODS AND STATISTICS 2 2 0 3

(Common to AG, AU, FD, ME, MTRS, EEE, EIE, BT, TT and FT)

Course Objectives

- Understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically.
- Summarize and apply the methodologies involved in solving problems related to ordinary and partial differential equations.
- Apply the concepts testing of hypothesis in their core areas.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Course Outcomes (COs)

1. Classify the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically.
2. Demonstrate and obtain the differentiation and integration of functions using the numerical techniques.
3. Obtain the solutions of all types of differential equations, numerically.
4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
5. Design an experiment for an appropriate situation using ANOVA technique.

UNIT I **6 Hours**

SOLUTION OF EQUATIONS

Solution of algebraic and transcendental equations: Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigen values of a matrix by Power method.

UNIT II **5 Hours**

INTERPOLATION, DIFFERENTIATIONAND INTEGRATION

Interpolation: Newton's forward and backward interpolation formulae – Numerical differentiation: Newton's forward and backward interpolation formulae. Numerical integration: Trapezoidal rule- Simpson's rules for single integrals- Two point Gaussian quadrature formula.

UNIT III **7 Hours**

SOLUTION OF DIFFERENTIAL EQUATIONS

Solution of first order ordinary differential equations: Fourth order Runge- Kutta method - Solution of partial differential equations: Elliptic equations: Poisson's equation- Parabolic equations by Crank Nicholson method- Hyperbolic equations by explicit finite difference method.

UNIT IV **6 Hours**

TESTING OF HYPOTHESIS

Sampling distributions- Large sample test: Tests for mean- Small sample tests: Tests for mean (t test), F-test- Chi-square test for Goodness of fit and Independence of attributes.

UNIT V **6 Hours**

DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design.

FOR FURTHER READING

Collection of data and use the testing of hypothesis to analyze the characteristics of the data.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Grewal B. S, *Numerical Methods in Engineering and Science with Programms in C & C++*, Ninth Edition, Khanna Publications, 2010.
2. Sankara Rao. K, *Numerical Methods for Scientists and Engineers*, Third Edition, PHI earning Private Limited, New Delhi, 2009.
3. Gerald C. F and Wheatley P.O, *Applied Numerical Analysis*, Seventh Edition, Pearson
4. Education, New Delhi, 2004.
5. Johnson R.A, *Miller and Freund's Probability and Statistics for Engineers*, Seventh Edition, Prentice Hall of India, New Delhi, 2005.
6. Walpole R.E, Myers R.H, Myers R.S.L and Ye K, Probability *and Statistics for Engineers and Scientists*, Seventh Edition, Pearsons Education, Delhi, 2002.

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2					6					8			4			2								22
2		2									12								6						20
3	2					2				4					4				6						18
4	2						4			6				4					6						22
5		2					4				6				6										18
																								Total	100

Assessment Questions

Remember

1. Define Algebraic and Transcendental equations.
2. Recall the order and condition of convergence of Newton-Raphson method.
3. Recognize the derivatives of Newton's Forward and Backward Interpolation formula.
4. List the conditions for applying Simpson's rule.
5. Reproduce the formula of Fourth order Runge – Kutta method.
6. Label the procedure used in Liebmann's process.
7. Define the region of acceptance.
8. Label the types of errors in the hypothesis testing.
9. Recall the difference between CRD and RBD.
10. Label the uses of Latin Square Design.

Understand

Illustrate the condition of convergence of Regula False position method.

1. Indicate the order and condition of convergence of Newton‘s method.
2. Infer the working rule in Gaussian elimination method.
3. Interpret y’ (2) from the following:

X:	0	1	2	3	4
Y:	6.9897	7.4036	7.7815	8.1281	8.4510

4. Interpret the value of $\int_1^5 \log x\, dx$, using Trapezoidal rule.
5. Using Runge – Kutta method of fourth order, find y(0.2) given that $y' = x + y\ ,\ y(0) = 1$
6. Exemplify the working rule for solving a boundary value problems using finite difference method.
7. Sample of 900 members is found to have a mean of 3.4 cms. Can it be regarded as a simple? Sample from a large population with mean 3.2 cms and SD 2.3 cms.
8. Narrate the properties and the advantages of $\chi^2 - test.$
9. Classify three basic principles of experimental design.
10. Indicate the applications of RBD and CRD.

Apply.

1. Find the inverse of the following matrix using Gauss Jordan method

$$\begin{pmatrix} 1 & 0 & -2 \\ 3 & 4 & 8 \\ -1 & 0 & 5 \end{pmatrix}$$

2. Find the solution by Gaussian elimination method:
   6x + 3y +12z = 36; 8x -3y +2z = 20; 4x +11y –z =33.
3. The table given below reveals the velocity V of a body during the time‘t‘specified. Find its acceleration at t = 1.1:

t:	1.0	1.1	1.2	1.3	1.4
v:	43.1	47.7	52.1	56.4	60.8

4. Using 11 ordinates calculate the value of $\int_0^\pi \sin x dx$ by Trapezoidal rule and Simpson’s 1/3 rule. Compare the results with the exact answer.
5. Construct $y_{tt} = y_{xx}$ up to t = 0.5 with spacing 0.1 subject to y(0,t) = 0, y(1,t) = 0, $y_t(x,0)$ = 0 and y (x,0) =10 + x (1-x).
6. Use Runge-kutta method, find y(0.01) from dy/dx= - x, y(0)=1.
7. Two independent samples of sizes 8 and 7 contained the following values :
   Sample I: 19 17 15 21 16 18 16 14
   Sample II: 15 14 15 19 15 18 16
   Is the difference between the sample means significant?
8. Apply Gauss two point formula to evaluate $\int_0^1 \frac{dx}{1 + x^2}$
9. Use χ^2 - test of goodness of fit, to test the normality of the following distribution.

x:	125	135	145	155	165	175	185	195	205	Total
f :	1	1	14	22	25	19	13	3	2	100

10. Compute y (0.2) given $\frac{dy}{dx} + y + x\, y^2 = 0$, y(0) = 1 by taking h = 0.1 using Runge – Kutta method of fourth order

Analyze / Evaluate

1. Organize to find the dominant Eigen value and the corresponding Eigen vector of the matrix

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

2. Determine the solution using Newton-Raphson method, cos x – x e^x = 0.
3. Use Newton's forward interpolation formula to find x when y = 20

X :	1	2	3	4
Y:	1	8	27	64.

4. From the following data, find y' at x = 43:

X:	40	50	60	70	80	90
Y:	184	204	226	250	276	304

5. Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square with sides x = 0 =y, x = 3 = y with u=0 on the boundary and mesh length 1.
6. Evaluate y(0.2) and y(0.4) from $y' = \frac{y^2 - x^2}{y^2 + x^2}$ given that y(0) = 1 by Runge – Kutta method of fourth order.
7. A survey of 320 families with five children each revealed the following distribution,

No. of boys :	0	1	2	3	4	5
No. of girls :	5	4	3	2	1	0
No. of families :	12	40	88	110	56	14

Is this result consistent with the hypothesis that male and female are equally probable?

8. Test whether the example having the values 63,63, 64, 65, 66, 69, 70, 70 and 71 has been chosen from a population with mean 65 at 5% LOS.
9. A farmer applied 3 types of fertilizers on 4 separate plots. The figure on yield per acre is tabulated below:

Fertilizers	Yield			
	A	B	C	D
Nitrogen	6	4	8	6
Potash	7	6	6	9
Phosphates	8	5	10	9
Total	21	15	24	24

Find out if the plots are materially different in fertility, as also, if the three fertilizers make any material difference yields.

10. In a Latin square experiment given below are the yields in quintals per acre on the paddy crop carried out for testing the effect of four fertilizers A, B, C and D. Analyze the data for variances.

A 18	C 21	D 25	B 11
D 22	B 12	A 15	C 19
B 15	A 20	C 23	D 24
C 22	D 21	B 10	A 17

15BT402 UNIT OPERATIONS 3 0 0 3

Course Objectives

- To impart the basic concepts of unit operation
- To understand the different unit operations and processes carried out in the chemical and biochemical companies
- To study the concept of heat transfer and its role in industries

Course Outcomes (COs)

1. Understand and operate various unit operations and heat transfer equipments in chemical and biochemical industries
2. Troubleshoot the problem in process involving basic unit operations
3. Apply the pre-treatment and separation techniques for the production of desired bioproduct
4. Understand principles of heat transfer and associated equipments
5. Perform calculations based on unit operation problems

UNIT I **9 Hours**

MECHANICAL OPERATIONS - SOLIDS HANDLING, SIZING AND SCREENING

Properties of particulate solids, Screening- Determination of particle size, Screen analysis, Surface area measurements, Size reduction of solids- laws, stages of reduction, operating variables, intermediate and fine size reduction, Sieve analysis, Power driven machines - Crushers, ball mills, conveyers.

UNIT II **9 Hours**

MIXING AND AGITATION

Introduction to agitation and mixing of liquids, Mixing ? types of mixers- ribbon and muller mixer, Mixing and bioreaction interactions-flow regimes with and without baffles, Agitation equipment, flow patterns in agitator, Power required for agitated vessels- power number and power number calculation, Scale up criteria for mixing and agitation equipment

UNIT III **9 Hours**

FILTRATION AND SEDIMENTATION

Filtration- Principles of cake filtration, Filter medium and filter aids, Constant rate filtration and constant pressure filtration. Batch and continuous filtration, Filtration equipments- plate and frame, leaf filter, rotary drum, Sedimentation and Settling theory, Equipment for sedimentation- thickeners, clarifiers

UNIT IV **9 Hours**

CONDUCTIVE AND CONVECTIVE HEAT TRANSFER

Modes of heat transfer- Principles of Conduction, convection and radiation; Fourier?s law of heat conduction, Conduction - Steady state heat conduction through unilayer and multilayer walls, Forced & natural convection, Condensation - Film wise & drop wise condensation

UNIT V **9 Hours**

HEAT EXCHANGERS AND EVAPORATORS

Heat exchangers-, Parallel and counter flow heat exchangers, Principle and Working of double pipe, shell and tube heat exchanger, Overall & Individual heat transfer co-efficient, LMTD, Fouling of a heat exchanger - the fouling factor, Evaporators-single effect and multiple effect evaporators, Boiling point elevation, capacity and economy of multiple effect evaporators.

FOR FURTHER READING

Flow of solids through fluids, Flocculation and Sedimentation,Centrifugal filtration, Ultra-centrifugation, Design of cooling coils, Steam jacketing and heat transfer fluids.

Total: 45 Hours

Reference(s)

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall of India, 2007.
2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations in Chemical Engineering, Tata McGraw-Hill Professional, 2005.
3. M. Coulson and J. F. Richardson, Coulson and Richardson?s Chemical Engineering, Vol. 2, Butterworth Heineman, 2004.
4. G. K. Roy, Fundamentals of Heat and Mass Transfer, Kanna Publications, 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					4				4					5			4				1			20
2	2					2				5				5					6						20
3		2				2					5			5				4			2				20
4			2				4			4					5			5							20
5		2					2				6			5				5							20
																								Total	100

Assessment Questions

Remember

1. Define specific surface area of the particle.
2. State the critical speed of ball mill.
3. Recall the Fourier law of heat conduction
4. List any two filter medium and filter aids.
5. State Duhring's rule in evaporator.
6. Reproduce Fourier's law.
7. Define steam economy and efficiency.
8. List two methods of analysing size of the particle
9. List any two filter medium and filter aids.
10. Define Mesh number.

Understand

1. Identify the advantage of forward feeding and backward feeding of multiple effect evaporation system
2. Formulate the equation which relates local and overall heat transfer coefficient.
3. Illustrate the arrangement of tubes inside the shell and tube heat exchanger.
4. Explain the principle of size reduction.
5. Identify the method to calculate ovearall heat transfer coefficient.
6. Indicate the role of filter aids in filtration.
7. Explain capacity and economy of evaporator.
8. Identify the equipment used for mixing paste.
9. Discuss the mode of heat transfer taking place in boiler
10. Identify the method for arranging the tubes in a heat exchanger.

Apply

1. Predict how much volume of filtrate will be collected when the speed of rotation of a rotary drum filter is doubled. Neglect filter medium resistance.
2. Assess the reason why speed of the ball mill should be always greater than its critical speed.
3. Show the direction of feed for multiple effect evaporator.
4. Sketch the drying equipment used for drying
   (i) Heat sensitive materials
   (ii)Food Stuffs.
5. Demonstrate two advantages of forward feeding and backward feeding of multiple effect evaporation system
6. Demonstrate the methods of analyzing the size of the particle.
7. Interpret the significance of LMTD.
8. Solve the equation which relates local and overall heat transfer coefficient.
9. Demonstrate how will you select the repeating variables in dimensional analysis.
10. Interpret the driving force and resistance in Fourier law of conduction.

Analyse

1. Differentiate conduction and convection.
2. Compare and contrast between turbine and propeller.
3. Outline the role of baffles in heat exchanger.
4. Justify the reason for low conductivity of heat insulating materials.
5. Contrast settling and sedimentation.

Evaluate

1. Defend the significance of power number.
2. Defend the statement ‘water is used extensively as coolent in heat exchange equipments’.
3. Check whether Nusselt number & Sherwood number is dimensionless.
4. Evaluate how will you increase the number of tube passes in heat exchanger.
5. Evaluate LMTD for cooling an aqueous stream from 95 to 30° C using cooling water at 20° C

Create

1. Investigate why water is used extensively as coolent in heat exchange equipments.
2. If speed of rotation of a rotary drum filter is doubled, investigate how it will affect volume of filtrate collected. Neglect filter medium resistance

15BT403 CELL BIOLOGY 3 0 0 3

Course Objectives

- To understand the basic structure and function of an organelle
- To understand the transportations through cell membrane
- To understand the concept of the cell division and signalling pathways

Course Outcomes (COs)

1. Fundamental knowledge of cells and its functions.
2. Apply cell biology concepts in their future research projects.
3. Know about the transportation across membranes
4. Understand the cell signaling, ion channels and receptor function

UNIT I **9 Hours**

CELL STRUCTURE AND FUNCTIONS OF THE ORGANELLES, CELL DIVISION AND CELL CYCLE

History of cell biology; Comparison of eukaryotic and prokaryotic cells; biological membrane organization- membrane proteins; cytoskeletal proteins; Types of cell division - mitosis and meiosis; cell cycle and molecules that control cell cycle; cell cycle and cancer, oncogenes; growth hormones and their roles.

UNIT II **9 Hours**

TRANSPORT ACROSS CELL MEMBRANES AND RECEPTORS

Passive and Active transport, permeases, sodium potassium pump, Ca2+ ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co-transport (symport, antiport), endocytosis and exocytosis; receptor-mediated endocytosis.

UNIT III **9 Hours**

RECEPTORS AND CELL SIGNALING

Cytosolic; Nuclear and membrane bound receptors; Examples of receptors; Autocrine, paracrine and endocrine models of action.

UNIT IV **9 Hours**

ION CHANNELS

Types of Ion-channels; Ligand-gated and Voltage-gated ion channels; Neurotransmitters- mechanism of action, nerve conduction.Ion-channel agonists and antagonists.

UNIT V **9 Hours**

SIGNAL TRANSDUCTION

Signal amplifications; different models of signal amplification; Second messengers - cAMP, Inositol phosphates, DAG, cGMP, G proteins, Ca; Protein kinases, serine threonine kinases.

FOR FURTHER READING

Apoptosis and programmed cell death;Entry of virus and toxins into cells;Quantification and characterization of receptors;Ion channel defects;TNF receptor families

Total: 45 Hours

Reference(s)

1. H. Lodish, A. Berk, S. L. Zipurursky, P. Matsudaria, D. Baltimore and J. Darnell, Molecular Cell Biology, W. H. Free Man and Company, 2000.
2. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, and P. Walter, Molecular Biology of the Cell, Garland Science, 2002.
3. S. C. Rastogi, Cell Biology, India: New Age International Pub. Ltd., 2001.
4. E. D. P. Robertis De and E. M. F. Robertis De, Cell and Molecular Biology, B.I. Publications, Pvt. Ltd., 2005.
5. Gerald Karp and Nancy L. Puritt, Cell and Molecular Biology, Concepts and experiments, John Wiley and Sons Inc., 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					4				4				4											16
2	2					5				4	2			5				2				2			22
3	2					5				5				6				4							22
4	2					5				3	2			4				4				2			22
5	2					4				4				4				4							18
																								Total	100

Assessment Questions

Remember

1. State the cell theory.
2. List the types of cell division.
3. What are cytoskeleton proteins?
4. What is cell cycle?
5. What are the molecules which controls cell cycle?
6. What are oncogenes?
7. Define cancer
8. What you mean by programmed cell death?
9. What are all neurotransmitters?
10. What are the molecules which controls cell cycle?

Understand

1. Explain the general organization of a Plasma membrane and its membrane proteins.
2. State the importance of extra cellular matrix.
3. Differentiate between prokaryotes and Eukaryotes
4. Distinguish between mitosis and meiosis.
5. What do you mean by apoptosis and programmed cell death?
6. Differentiate the prokaryotes and Eukaryotes
7. Explain in detail of ATP dependent proton pumps
8. Differentiate with example for Autocrine, Endocrine and Paracrine hormones
9. How the receptors are helpful in cell signaling?
10. Explicate the TNF receptor families

Apply

1. How the virus and toxin enter in to the host cell?
2. How do you quantify and characterize the receptors?
3. Demonstrate calcium ion flux and cell signaling.
4. Evaluate the role of Cyclic GMP and G protein in cell signaling.
5. What are the different stages of cell cycle?

Analyse

1. Identify the cytoskeltons present in the cells?
2. Elucidate the types of cotransport.
3. Distinguish prokaryotes and eukaryotes.
4. Differentiate endocytosis and exocytosis.
5. Distinguish osmosis and diffusion.
6. Analyse the mechanism of action of Neurotransmitters
7. Anayse the different methods of signal amplification

Evaluate
1. Appraise the the different stages of cell cycle.
2. Interpret the applications ofÂ ion channels defects.
3. Explain the functioning of exocytosis and endocytosis.

Create
1. Propose a methodology for the receptor purification and charecterization.
2. Develop a protocol which follows the entry of virus into cells.
3. Draft a methodology for programmed cell death process

15BT404 MOLECULAR BIOLOGY 3 0 0 3

Course Objectives
- To familiarize students on macromolecule's properties, structures and functions
- To expose students to various molecular events in prokaryotes
- To create deeper understanding on regulation of genes activities

Course Outcomes (COs)
1. Infer various macromolecules and their classes
2. Interpret prokaryotic DNA replication and plasmid characteristics
3. Understand mechanism of transcription and genetic code
4. Learn the process of translation and DNA repair system
5. Demonstrate the mechanism of regulation of gene activities in prokaryotes

UNIT I **9 Hours**
MACROMOLECULES
Macromolecules major classes, chemical structures, properties; Physical and chemical structure of DNA; Alternative structure of DNA; RNA molecules- classes, structure and functions.

UNIT II **9 Hours**
DNA REPLICATION
Properties of genetic material; DNA replication in prokaryotes- untwisting of highly coiled DNA, de novo andcovalent extension initiations, elongation and termination; Prokaryotic and eukaryotic DNA polymerases; Plasmids- characteristics, types and applications.

UNIT III **9 Hours**
TRANSCRIPTION AND GENETIC CODE
Bacterial and eukaryotic RNA polymerases; Transcription in prokaryotes - initiation, elongation and termination; The genetic code- salient features, RNA and DNA codon tables; Wobble base pair; Aminoacyl-tRNAsynthetases; Posttranscriptional modification - mRNA processing.

UNIT IV **9 Hours**
TRANSLATION AND DNA REPAIR
Translation in prokaryotes- initiation, elongation and termination; DNA damage - sources and types; DNA repair mechanisms - direct reversal, excision repair, recombinational repair and SOS response; Inhibitors of translation antimicrobial agents that bind with 30S and 50S ribosomal subunits.

UNIT V **9 Hours**

REGULATION OF GENE ACTIVITY

Principles of gene regulation and operon concept; Transcriptional regulation - lac operon, galactose operon, arabinose operon, tryptophan operon, attenuation, autoregulation; Feedback inhibition and allosteric control.

FOR FURTHER READING

Hydrolysis of nucleic acids; Conformations of plasmid DNA; DNA replication in eukaryotes- initiation, elongation and termination; DNA transcription and translation in eukaryotes.

Total: 45 Hours

Reference(s)

1. G. M. Malacinski, Freifelder's Essentials of Molecular Biology,Narosa Publishing House, 2005
2. J. K. Pal and S. S. Ghaskadbi, Fundamentals of Molecular Biology, Oxford University Press, New Delhi, 2011
3. J. Watson, T. Baker, S. Bell, A. Gann, M. Levine and R. Losick, Molecular Biology of the Gene, Pearson Education, Inc., 2008
4. J. E. Krebs, E. S. Goldstein and S. T. Kilpatrick, Lewinâ??s Genes X, Sudbury, MA: Jones & Bartlett Publishers, 2009
5. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter, Molecular Biology of the Cell, Garland Science, 2008
6. H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, M. P. Scott, A. Bretscher, H. Ploegh, and P. Matsudaira, Molecular Cell Biology, W. H. Freeman & Co., 2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					4				4				4											16
2	2					5				4	2			5				2				2			22
3	2					5				5				6				4							22
4	2					5				3	2			4				4				2			22
5	2					4				4				4				4							18
																								Total	100

Assessment Questions

Remember

1. Define random coli.
2. Recognise the chemical structures of thymine.
3. Recall the chemical structures of cytosine.
4. Recall the chemical structures of adenine.
5. Recognise the structure of dinucleotide and level the phosphodiester group.
6. Define Okazaki fragment.
7. Recognise the chemical structure of a RNA primer.
8. Recognise the product of deamination of cytosine.
9. Recall the subunits of RNAP in prokaryotes.
10. Define IPTG

Understand

1. Classify amino acids based on the basic R group.
2. Explain various Classes of RNA molecules and their distribution in ribosomes.
3. Distinguish between positive and negative supercoiling.
4. Infer plasmid.
5. Summarize the mechanism of De Novo and covalent extension initiation of prokaryotes with diagramme.
6. Interpret open promoter complex.
7. Summarize the mechanism of intrinsic and rho dependant terminations of prokaryotic transcription with diagramme.
8. How photolyase enzyme is used in DNA repair?
9. Summarize the mechanism of SOS repair
10. What are allosteric inhibitors?

Apply

1. Find the type of RNA found in 70S ribosome.
2. Predict the structure and functions of rRNA, mRNA and tRNA.
3. Find the RNA found in 55S ribosome.
4. Demonstrate the physiological roles of prokaryotic DNA polymerases
5. Demonstrate the physiological roles ofÂ eukaryotic DNA polymerases
6. Access the role of gene activator protein in transcription.
7. Predict the role of CAP protein in transcription.
8. Predict the role of NusA protein.
9. Find the reason why DNA is more stable than RNA.
10. Demonstrate the role of cAMP in lactose operon.

Analyse

1. Differentiate between nucleoside and nucleotide.
2. Organise the non-covalent interactions found in macromolecules.
3. Distinguish between DNA polymerase I and III.
4. Compare the elongation and termination steps of prokaryotic DNA replication with diagramme.
5. Compare the initiation and elongation of prokaryotic DNA replication with diagramme.
6. Differentiate between arabinose and tryptophan operon.
7. Compare exision repair with recombinational DNA repair.

Evaluate

1. Evaluate physiological roles of prokaryotic DNA polymerase.
2. Judge the physiological role of eukaryotic RNA polymerase.
3. Determine the significance of recA and lexA protein in SOS repair

Create

1. Generalize DNA codon table for E.coli bacteria
2. Construct any end product inhibition pathway with example.

15BT405 INSTRUMENTAL METHODS OF ANALYSIS 2 2 0 3

Course Objectives

- To expose the electrical and electronic components used in the analytical instruments
- To learn and understand the principles and operation of different instrumentation techniques
- To know the different molecular spectroscopic techniques and their analytical applications
- To understand the theory, instrumentation and uses of chromatographic and electroanalytical techniques

Course Outcomes (COs)

1. Learn the functions of electrical and optical components in instruments and calibration
2. Know how to use FT-IR, UV-VIS, NMR and Raman spectroscopic techniques to identify and estimate analytes
3. Know about thermal methods to analyse structure and thermal behavior of materials and their instrumentation and uses
4. Use the different chromatographic techniques and electro phoresis to separate and purify biomolecules and know their instrumentation
5. Understand the electrodes, principle and instrumentation of electroanalytical techniques and uses

UNIT I **6 Hours**

BASICS OF MEASUREMENT AND OPTICAL METHODS

Classification of instrumental methods - calibration methods for instruments - electrical components in circuits and their function - signal to noise ratio - signal - noise enhancement-sofware and hardware techniques. General design of optical instruments - sources of radiation - wavelength selectors - materials for optical components and sample holders. Radiation transducers

UNIT II **6 Hours**

MOLECULAR SPECTROSCOPY

Types of optical instruments- Fourier transform measurements-Theory and advantages. Measurement of transmittance and absorbance- Beer's law - Derivation and types of Deviation. Spectrophotometer analysis - qualitative and quantitative absorption measurements - types of spectrometers - UV - visible, IR, Raman and NMR-theory, instrumentation and applications

UNIT III **6 Hours**

THERMAL METHODS

Thermo-gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) theory, instrumentation and applications

UNIT IV **6 Hours**

SEPARATION METHODS

Introduction to chromatography - models - ideal separation - retention parameters - van - deemter equation - GC-MS - stationary phases - detectors - kovats indices- HPLC - pumps - columns- Detectors and instrumentation. Size exclusion, hydrophobic interaction, supercritical chromatographic techniques. Ion exchange, affinity theory, instrumentation and applications. Capillary electrophoresis.

UNIT V **6 Hours**

ELECTRO -ANALYTICAL TECHNIQUES

Electrodes, reference electrodes, ion selective electrodes and pH meter. Potentiometry, Voltametry, coulometry and amperometry- theory, instrumentation and applications in life sciences.

FOR FURTHER READING

Atomic absorption spectroscopy, mass spectrometry, polarography, thermometry. X-ray crystallography of proteins, X-ray fluorescence spectroscopy

Total: 30+30=60 Hours

Reference(s)

1. H. H. Willard, and L. L. Merrit, Instrumental Methods of Analysis, Prentice Hall of India, 2005.
2. D. A. Skoog, J. F. Holler and T. A. Nieman, Principles ofInstrumental Analysis, Thomson, 2006.
3. G. W. Ewing, Instrumental Methods of Chemical Analysis, Mc Graw Hill, 1985.
4. R. D. Braun, Introduction to Instrumental Analysis, Pharma Book Syndicate, Adithiya Art Printers, 1987.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					7					6							4							20
2	3					6				5			3					3							20
3	3					6				5				6									4		24
4	3					3					4			4			2								16
5	3					2	2				4								5				4		20
																								Total	100

Assessment Questions

Remember

1. What are the classical methods used for separation, identification and quantification of different chemical components in a mixture?
2. What is specific absorptivity? Give its unit
3. What are low pass and high pass filters?
4. What are filters and monochromators?
5. What is a radiation transducer?
6. What is Beer-Lambert law?
7. Define chemical shift
8. What is a thermobalance?
9. Give the fundamental chromatographic equation
10. What is pH meter?
11. How electrodes are classified? Give examples for each?
12. What is polarography? Mention its uses?

Understand

1. What are signals and noises? How the S/N ratio is enhanced in instrumental analysis?
2. Name four important characteristics of emr associated with an analyte and the associated instrumentation methods of analysis.

3. Distinguish spectrophotometry and photometry
4. What is Fourier Transform?
5. Define selectivity and sensitivity
6. What is calibration?
7. Define detection limit and figure of merit
8. Distinguish capacitor, inductor and resistor
9. Differentiate impedance, reactance and resistance
10. What are semiconductors? Give examples
11. What are boxcar and ensemble averaging?
12. How instrumental noises are classified? Expalin briefly the various hard and software techniques used to improve signal to noise ratio
13. What are Rayleigh and Raman scatterings?
14. Distinguish flourescence and phosphorescence
15. What is scattering of light?
16. List the different types of electronic transition in molecules.
17. Expalin the Jaquinot and Fellgett advantages in FT
18. Discuss on the sources of UV- Visible(line & continuous) and IR radiations
19. Why iodine is added to the tungsten-halogen lamp?
20. What is the bandwidth or full width at half maximum (FWHM) in an absorption filter?
21. Define transmittance and optical density.
22. What is Resonance Raman spectroscopy?
23. Explain the theory underlying Raman Effect.
24. What are normal and reverse phase chromatographic techniques?
25. Define affinity and bonded phase chromatographic techniques
26. What is endosmosis?
27. Give the van Deemter equation and explain the parameters involved in this equation
28. What are reference electrodes? Give the required features for reference electrodes?
29. What is potentiometry?
30. What is cyclic votammetry? Give its applications
31. What are the various modes of mass transport in voltammetry?
32. Distinguish electrochemical and electrolytic cells

Apply

1. Define fundamental frequency and finger print region in FT-IR
2. What are the advantages of Raman spectroscopy over IR spectra?
3. An empty IR cell exhibited 9.5 interference peaks in the region of 1250 to 1480 cm-1. What was the path length of the cell?
4. Write briefly on the IR detectors and their function.
5. How alanine and phenyl alanine are distinguished using IR spectroscopy?
6. Write briefly the qualitative and quantitative applications of FT-IR spectroscopy

Analyse

1. What is the role of suppoting electrolytes in CV?
2. What is size exclusion chromatography? Explain its applications
3. What are the carrier gases used in GC? What is the function of a carrier gas?
4. How protein molecules are separated using ion exchange chromatography?
5. Explain the theory, instrumentation and uses of GC-MS
6. Explain briefly on FID and TCD
7. Explain the theory and applications of HPLC.
8. Derive Nernst eqaution for half cell potential

Evaluate

1. Distinguish DSC, DTG and DTA
2. Represent a DSC thermogram with first and second order transions, crystallization and exothermic degradation
3. Why the applications of TG are more limited than those DTA and DSC?

Create

1. Discuss the theory, instrumentation and uses of proton NMR spectroscopy
2. Discuss the instrumentation in heat compensated and heat flux DSC. Write briefly the applications of DSC.

15BT406 CHEMICAL THERMODYNAMICS

3 2 0 4

Course Objectives

- To get familiar with the process, system and free energy which are essential for Biochemical engineering
- To understand the physiological conditions such as pressure and temperature which are essential for any process or product development
- To perform calculations and estimate the necessary conditions for an industrial process

Course Outcomes (COs)

1. Understand the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium
2. Determine the feasibility or spontaneity of any chemical reactions.
3. Identify the behavior of system at molecular level using modeling and simulation
4. Analyze the system behavior at different conditions using phase equilibria and chemical reaction equilibria
5. Identify the behavior of system at molecular level using modeling and simulation

UNIT I **9 Hours**

THERMODYNAMIC PROPERTIES OF PURE FLUIDS

Introduction and Basic Concepts; Laws of thermodynamics; First law of thermodynamics for Flow Process; P-V-T behaviour of Pure fluids; Volumetric properties of fluids exhibiting non ideal behavior; residual properties; Maxwell?s relations and applications.

UNIT II **9 Hours**

THERMODYNAMIC PROPERTIES OF MIXTURES

Estimation of thermodynamic properties using equations of state; calculations involving actual property changes ; Gibbs free energy; Partial molar properties; concepts of chemical potential and fugacity; activity and activity coefficient; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; Gibbs Duhem equations.

UNIT III **9 Hours**

PHASE EQUILIBRIA

Criteria for phase equilibria; VLE calculations for binary and multi component systems; activity coefficient - composition models.

UNIT IV **9 Hours**

CHEMICAL REACTION EQUILIBRIA

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yield for single and multiple reactions

UNIT V **9 Hours**

INTRODUCTION TO STATISTICAL THERMODYNAMICS

Introduction, statistical thermodynamics, basic statistical mechanical concept. Fermi-Dirac and Bose Einstein statistics, ensemble and partition function, molecular interaction and lattice model, hole theory & lattice fluid model, biomacromolecules in solution and at interfaces, ideal and real gas models, solid properties, liquid theory and molecular simulation

FOR FURTHER READING

Residual properties, Ideal and non-ideal solutions, Activity coefficient, Calculation of equilibrium conversion, Solid properties

Total: 45+30=75 Hours

Reference(s)

1. S.I.Sandler, Chemical, Biochemical, and Engineering Thermodynamics, John Wiley publications, 2006
2. P. Atkins, J. D. Paula, Physical chemistry, Oxford University Press, 2002.
3. K. V. Narayanan, A Text Book of Chemical Engineering Thermodynamics, Prentice Hall of India, 2001.
4. Terrell L. Hill.. An Introduction to Statistical Thermodynamics, Dover Publications
5. J. M. Smith, H. C. Van Ness and M. M. Abbot, Chemical Engineering Thermodynamics, McGraw-Hill Inc., 2001.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
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2		2					4				4			4					4			2			20
3		2					2			3	2				4				2	3		2			20
4			4			2	2				3				2			3	2			2			20
5			3			2	4			2	4				3								2		20
																								Total	100

Assessment Questions

Remember

1. Recall compressibility factor.
2. Recall the mathematical expression for second law of thermodynamics
3. Reproduce the physical significance of criterion of chemical equilibrium
4. Recall the different types of thermodynamic diagrams. List their respective fields

5. Recognize “Lewis fugacity rule”
6. 7hp = -------watt ; 4ppm = -----------%
7. Retrive the value of Critical pressure
8. Draw the Sublimation curve
9. State joule- Thomson coefficient
10. State azeotropes.

Understand

1. Infer that Raoult`s law is a simplified form of the Lewis – Randall rule
2. How would you predict the feasibility of a reaction from the value of standard free energy change?
3. 5 moles of SO_2 and 5 moles of O_2 are allowed to react. At equilibrium, it was found that 60% of SO_2 is used up. lf the partial pressure of the equilibrium mixture is one atmosphere. the partial pressure of O_2 is-----
4. Explain Gibbs free energy and show at constant temperature and pressure the decrease in energy measures the maximum work.
5. Prove that at constant temperature the decrease in work function measures the maximum work from a given change of state
6. What is Joule Thomson coefficient? If a gas cools on throttling, will it be positive or negative?Justify
7. Calculate the mole fraction of solute molecules in a dilute aqueous solution of concentration 50.0 mmol dm-3.
8. What do you understand by an equation of state? What are the limiting conditions to be satisfied by such equations?
9. 18 Calculate the fugacity of liquid water at 303 k and 10 bar if the saturation pressure at 303 k is 4.241 kPa and the specific volume of liquid water at 303 k is 1.004X10-3 m3/kg
10. A vial contains 1 mL of water and 1 mL of 1,1,2,2-tetrachloroethane, which are immiscible. To the vial is added 0.1 g of acetone, which is soluble in both water and TCE. When the equilibrium distribution of acetone between the two solvents has been achieved, it is found that Kd = [acetone]H2O/[acetone]TCE = 2.8.
    What mass of acetone is present in each liquid layer at equilibrium?
    What is the molarity of acetone in each layer at equilibrium?
11. At 300 K 1bar , the volumetric data for a liquid mixture of benzene and cyclohexane are represented by V = 109.4 × 10-6 – 16.8× 10-6 x-Â 2.64× 10-6 x2 where x is the mole fraction of benzene and V has the units of m3/mol. Find expressions for the partial molar volumes of benzene and cyclohexane.
12. Elucidate the natural helical crystal lattice model used in developing carbon nanotubes .
13. Explicate the statistical properties of a system in thermodynamic equilibrium using partition function
14. Calculate the vapor pressure of water at 363 K, if vapor pressure at 373 K is 101.3 kPa and mean heat of vaporization is 2279KJ/kg.

Apply

1. The volume of a solution formed from MgSO4 and 1kg of water fits the expression V=1.00121×10-3 + 34.69×10-6 (m-0.070)2 .where m is the molarity of the solution. Calculate the partial molar volume of the salt and solvent when m = 0.05 mol /kg.
2. Calculate the number of ways of arranging 7(seven) indistinguishable particles in four boxes which are (a) distinguishable, (b) indistinguishable
3. Interpret on the basic theory of black hole thermodynamics with laws of thermodynamics.
4. A gas mixture containing 3 moles nitrogen, 5moles hydrogen and 2 moles ammonia initially, is undergoing the following reaction:
   Â N2 + 3H2 →2NH3
   (i) Predict expressions for the mole fractions of various components in the reaction mixture in terms of the extent of reaction.
   (ii) Explain how the conversion of limiting reactant is related to the extent of reaction.
5. Liquid A and B form an azeotrope containing 46.1 mol percent at 101.3 kPa and 345 K. At 345 K, the vapor pressure of A is 84.8 kPa and that of B is 78.2 kPa. Calculate the Van laar constants.
6. The volume of a solution formed from MgSO4 and 1kg of water fits the expression V=1.00121×10-3 + 34.69×10-6 (m-0.070)2 .where m is the molarity of the solution. Calculate the partial molar volume of the salt and solvent when m = 0.05 mol /kg.
7. 34 Liquid A and B form an azeotrope containing 46.1 mol percent at 101.3 kPa and 345 K. At 345 K, the vapor pressure of A is 84.8 kPa and that of B is 78.2 kPa. Calculate the Van laar constants.
8. In a barometer, pressure is determined by measuring the height of a column of liquid. Calculate the pressure, in units of Pa, at the bottom of a 347 mm high column of paraffin oil, of density 0.798 g cm-3.
9. Consider the motion of an electron having a mass of 9.106 X 10^{-31} kg at a velocity of 108 m/s. Calculate the characteristic wavelength in this case.

Analyse

1. A mixture of 3 mol CO and 3 mol water vapor is undergoing the water-gas shift reaction at a temperature of 1100K, pressure of 1bar where the equilibrium constant for the reaction is 1 (assume ideal gas)
   Calculate the fractional dissociation of steam if the reactant stream is diluted with 4 mol nitrogen.
2. The volume of a solution formed from MgSO4 and 1kg of water fits the expression V=1.00121×10-3 + 34.69×10-6 (m-0.070)2 .where m is the molarity of the solution. Calculate the partial molar volume of the salt and solvent when m = 0.05 mol /kg.

Evaluate

1. Calculate an equilibrium constant K at 298 K for N2O4 (g) →2NO2 (g) if standard free energy of formation of N2O4 and NO2 are 97540 and 51310 (J/Mole) and R = 8.314J/Mole K.
2. Determine the change in entropy of solid magnesium when the temperature is increased from 300 K to 850 K at atmospheric pressure Where, Cp = 26.04+5.586×10-3 T+28.476×10-4 T-2.
3. Explain the effect of temperature on equilibrium constant and derive trelationship of equilibrium constant to standard free energy change of reaction.

4. Consider an α -particle travelling with a kinetic energy of 5 MeV. Find the de Broglie wavelength associated with the particle?
5. Consider a system of N particles and a phase space of two cells, and take g1 = g2 = 1. If the energy ε of a particle is the same in both the cells, find the number of particles in each cell and the total energy of the system in equilibrium.

15BT407 CELL AND MOLECULAR BIOLOGY LABORATORY

0 0 2 1

Course Objectives

- To make wider practical dexterity in the area of cell and molecular biology tools and techniques
- To acquire practical skill in isolating and analyzing DNA and RNA from living cells

Course Outcomes (COs)

1. Analyze stages of mitosis and learn the isolation of chloroplast
2. Demonstrate isolation and quantification of genomic DNA, isolation of RNA and agarose gel electrophoresis

4 Hours

EXPERIMENT 1
Mitosis in onion root tip

4 Hours

EXPERIMENT 2
Isolation of chloroplast from spinach leave

4 Hours

EXPERIMENT 3
Isolation of genomic DNA from bacteria

4 Hours

EXPERIMENT 4
Isolation of genomic DNA from plant

4 Hours

EXPERIMENT 5
Isolation of genomic DNA from animal tissue

4 Hours

EXPERIMENT 6
Quantification of genomic DNA by DPA method

4 Hours

EXPERIMENT 7
Extraction of total RNA from bacteria

2 Hours

DESIGN EXPERIMENT
Agarose gel electrophoresis

Total: 30 Hours

Reference(s)

1. J. Sambrook, D. Russell, and D. W. Russell, Molecular cloning-A laboratory Manual (A set of Volume 1, 2 and 3), USA: Cold Spring Harbor Laboratory Press, 2000

15BT408 CHEMICAL ENGINEERING LABORATORY 0 0 2 1

Course Objectives

- To impart the skills in flow measuring devices
- To understand the concept in separation of liquid from other liquid and solid
- To acquire knowledge in heat transfer coefficients
- At the end of the laboratory course the student able to be well versed in handling and operation of various chemical engineering equipments

Course Outcomes (COs)

1. Impart the skills in flow measuring devices
2. Understand the concept in separation of liquid from other liquid and solid
3. Acquire knowledge in heat transfer coefficients
4. Handle and operate the various chemical engineering equipments

2 Hours

EXPERIMENT 1
Flow rate Measurement using Orificemeter

4 Hours

EXPERIMENT 2
Flow rate Measurement using Venturimeter

4 Hours

EXPERIMENT 3
Determination of friction factor and pressure drop

4 Hours

EXPERIMENT 4
Study of Fluid flow characteristics Fluidized bed column

4 Hours

EXPERIMENT 5
Filter medium and cake resistant studies using Plate and Frame filter press

4 Hours

EXPERIMENT 6
Filter medium and cake resistant studies with filter aids

4 Hours

EXPERIMENT 7
Double pipe heat exchanger

4 Hours

EXPERIMENT 8
Liquid-liquid extraction - Batch

Total: 30 Hours

Reference(s)

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall of India, 2007.
2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations in Chemical Engineering, Tata McGraw-Hill Professional, 2005.
3. M. Coulson and J. F. Richardson, Coulson and Richardsons Chemical Engineering, Vol. 2, Butterworth Heineman, 2004.

15BT409 MINI PROJECT II 0 0 2 1

Course Objectives

1. To develop knowledge to formulate a real world problem and project's goals.
2. To identify the various tasks of the project to determine standard procedures.
3. To identify and learn new tools, algorithms and techniques.
4. To understand the various procedures for validation of the product and analysis the cost effectiveness.
5. To understand the guideline to Prepare report for oral demonstrations.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations

15GE410 LIFE SKILLS: VERBAL ABILITY 0 0 2 -

Course Objectives

- Read and understand the unseen passages with appropriate speed
- Effectively deal with different kinds of structures
- Develop strategies for vocabulary development

Course Outcomes (COs)

1. Improve their performance in the verbal ability sections of different competitive examinations.

15 Hours

UNIT I

Synonyms - Antonym - Word groups - Verbal analogies - Etymology - Spellings - Critical Reasoning - Cloze Test - One Word Substitutes - Idioms and Phrases - Text Completion

15 Hours

UNIT II

Sentence Formation - Sentence Correction - Sentence Improvement - Completing Statements - Sequencing of Sentences - Paragraph Formation - Instructions - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use - A Self - study Reference and Practice Book For Intermediate Learners of English.IVed. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman.Word Power Made Easy. New York: Pocket Books.1991.
3. Baron's The Official Guide for New GMAT Review 2015. New Jersey: John Wiley &Sons, Inc.

15BT501 GENETIC ENGINEERING 3 0 0 3

Course Objectives

- To familiarize students on various enzymes and vectors used in genetic engineering
- To give exposure on cloning techniques and their applications
- To create deeper understanding on various techniques of gene manipulation

Course Outcomes (COs)

1. Infer important enzymes and their roles in genetic engineering
2. Construct various vectors used for gene cloning and expression
3. Understand the mechanism of construction of DNA libraries
4. Demonstrate various molecular techniques for genetic engineering
5. Learn applications of genetic engineering in biotechnology

UNIT I **9 Hours**

ENZYMES USED IN GENETIC ENGINEERING

Nuclease- exonucleases and endonucleases; Restriction enzymes- nomenclature, types, applications; Restriction endonuclease- blunt and sticky ends; RNases, DNA Ligase, Polymerases; DNA Modifying enzymes- alkaline phosphatase, polynucleotide kinase and terminal deoxynucleotidyl transferase.

UNIT II **9 Hours**

VECTORS FOR GENE CLONING AND EXPRESSION

Characteristics of cloning and expression vectors; Plasmids-pSC101, pBR322, pSF2124, colE1, pUC, pGEMÂ®, pMUTIN, pGEX-3X, pET and pTrcHis, Ti plasmid; Bacteriophage vectors- lambda and M13; Yeast vectors- plasmids and YAC; Shuttle vectors; Cosmid and phagemid vectors.

UNIT III **9 Hours**

CONSTRUCTION OF LIBRARIES

Linkers, adaptors and homopolymer tailing; Construction of genomic library; cDNA construction- hairpin loop strategies; Directional and non directional cDNA synthesis; Construction of full length cDNA library- Oligo capping; Okayama and Berg method of cDNA cloning; Screening of libraries.

UNIT IV **9 Hours**

TECHNIQUES FOR GENETIC ENGINEERING

Principle and applications of PCR; Molecular markers- RAPD, RFLP, AFLP, SNP; Molecular beacons and Taqman assay; Nucleic acid sequencing- Maxam and Gilbert method, Sanger's method; DNA and RNA blotting techniques

UNIT V **9 Hours**

APPLICATIONS OF GENETIC ENGINEERING

GMO vs LMO; Genetic engineering in medicine- recombinant therapeutics and biopharmaceuticals, antibiotics, vaccines; Genetic engineering in agriculture- bio pesticides, herbicides; Applications in environment-bioremediation or environment clean-up

FOR FURTHER READING

Plant and animal viral vector vectors; Binary vectors; Primer designing; Real Time PCR; Direct gene transfer techniques; National regulatory mechanism for implementation of Biosafety guidelines for handling GMOs; Regulation for GM plants, Hybridization and labeling.

Total: 45 Hours

Reference(s)

1. Smita Rastogi and Neelam Pathak, Genetic Engineering, Oxford University Press, 2009
2. T.A.Brown, Gene Cloning an Introduction, U.K: Blackwell Publishers, 2001
3. R.W.Old and S.B.Primrose, Principles of Gene Manipulation: An Introduction to Genetic Engineering, Blackwell Science Publications, 2001.
4. B.D.Singh, Biotechnology, Kalyani Publishers, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					6				4				4											18
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4	2					4				4	2			4				4				2			22
5	2					3				4	2			4				3							18
																								Total	100

Assessment Questions

Remember

1. List four examples of endoribonuclease.
2. Define autoradiography.
3. State any two applications of plasmid DNA.
4. List two features of pGEX-3X vector.
5. Recall the three strategies for the synthesis of first strand of cDNA.
6. Define homopolymer tail.
7. Recognize pyrosequencing.
8. Recall the advantages of TaqMan probe.
9. Recognize lipofection.
10. Define golden rice.

Understand

1. Summarize the steps of Southern blotting.
2. Illustrate the steps of Western blotting.
3. Infer promoter sequence
4. Interpret MCS.
5. What is monoclonal antibody?
6. Summarize the steps of Okayama and Berg method of cDNA clonning.
7. What are random primers?
8. Compare RAPD PCR and RACE PCR.
9. Infer microinjection.
10. Illustrate the production strategies of transgenic mice.

Apply

1. Find two real applications of alkaline phosphatase in genetic engineering.
2. Apply DNA modifying enzymes in DNA manipulation.
3. Find two applications of Agrobacterium tumefaciens in genetic engineering
4. Access various types of yeast expression vectors in biotechnology.
5. Find the reason why complete restriction endonuclease digestion is avoided.
6. Demonstrate the method for generating steaky ends on a blunt ended DNA.
7. Access the TaqMan probe in biotechnology.
8. Choose a suitable vectror for plant DNA transformation.
9. Find two applications of transgenic animals.
10. Demonstrate the steps of embryonic stem cell method of production of transgenic animal.

Analyse

1. Differentiate between palindromic sequence and mirror repeat
2. Compare between sticky end and flush end
3. Distinguish between tobacco mosaic virus and potato virus.
4. Identify the COS and ARS sites in a suitable vectors
5. Differentiate between electroporation and heat shock methods of transformation.
6. Compare the microinjection and lipofection methods of gene transfer.

Evaluate

1. Evaluate the significance of reverse transcriptase in construction of cDNA library.
2. Judge the significance of synthesizing fragment II of cDNA during Okayama & Berg method of cDNA cloning.
3. Critique the significance of MgCl2 in PCR
4. Evaluate the role of dNTPs in PCR assay.

Create

1. Construct a vector map for plant DNA transfer.
2. Generate a GMO for degradation of oil spillage in ocean.

15BT502 BIOPROCESS PRINCIPLES 3 0 0 3

Course Objectives

- To study medium requirement for various bioprocess operations
- To inculcate the stoichiometry and energetics of cell growth and product formation
- To study the modern bio technological processes

Course Outcomes (COs)

1. Develop skills of the students in the area of bio process technology with emphasis an bioprocess principles
2. Learn about fermentation processes, metabolic stoichiometry, energetics, kinetics of microbial growth etc
3. Understand the kinetics of microbial growth that plays a vital role in the fermentation process

UNIT I **9 Hours**

FERMENTATION PROCESSES

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of Fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes .

UNIT II **9 Hours**

STERILIZATION KINETICS

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT III **9 Hours**

MEDIUM REQUIREMENTS FOR FERMENTATION PROCESS

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations â?? medium optimization methods.

UNIT IV **9 Hours**

METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT V **9 Hours**

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Modes of operation - batch, fed batch and continuous cultivation; Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

FOR FURTHER READING

General requirements of fermentation processes, Air sterilization, Vitamins and other complex nutrients, Elemental balances, Growth of filamentous organisms

Total: 45 Hours

Reference(s)

1. Michael L. Shuler and Fikret Kargi, Bioprocess Engineering - Basic Concepts, Prentice Hall, 2002.
2. M. Pauline Doran, Bioprocess Engineering Principles, Academic Press Limited, 1995.
3. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Principles of Fermentation Technology, Butterworth Heinemann publications, 1995.
4. Harvey W. Blanch, S. Douglas and Clark, Biochemical Engineering, New York: Marcel Dekker Inc., 1997.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
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4	2					4				4	2			4				4				2			22
5	2					3				4	2			4				3							18
																								Total	100

Assessment Questions

Remember

1. Differentiate heating, holding & cooling period in sterilization curve
2. Name the designing organism used in sterilization studies
3. What are the potential methods available to sterilize the air and liquid?
4. Mention the role of HEPA filters.
5. Comment on Sterilization Kinetics
6. What is the role of antibiotics and inhibitors in media?
7. Name the four different mechanisms involved in air filtration.
8. Define Diauxic growth
9. State the role of cryptic growth
10. Give the role of vitamins and other growth factors in media
11. What are the conditions to be followed in Placket Burman media optimization method?
12. Define Del factor and risk of contamination

Understand

1. What kind of steps to be taken to control the process parameters during fermentation?
2. What are the basic Criteria mandatory for good medium?
3. Crabwise increment in media optimization
4. What is the advantage of dissolved oxygen?
5. What are the three major microbial products based on their growth?
6. Mention the importance of Endogenous metabolism.

Apply

1. Explain the general aspects of fermenter.
2. Explain about the multipurpose fermenter in industries
3. For obtaining stationary phase culture batch cultivation is preferred than continuous cultivation .State the reason

Analyse

1. Milk is pasteurized but not sterilized. Why?
2. Compare the energy and volume advantages of oil over carbon sources
3. How to check the purity of any media?
4. What are the criteria should be considered during scale up process.

Evaluate

1. Differentiate structured model Vs unstructured model.
2. Figure out the leudeking Piret model
3. Elucidate the main parameters to be monitored and controlled in fermentation process.

Create

1. How to reduce the cost of media by choosing the proper substrate?
2. Design the media for gram negative bacteria using placket Burman method

15BT503 MASS TRANSFER OPERATIONS 3 2 0 4

Course Objectives

- To impart the significance of mass transfer principles used in bioprocess.
- To develop knowledge for application of mass transfer equipments
- To acquire knowledge in design principles

Course Outcomes (COs)

1. Predict the interface mass transfer in a liquid liquid diffusion and calculate the rate of diffusion.
2. Demonstrate the design principles of absorption column and. distillation column
3. Facilitate the industrial application of mass transfer equipments.
4. Understand the different modes and stages of extraction and leaching operations
5. Classify drying equipments and understand the rate of drying calculations involved in it.

UNIT I **9 Hours**

INTRODUCTION TO MASS TRANSFER AND DIFFUSION

Introduction to mass transfer operations; Fick's Law of Diffusion, one component transferring to non diffusing component and equimolar diffusivity estimation; Theories of mass transfer. Interphase mass transfer- The two-film theory.

UNIT II **9 Hours**

ABSORPTION

Principles of absorption; Single and multi component absorption; Design of absorbtion tower, HTU, NTU and HETP concept

UNIT III **9 Hours**

DISTILLATION

Basic concepts of distillation , VLE, Raoult's law, Relative volatility; Methods of distillation - Simple, steam, flash distillation, azeotropic, extractive and molecular distillation, Continuous fractionation-McCabe-Thiele method, Minimum reflux ratio., total reflux and optimum reflux ratio.

UNIT IV **9 Hours**

EXTRACTION AND LEACHING

Liquid liquid extraction applications; Solvent selection; Design calculations for stage wise extraction, single stage and multi stage operation, crosscurrent and countercurrent operations; liquid extraction equipment. Solid liquid extraction, (leaching). Contacting equipments. Batch contact, crosscurrent and countercurrent extraction calculations.

UNIT V **9 Hours**

DRYING AND ADSORPTION

Drying of wet solids; Classification of drying equipment; Drying calculations - cross circulation drying and through circulation drying. Adsorption -adsorption Isotherm, freudlich, langmuir and BET equation.

FOR FURTHER READING

Problem solving on the absorption, distillation, drying and extraction

Total: 45+30=75 Hours

Reference(s)

1. R. E. Treybal, Mass Transfer Operations, New York: McGraw-Hill, 2002.
2. K. A. Gavhane, Mass transfer operations, Nirali Prakashan, 2008.
3. J. M. Coulson and J. F. Richardson,Chemical Engineering,Vol.I&II, Pergamon Press, 1998.
4. W. L. Mc-Cabe, J. C. Smith and P. Harriot, Unit Operations in Chemical Engineering, New York: McGraw-Hill Inc., 2005.
5. G. K. Roy, Fundamentals of Heat and Mass Transfer, Kanna Publishers, 2006.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	7					4			4					3											18
2	3					3					4			3					2			3			18
3	3					3				6				3					4			2			21
4	3					3			6					3					4			2			21
5	3					3			6					4					4			2			22
																								Total	100

Assessment Questions

Remember

1. State fick's law of diffusion with units
2. Name any four packing materials used in packed bed absorption column.
3. Define the term HETP in absorption tower.
4. Define relative volatility.
5. Enlist the methods used for calculating number of trays in a distillation column.
6. Give the unit for mass transfer coefficient
7. Write Murphree stage efficiency in liquid extraction.
8. Define Interphase mass transfer
9. Explain the two-film theory
10. Define Absorption in Mass Transfer
11. Define Raoult's law
12. Define Relative volatility
13. Enlist the various methods of Distillation
14. Define the following: a) Minimum reflux ratio, b) Total reflux ratio and c) Optimum reflux ratio

Understand

1. Explain tie line in triangular phase diagram of extraction process
2. Explain how the slope of the feed – line is estimated for a distillation column?
3. Differentiate Eddy diffusivity and molecular diffusivity
4. Explain the Analogy for the following?
   a. Nusselt Number b. Sherwood number
5. Explain how will you obtain over - all mass transfer coefficient from individual mass transfer coefficients?
6. Explain Equimolar diffusivity estimation
7. Briefly explain Continuous fractionation
8. Explain the Liquid – liquid extraction equipments
9. Classifiy the various kinds of drying equipments
10. Explain the process of solid-liquid extraction and list out its equipments

Apply

1. Write any one application of adsorption in industries
2. Name the equipments used for drying
3. Explain when is steam distillation recommended?
4. Elaborate various kinds of mass transfer operations and their applications
5. Explain the theories of mass transfer and their applications
6. Explain Single and multi component absorption systems
7. Outline the features in Design of absorbtion tower
8. Briefly explain the concepts of HTU, NTU and HETP
9. Explain in detail any two methods of Distillation
10. Explain the applications of various Methods of distillation

Analyse

1. A packed absorption is designed to recover 98% CO2 from a gas mixture air using water. If the height of the tower is 11.29m and HTU is 1m calculate the value of NTU.
2. A 1400 kg of solid is dried under constant drying conditions. Calculate the time required for drying if falling rate period is 1.69 hr and constant rate period is 0.57 hrs.

Evaluate

1. On what factors does the mass transfer rate between two fluid phases depend?
2. Enlist the properties of good adsorbent?
3. Explain how will you measure specific surface area of the adsorbent?
4. Explain how will you increase the rate of mass transfer in a process?
5. Draw the break through curve for continuous adsorption process.
6. Draw and write the material balance for batch leaching process.
7. Evaluate theÂ calculations for stage wise extraction in crosscurrent and countercurrent operations
8. Evaluate and explain Adsorption Isotherm, freudlich, langmuir and BET equation

Create

1. Represent the ternary system for extraction in a triangular diagram.
2. Write the correlated equation used for determining mass transfer coefficient for forced convection using dimensional analysis method.

15BT504 IMMUNOLOGY 2 0 2 3

Course Objectives

- To understand the concepts of immune system and the structure, functions and properties of different cell types and organs that comprise the immune system
- To comprehend the range of immunological agents and the strategies that may be used to prevent and combat infectious diseases
- To understand transplantation and autoimmunity

Course Outcomes (COs)

1. Gain knowledge about basics of immune system and its components
2. Know about various antigen antibody reactions
3. Understand the mechanism of cell mediated immunity
4. Can analyze the immune response related to microbial infection, allergy and hypersensitivity
5. Know about organ transplantation and immunological anomalies related to autoimmune disorders and tumor

UNIT I **6 Hours**

INTRODUCTION TO IMMUNE SYSTEM

Cells of immune system - B-Lymphocytes, T-Lymphocytes, Macrophages, Dendrite cells, Natural Killer, Eosinophils, Neutrophils, Mast cells, Organization and structure of lymphoid organs, Types of immunity and immune responses - innate and acquired immunity

UNIT II **6 Hours**

HUMORAL RESPONSE

Development, maturation, activation and differentiation of B-cells, Theory of clonal selection, Antibodies: structure, function and classification; Monoclonal and polyclonal antibodies - principles and production

UNIT III **6 Hours**

CELLULAR RESPONSE

Development, maturation, activation and differentiation of T-cells. T Cell Receptor, APC, Processing and presentation of antigen for immune response, Major histocompatibility complex

UNIT IV **6 Hours**

INFECTION AND IMMUNITY

Injury and inflammation, Immune responses to infections - immunity to viruses, bacteria, fungi and parasites, Cytokines, Complement, Immunosuppression, Immunotolerance, Allergy and hypersensitivity

UNIT V **6 Hours**

TRANSPLANTATION, AUTOIMMUNITY AND TUMOR IMMUNOLOGY

Transplantation of organ and tissue transplantation, genetics of transplantation - HLA system, mechanism and prevention of graft rejection, immunosuppressive drugs, autoimmune disorders, treatment of autoimmune disorders

FOR FURTHER READING
Types of antigen antibody reactions - agglutination, precipitation, Immunodiffusion - single, double, radial, immunoelectrophoresis affinity, rocket, ELISA

4 Hours

EXPERIMENT 1
Blood grouping and Blood Typing (ABO)

5 Hours

EXPERIMENT 2
Detection of Salmonella antibody in serum (Widal test)

4 Hours

EXPERIMENT 3
Ouchterlony double immunodiffusion (ODD)

4 Hours

EXPERIMENT 4
Radial immunodiffusion (RID)

4 Hours

EXPERIMENT 5
Rocket immunoelectrophoresis (RIE)

5 Hours

EXPERIMENT 6
Determination of antibody titre by Direct ELISA

4 Hours

EXPERIMENT 7
Design experiment -Isolation of IgG from serum

Total: 60 Hours

Reference(s)

1. P. M. Lydyard, A. Whelan and M. W. Fanger, BIOS Instant Notes in Immunology, Taylor & Francis Publication, 2011
2. Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby, Kuby Immunology, W.H. Freeman & Company, 2006.
3. David Male, Jonathan Brostoff, David Roth and Ivan Roitt, Immunology, Mosby Publication, 2006.
4. Ashim K. Chakravarty, Immunology and Immunotechnology, Oxford University Press India Publication, 2006.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	5					5					4			3				3							20
2	3					6				3				5				3							20
3	3					4				5				5				3							20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions
Remember
1. List out antigen presenting cells
2. State innate immunity
3. Recall the types of antigen
4. Label the structure of antibody
5. Define Monoclonal antibody
6. Retrieve the function of T cells
7. List out different types of cytokines with an example
8. Define hypersensitivity
9. State immunosupressive drugs
10. Recall any two autoimmune disorders and its symptoms

Understand
1. Illustrate the structure of primary lymphoid organ
2. Interpret the function of neutrophil
3. Exemplify B cell maturation
4. Indicate the advantage of monoclonal antibody over polyclonal antibody
5. Exemplify the role of T cell receptor
6. Abstract the importance of Major histocompatibility complex
7. Interpret the process of inflammation
8. Abstract the process of complement activation
9. Interpret the mechanism of graft rejection
10. Summarise the treatment procedure of rheumatoid arthritis

Apply
1. Show the preparation of inactivated vaccine
2. Design *Haemophilus influenza* type B subunit vaccine
3. Predict the purification strategy of Monoclonal antibodies
4. Assess the therapeutic application of Monoclonal antibodies
5. Explain the assay methods of lymphokines and cytokines.
6. Show the HLA typing assay
7. Implement the complement activation pathway to combat *V.cholerae* infection
8. Use mantoux test to assay delayed type hypersensitivity
9. Predict the post operative care of kidney transplantation
10. Demonstrate the action of cyclosporine as an immunosuppressive drug

Analyse
1. Justify the action of Natual Killer cells
2. In an animal how do you cause the secondary immune response to occur?
3. In an experiment is it easier to measure ‘avidity’ or ‘affinity’? Explain your answer.

Evaluate
1. Fully describe how a hapten could be conjugated to enhance its immunogenicity

Create
1. Relate monoclonal antibodies with cancer treatment.
2. Conclude how a hapten can be converted to be an immunogen

15BT507 BIOPROCESS LABORATORY-I 0 0 2 1

Course Objectives

- To build the students with sound practical knowledge on enzyme characterization, immobilization and medium optimization methods.
- To train on methods to investigate the growth of microorganisms in different systems under different conditions

Course Outcomes (COs)

1. Explain about Enzyme kinetics and characterization and how to use them for practical applications
2. Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques.
3. Determine an experimental objective, understand the theory behind the experiment,and operate the relevant equipment safely.

4 Hours

EXPERIMENT 1
Growth of Bacteria - Estimation of biomass, Calculation of Specific growth rate, yield coefficient

4 Hours

EXPERIMENT 2
Growth of Yeast- estimation of biomass, calculation of specific growth rate, yield coefficient

4 Hours

EXPERIMENT 3
Enzyme kinetics - Determination of Michaelis Menten parameters for amylase (free

4 Hours

EXPERIMENT 4
Enzyme activity -Effect of Temperature and pH

4 Hours

EXPERIMENT 5
Medium optimization - Plackett Burman Design

4 Hours

EXPERIMENT 6
Medium optimization-Response Surface Methodology

6 Hours

EXPERIMENT 7
Extraction of industrially important enzymes (pectinase/lipase/protease/amylase)

Total: 30 Hours

15BT508 GENETIC ENGINEERING LABORATORY 0 0 2 1

Course Objectives

- To build sound practical knowledge in genetic engineering tools and techniques
- To acquire practical skills in gene cloning, plasmid DNA isolation and restriction enzyme digestion

Course Outcomes (COs)

1. Demonstrate the gene cloning techniques
2. Analyze the plasmid DNA and restriction enzyme digestion
3. Prepare competent cell for transformation

4 Hours

EXPERIMENT 1
Isolation of gene of interest by PCR

4 Hours

EXPERIMENT 2
Purification of PCR amplicon

4 Hours

EXPERIMENT 3
Ligation of foreign DNA into plasmid vector

4 Hours

EXPERIMENT 4
Preparation of competent cells by CaCl2 method

4 Hours

EXPERIMENT 5
Transformation by heat shock

4 Hours

EXPERIMENT 6
Blue White screening of recombinants

4 Hours

EXPERIMENT 7
Isolation of plasmid DNA

2 Hours

DESIGN EXPERIMENT
Restriction enzyme digestion

Total: 30 Hours

Reference(s)

1. J. Sambrook, D. Russell, and D. W. Russell, Molecular cloning-A laboratory Manual (A set of Volume 1, 2 and 3), USA: Cold Spring Harbor Laboratory Press, 2000

15BT509 TECHNICAL SEMINAR I

0 0 2 1

Course Objectives

1. To develop the self-learning skills to utilize various technical resources available from multiple field.
2. To promote the technical presentation and communication skills.
3. To impart the knowledge on intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple field.
2. Improve the technical presentation and communication skills.
3. Understand the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.
4. Interact and share their technical knowledge to enhance the leadership skills.
5. Understand and adhere to deadlines and commitment to complete the assignments.

Total: 30 Hours

0 0 2 1

15BT510 MINI PROJECT III

Course Objectives

1. To develop knowledge to formulate a real world problem and project's goals.
2. To identify the various tasks of the project to determine standard procedures.
3. To identify and learn new tools, algorithms and techniques.
4. To understand the various procedures for validation of the product and analysis the cost effectiveness.
5. To understand the guideline to Prepare report for oral demonstrations.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

Total: 30 Hours

15GE511 LIFE SKILLS: APTITUDE I 0 0 2 -

Course Objectives

- To expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.

Course Outcomes (COs)

1. Distinguish the pattern of coding and decoding.
2. Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions
3. Difference between sequence and series
4. Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors
5. Identify the odd man out
6. Calculate the percentages and averages
7. Demonstrate the blood relation concept in Verbal Reasoning
8. Plot the diagrams based on direction
9. Explain the various operations

3 Hours

CODING AND DECODING
Introduction - Description of Coding method - Coding patterns - Concepts of Coding and Decoding - Problems involving Coding and Decoding methods

3 Hours

SEQUENCE AND SERIES
Introduction - Sequences of real numbers - Number and Alphabet series - Description of Number and Alphabet series - Analogy - Odd man out- Power series

3 Hours

DATA SUFFICIENCY
Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid

3 Hours

DIRECTION
Introduction to Direction - sense test - Overview of the wide variety of Direction problems -Direction - Plotting diagrams

3 Hours

PROBLEM ON AGES
Introduction- basic concept - usage of percentage and averages- applications

3 Hours

ANALYTICAL REASONING
Introduction - basic concept - non verbal analytical reasoning - arrangements

3 Hours

BLOOD RELATION
Introduction - Basic concept - Kinds of relation - Tree diagram - Relations

3 Hours

BLOOD RELATION
Introduction -Basic concept - Kinds of relation - Tree diagram - Relations

3 Hours

VISUAL REASONING
Introduction - Basic concepts - Odd man out - Next series - Mirror image and water image

3 Hours

SIMPLIFICATIONS
Introduction - Basic concepts - Arithmetic operations -Equation solving methods - Puzzles

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
4. Edgar Thorpe , Course In Mental Ability And Quantitative Aptitude For Competitive Examinations, Third Edition, Tata McGraw-Hill Publishing Company Ltd, 2013.
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

15GE601 PROFESSIONAL ETHICS **2 0 0 2**

Common to AE, AG,AU,CE,ME,MTRS,BT,FT,TT (VI Semester);
CSE,ECE,EEE,EIE,IT (VII Semester)

Course Objectives

- To understand Human values, ethical theory, codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues
- To understand personal ethics, legal ethics, cultural associated ethics and engineer's responsibility

Course Outcomes (COs)

1. Articulate engineering ethics theory with sustained lifelong learning to strengthen autonomous engineering decisions
2. Be an example of faith, character and high professional ethics, and cherish the workplace responsibilities, rights of others, public's welfare, health and safety
3. Contribute to shape a better world by taking responsible and ethical actions to improve the environment and the lives of world community
4. Fortify the competency with facts and evidences to responsibly confront moral issues raised by technological activities, and serve in responsible positions of leadership
5. Be Proficient in analytical abilities for moral problem solving in engineering situations through exploration and assessment of ethical problems supported by established experiments

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of 'Engineering Ethics'- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlberg's and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse - Sample codes NSPE - IEEE - Institution of Engineers (India).

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl case studies - Fundamental Rights, Responsibilities and Duties of Indian Citizens -Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	5	5				5					5														20
2		5			5						5										5				20
3		5					10				5														20
4	5									5											5	5			20
5	5					5				5					5										20
																								Total	100

Assessment Questions

Remember

1. Define Human Values.
2. What are Morals and Values?
3. What do you mean by Civic virtue and Respect for others?
4. Write the various meanings of Spirituality?
5. List four different types of Virtues.
6. Mention different Human values.
7. What is meant by moral autonomy?
8. Classify the types of inquiry
9. What are the steps needed in confronting moral dilemmas?
10. List the levels of moral development suggested by Kohlberg
11. What do you understand by self-interest and ethical egoism?
12. What are the steps needed in confronting moral dilemmas?
13. What are the three virtues of religion?
14. What are the professional responsibilities?

Understand

1. Which are the practical skills that will help to produce effective independent thought about moral issues?
2. Why does engineering have to be viewed as an experimental process?
3. Why isn‘t engineering possible to follow a random selection in product design?
4. Why is the code of ethics important for engineers in their profession?
5. What does the Balanced Outlook on Law stress in directing engineering practice?
6. Are the engineers responsible to educate the public for safe operation of the equipment? How?
7. What kind of responsibility should the engineer have to avoid mistakes that may lead to accident due to the design of their product?
8. What is the use of knowledge of risk acceptance to engineers?
9. Why is Environmental Ethics so important to create environmental awareness to the general public?
10. Why do the engineers refuse to do war works sometimes?

Apply

1. How does the consideration of engineering as a social experimentation help to keep a sense of autonomous participation is a person's work?
2. How does the code of ethics provide discipline among the engineers?
3. Exemplify the space shuttle Challenger case accident?
4. How does the manufacturer understand the risk in a product catalog or manual?
5. How does the knowledge of uncertainties in design help the engineers to access the risk of a product?
6. How can the quantifiable losses in social welfare resulting from a fatality be estimated? Give some examples.
7. How does the engineer act to safeguard the public from risk?

3 0 0 3

15BT602 BIOPROCESS ENGINEERING

Course Objectives

- Understand the role of biotechnologists in bioprocess industry.
- Apply the engineering concepts for biological conversion of raw materials.
- Perform simulations of reactors and model the kinetics of product formation

Course Outcomes (COs)

1. Specify required technologies for the production of industrial products.
2. Design reactors for the production of various metabolites.
3. Predict yield coefficients using the principles of stoichiometry and energetics of microbial growth.
4. Simulate and model the growth of microorganisms bioprocess applications.
5. Relate metabolic engineering and product formation kinetics.

UNIT I **9 Hours**

BIOREACTOR AND FERMENTATION

Bioreactor classification, applications. Parameters for control- critical and non-critical parameters.Various accessories of bioreactors.Cultivations of organisms in batch, continuous and fed-batch systems. General requirements of fermentation process.

UNIT II **9 Hours**

DESIGN ANDANALYSIS OF BIOREACTORS

Rheology of fermentation broth, Nature of fluids and its classification, non-ideal flow.Design and construction of bioreactor.Monitoring and control of fermenter.Packed bed reactor, Airlift reactor, Solid state and submerged fermentation and their applications.

UNIT III **9 Hours**

MASS TRANSFER AND SCALE-UPOPERATIONINBIOREACTORS

Mass transfer by diffusion and convection, Methods for the measurement of kLa, oxygen mass transfer methodology in bioreactors - microbial oxygen demands; Factors affecting oxygen transfer rate; Scale up and selection of bioreactors.

UNIT IV **9 Hours**

MODELLING AND SIMULATION OF BIOPROCESSES

Study of structured models for analysis of various bioprocesses Ã¢?? compartmental models, metabolic models, single cell models, plasmid replication and plasmid stability model, Dynamicsimulation of batch,fedbatch,steadyandtransientculture metabolism.

UNIT V **9 Hours**

MAJOR METABOLIC PATHWAYS

Bioenergitics. Glucose Metabolism, Respiration, Control sites in Aerobic Glucose metabolism. Metabolism of Nitrogenous compounds and Hydrocarbons.Overview of Biosynthesis.Metabolic pathway control.

FOR FURTHER READING

Media optimization, RTD and stability analysis, Power consumption and impeller tip speed, Modelling of Non-ideal behavior, Overview of Anaerobic and Autotrophic metabolism.

Total: 45 Hours

Reference(s)

1. D.G.Rao, Introduction to Biochemical Engineering, Tata McGraw-Hill Publications,
2. Michael L. Shuler and FikretKargi, Bioprocess Engineering - Basic Concepts, Prentice Hall, 2002.
3. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill, 1986.
4. Harvey W. Blanch, S. Douglas and Clark, Biochemical Engineering, Marcel Dekker Inc., 1997.
5. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Principles of Fermentation Technology, Butterworth Heinemann, 1995
6. B. Atkinson and F. Mavituna, Biochemical Engineering and Biotechnology Handbook, Mc-Millan, 1991

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
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1	7				6				4					3											20
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3	3				3					4				3					4			3			20
4	3				3				6					3					4			3			22
5	2				2				6					2					4			2			18
																								Total	100

Assessment Questions

Remember

1. Define fermentation.
2. Schematically represent the typical fermentation process.
3. List any three bioreactors used for the process of fermentation.
4. Define ‘mean’ and ‘variance’ in RTD studies.
5. State the principle of static method for KLa determination.
6. Enlist the methods for determination of KLa.

7. Draw the schematic diagram of two and three compartment models.
8. Define respiratory quotient.
9. Recall the significance of Damkohler number.
10. State the characteristic features of packed bed reactors.

Understand

1. Interpret the methodology for waste water treatment system for removal of residual nitrogen and phosphorus.
2. Summarize the general requirements of fermentation process.
3. Explain the salient features of airlift bioreactor.
4. Infer the three types of multiphase reactors.
5. Paraphrase the scale up criteria used to design a bioreactor based on its Constant impeller tip speed, Constant KLa, Constant P/V
6. Interpolate the steps involved in transport of oxygen from gas phase to the active site in the cell cluster.
7. Summarize the compartmental model of Williams et al.
8. Illustrate the metabolic model formulated by Hall and coworkers for growth of yeast on glucose.
9. Exemplify the diffusional limitations in immobilized systems with emphasize on Damkohler number and effectiveness factor.
10. Explain in detail about the various process conditions which are important in the operation of bioreactor.

Apply

1. Assess the role of and importance of fermentation in human welfare.
2. Compute the advantages of solid state fermentation in the production of therapeutics.
3. Compute the mass transfer aspects to be considered in the fermenter design.
4. Implement the fermenter dynamics and indicate the conditions for stability in a fermentation process.
5. Demonstrate the process of Oxygen transfer methodology from the air bubble to the cell in fermentation broth.
6. Assess the methods used for regime analysis of the bioreactor.
7. Predict the requirements in choosing suitable mathematical model to address genetic instability.
8. Show plasmid instabilities observed for genetically modified organisms and derive the expression for the same.
9. Implement the film and pore diffusion effects on kinetics of immobilized enzyme reactions.
10. Design a packed bed reactor using two dimensional model.

Analyse

1. Differentiate aerobic and anaerobic fermentation.
2. Attribute the advantages of fluidized bed reactor over other conventional bioreactors.
3. Compare the static method and Dynamic methods for the determination of kLa.
4. Justify the need of mathematical model for plasmid replication.
5. Integrate the relationship between effectiveness factor and Thiele Modulus in immobilized reactor.

Evaluate

1. Critique the production of ethanol through conventional and non-conventional substrates.
2. Criticize the working principle of air-lift reactor in fermentation process.
3. Judge whether ‘constant KLa’ concept is a better approach for scale up.
4. Defend the assumptions for studying models based on cellular energetics and metabolism of microbes.
5. Determine the effects of mass transfer resistance in immobilized enzyme systems

Create

1. Plan a design of solid state fermentation for the production of probiotics.
2. Derive an expression to find the concentration profile for a zero order spherical particle and also find the effectiveness factor.

15BT603 CHEMICAL REACTION ENGINEERING 3 2 0 4

Course Objectives

- To impart the basic concepts in reaction kinetics
- To develop knowledge for the design of ideal and non ideal reactors.
- To endow knowledge in industrial reactors and its functions

Course Outcomes (COs)

1. Formulate chemical kinetics and determine the activation energy for homogeneous reactions
2. Interpret the batch reactor data and characterize the rate of reaction
3. Analyze various design principles of industrial reactors.
4. Facilitate the industrial application of chemical reactors
5. Model non ideal flow reactors and compare with ideal reactors.

UNIT I **9 Hours**

CHEMICAL REACTION RATE AND CHEMICAL KINETICS

Classification of chemical reactions. Variables affecting the rate of reaction; Definition of order and molecularity, rate equation, rate constant;, Concentration and temperature dependence; Kinetics of homogeneous reaction; Search for reaction mechanism; Interpretation of batch reactor data-Integral and differential method of analysis (Only for constant volume batch reactor)

UNIT II **9 Hours**

IDEAL REACTORS

Design of performance equations -for batch, plug flow and mixed flow reactors; Space time and Space velocity; Recycle reactor .

UNIT III **9 Hours**

NON IDEAL REACTORS

Basics of non ideal flow; RTD function and measurement; RTD in plug flow and mixed flow reactor, conversion in non ideal flow, relation among E,F and C curve, non - ideal flow models- tank in series and dispersion models

UNIT IV **9 Hours**

HETEROGENEOUS REACTING SYSTEM

Effectiveness factor for a straight catalyst pore for a first order reaction,, Contacting patterns; Kinetics of fluid particle reactions-Progressive conversion model and shrinking core model - Determination of rate controlling step; Gas solid and gas liquid reactions.

UNIT V **9 Hours**

INDUSTRIAL REACTORS

Trickle bed, slurry reactors; three phase-fluidized beds; Reactors for fluid-fluid reactions

FOR FURTHER READING

Calculations on the Ideal, Non ideal and heterogenous reactor kinetics and modelling

Total:45+30= 75 Hours

Reference(s)

1. O. Levenspiel, Chemical Reaction Engineering, John Wiley,2004
2. H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall of India, 2002.
3. R. W. Missen, C. A. Mims and B.A Saville, Introduction to Chemical Reaction Engineering and Kinetics,John Wiley, 2000.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	7					6			4					3											20
2	3					3					4			3					4			3			20
3	3					3				4				3					4			3			20
4	3					3			6					3					4			3			22
5	2					2			6					2					4			2			18
																								Total	100

Assessment Questions

Remember

1. Write the rate equation in terms of unit mass of solid in fluid –solid system.
2. Define space time and space velocity.
3. Explain what are the factors required to evaluate the conversion in non ideal flow reactors?
4. Define vessel dispersion number
5. Define a Recycle reactor
6. Classify the chemical reactions based on their kinetics
7. Define Order and molecularity of a reaction
8. Define a Recycle reactor
9. Define Activation energy
10. Define RTD and brief its function

Understand

1. Differentiate elementary and non – elementary reaction with suitable example.
2. State the significance of Hatta Number.
3. Differentiate between Trickle bed and slurry reactors
4. Explain few types of Industrial Reactors
5. Explain Progressive conversion model and shrinking core model
6. Explain the concepts in Gas solid and gas liquid reactions.
7. Explain RTD in a plug flow and mixed flow reactor
8. Explain the design of performance equations for batch, plug flow and mixed flow reactors
9. Enlist the Variables affecting the rate of a reaction
10. Explain in detail on Progressive conversion model and shrinking core model

Apply

1. Explain where will you apply vessel dispersion number?
2. Explain how will you find a rate controlling/limiting step in a heterogeneous reaction?
3. Explain how will you apply half life period method for determining kinetic constants?
4. Define three phase-fluidized beds reactors and explain its working principle and applications
5. Derive the Kinetics of a homogeneous reaction

6. Differentiate between batch, plug flow and mixed flow reactors
7. Interpret RTD in a plug flow and mixed flow reactor
8. Explain tank in series and dispersion models
9. Derive the Kinetics of fluid particle reactions
10. Explain the operation of Trickle bed and slurry reactors

Analyse

1. Write the significance of activation energy in the process of transformation of reactants into products for elementary reactions.
2. "RTD in plug flow reactor is same through the reactor", Justify this statement
3. Analyse and give the reason for considering the area under the curve for plug flow reactor for designing the performance equation instead of area under rectangle.
4. Analyse a design of CSTR reactor and write the material balance equation.
5. Interpret the Integral and differential method of analysisÂ for constant volume batch reactor
6. Analyse the relation among E,F and C curves
7. Differntiate Ideal and Non Ideal Reactors

Evaluate

1. Liquid A decomposes by first order kinetics, and in a batch reactor 50% of A is converted in 5 minutes. How long it will take to reach 75% conversion?
2. In a homogeneous isothermal liquid polymerization 20% of the monomer get disappeared in 34 minutes for initial monomer concentration of 0.04 and also for 0.8 mol//l. What is the rate expression for the disappearance of the monomer?
3. A 10minutes experimental run shows that 75% of liquid reactant A‘ is converted by a ½ order rate .What would be the amount of A converted in 30minutes.

Create

1. Draw the pulse input and output curves for RTD measurements
2. Draw the E curve and give the reason for considering that area under the curve as 1.

15BT604 BIOPHARMACEUTICAL TECHNOLOGY

3 0 0 3

Course Objectives

- Introduce various types of biopharmaceuticals and their sources
- Expose students to industrial processes of drug manufacture
- Create deeper understanding of drug action and drug design

Course Outcomes (COs)

1. Learn about the production of biopharmaceuticals
2. Acquire the basic knowledge about mechanisms of drug metabolism
3. Attain the in depth knowledge on drug formulations

UNIT I **7 Hours**

INTRODUCTION

Drug: definition, pharmaceuticals of animal, plant and microbial origin, routes of drug administration.

UNIT II **9 Hours**

BIOPHARMACEUTICALS

Hormones of therapeutic interest - Insulin, Glucagon, Enzymes of therapeutic value â?? Asparaginase and Glucocerebrosidase, debriding agents and digestive aids, Vaccine technology - development of AIDS and cancer vaccine.

UNIT III **9 Hours**

PRINCIPLES OF DRUG MANUFACTURE

Liquid dosage forms - solutions, suspensions and emulsions, Semi solid dosage forms - ointments, creams and suppositories, Solid dosage forms - tablets, capsules, coating of tablets, preservation.

UNIT IV **10 Hours**

DRUG METABOLISM AND PHARMACOKINETICS

Mechanism of drug absorption, distribution, metabolism and excretion, bioavailability and bioequivalence.

UNIT V **10 Hours**

DRUG DESIGN

Drug design: Pharmacokinetic issues, solubility and membrane permeability, making drug more resistance to hydrolysis and drug metabolism, making drugs less resistant to drug metabolism. Cimetidine - a rational approach to drug design (Overview).

FOR FURTHER READING

Nucleic acid therapeutics - gene therapy, antibiotics, laxatives, good manufacturing practices (GMPs), packing techniques.

Total: 45 Hours

Reference(s)

1. D. M. Brahmankar and Sunil B. Jaiswal, Biopharmaceutics and Pharmacokinetics - A Treatise, Vallabh Prakashan, 2006
2. G. Walsh, Pharmaceutical Biotechnology: Concepts and Applications, John Wiley, 2007.
3. Remington, The Science and Practice of Pharmacy, Vol.I & II, Lippincott Williams & Wilkins, 2005.
4. G. Walsh, Biopharmaceuticals: Biochemistry and Biotechnology, John Wiley, 2003.
5. E. A. Rawlins, Bentleys Textbook of Pharmaceutics, Bailliere Tindall, 1996.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1			3			6					8			3											20
2		3						4		4									5			4			20
3	3					2						5		5									5		20
4		3									6			4				5							18
5	3						3					4							6				6		22
																								Total	100

Assessment Questions

Remember

1. Define Biopharmaceuticals with an example.
2. What are prodrugs?
3. Name any four pharmaceuticals of microbial origin
4. Give any two examples for preservatives used in pharmaceutical preparations.
5. What are monooxygenases?
6. Define pharmacokinetics
7. Distinguish bioavailability and bioequivalence.
8. Why diluents are used in tablet manufacture?

Understand

1. Plants are the good sources of biopharmaceuticals – Discuss
2. Differentiate soft and hard capsules.
3. Distinguish bioavailability and bioequivalence.
4. Why diluents are used in tablet manufacture?
5. Why phase II drug metabolism is also called conjugation reactions?
6. Explain about various liquid dosage forms
7. What are prodrugs?
8. Name any four pharmaceuticals of microbial origin

Apply

1. Write about the role of FDA in drug development process.
2. List any four types of compressed tablets.
3. Draw the neat sketch of a simple compartment open - model system.
4. Write the difficulties associated with the development of AIDS vaccine.
5. State the importance of oxidation reactions in drug metabolism.
6. Explain the process of drug design

Analyse

1. How can liposomes be used as drug delivery system?
2. Explain the various steps involved in wet and dry granulation processes.
3. Explain the steps involved in development of cancer vaccine
4. Expalin the pharmacokinetics and drug-receptor interaction of Asparginase enzyme

Evaluate

1. Support the Antisense technology in drug development

Create

1. Design a new drug with minimal side effects from doxorubicin parent molecule, without affecting its efficacy

15BT607 BIOPROCESS LABORATORY-II 0 0 2 1

Course Objectives

- Learn key methods on metabolite production in the bioreactor.
- Equip themselves with industry oriented experiments involving biochemical operations.
- Familiarize in the mass transfer aspects for the production of metabolites.

Course Outcomes (COs)

1. Evaluate the cultivation, enrichment and microbial growth enhancement methods to enhance product yield.
2. Analyze and interpret heat and mass transfer coefficients in the fermenter.

3 Hours

EXPERIMENT 1
Calculation of del factor for batch sterilization process

3 Hours

EXPERIMENT 2
Estimation of Sterilization holding time

3 Hours

EXPERIMENT 3
Batch cultivation and evaluation of growth parameters

3 Hours

EXPERIMENT 4
Residence time distribution

3 Hours

EXPERIMENT 5
Solid state fermentation

3 Hours

EXPERIMENT 6
Fed batch cultivation and estimation of growth parameters

3 Hours

EXPERIMENT 7
Simulation of bioreactor

3 Hours

EXPERIMENT 8
Enzyme immobilization

6 Hours

EXPERIMENT 9
Design Experiments - Determination of Overall Heat transfer coefficient

Total: 30 Hours

15BT608 BIOPHARMACEUTICAL TECHNOLOGY LABORATORY

0 0 2 1

Course Objectives

- Build the basic knowledge on biopharmaceuticals
- Impart the knowledge about isolation of various biopharmaceutical substances
- Have hands on experience in the synthesis and assay of various pharmaceutical substances

Course Outcomes (COs)

1. Understand basic methods of pharmaceutical preparations
2. Carry out various methods of drug synthesis
3. Isolate pharmaceuticals from natural sources

2 Hours

EXPERIMENT 1
Synthesis of Methyl salicylate

4 Hours

EXPERIMENT 2
Synthesis of Paracetamol

4 Hours

EXPERIMENT 3
Synthesis of Mucic acid

4 Hours

EXPERIMENT 4
Isolation of Naringin

4 Hours

EXPERIMENT 5
Isolation of Hesperidin

4 Hours

EXPERIMENT 6
Assay of Riboflavin tablets

4 Hours

EXPERIMENT 7
Assay of Dextrose Injection

4 Hours

EXPERIMENT 8
Analysis of dextrose content in intravenous formulation

Total: 30 Hours

Reference(s)

1. Remington, The Science and Practice of Pharmacy, Vol.I & II, Lippincott Williams & Wilkins, 2005

15BT609 TECHNICAL SEMINAR II

0 0 2 1

Course Objectives

1. To develop the self-learning skills to utilize various technical resources available from multiple field.
2. To promote the technical presentation and communication skills.
3. To impart the knowledge on intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple field.
2. Improve the technical presentation and communication skills.
3. Understand the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.
4. Interact and share their technical knowledge to enhance the leadership skills.
5. Understand and adhere to deadlines and commitment to complete the assignments.

Total: 30 Hours

15BT610 MINI PROJECT IV

0 0 2 1

Course Objectives

1. To develop knowledge to formulate a real world problem and project's goals.
2. To identify the various tasks of the project to determine standard procedures.
3. To identify and learn new tools, algorithms and techniques.
4. To understand the various procedures for validation of the product and analysis the cost effectiveness.
5. To understand the guideline to Prepare report for oral demonstrations.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

Total: 30 Hours

15GE611 LIFE SKILLS: APTITUDE II 0 0 2 -

Course Objectives

- The undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values

Course Outcomes (COs)

1. Perform arithmetical operations with complex numbers
2. Explain the meanings of a relation defined on a set, an equivalent relation and a partition of a set
3. Calculate percentages in real life contexts , find any percentage of a given whole using their knowledge of fraction multiplication and increase / decrease a given whole by a percentage
4. Calculate the Ratio, Proportions and Variation
5. Identify the percentage gain or percentage loss
6. Differentiate Pipes and Cisterns
7. Demonstrate the situations like motion in as straight line , Boats and Streams , Trains, Races and clocks
8. Evaluate the Counting techniques, Permutation and Combination, Recursion and generating functions
9. Categorize the distributions of probability with respect to the random variables
10. Discuss the different cases of Mixtures and Alligation

3 Hours

NUMBER SYSTEMS

Introduction - definition- classification on Numbers -power cycles and remainders - short cut process - concept of highest common factor - concept of least common multiple - divisibility - number of zeros in an expression

3 Hours

PERCENTAGES

Introduction - definition and Utility of percentage - importance of base/denominator for percentage calculations - concept of percentage values through additions - fraction to percentage conversion table

3 Hours

AVERAGES

Introduction - average of different groups - addition or removal of items and change in average-replacement of some of the items

3 Hours

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- properties-dividing a given number in the given ratio - comparison of ratios - proportions - useful results on proportion- continued proportion - relation among the quantities more than two – variation

3 Hours

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-multiplying equivalents to find sale price - relation among cost price, sale price, gain/loss and percentage gain or percentage loss - an article sold at two different selling price - two different articles sold at same selling price - percentage gain or percentage loss on selling price - percentage gain or percentage loss on whole property

3 Hours

TIME AND WORK
Introduction - Basic concepts -Concepts on working with different efficiency - Pipes and Cisterns - Work Equivalence (Man Days) -Alternative approach

3 Hours

TIME, SPEED AND DISTANCE
Definition - Basics of Time, Speed and Distance - Relative speed - Problems based on Trains? Problems based on Boats and Streams -Problems based on Races - time taken with two difference modes of transport - time and distance between two moving bodies

3 Hours

PERMUTATION AND COMBINATION
Definition - Fundamental rules - Theorems on Permutation - Theorems on Combination

3 Hours

PROBABILITY
Concept and importance of probability - underlying factors for Real- Life estimation of probability - Basic facts about probability - some important consideration while defining event.

3 Hours

MIXTURES AND ALLIGATION
Definition - alligation rule - mean value (cost price) of the mixture - some typical situations where allegation can be used.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
3. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
4. Edgar Thorpe , Course In Mental Ability And Quantitative Aptitude For Competitive Examinations, Third Edition, Tata McGraw-Hill Publishing Company Ltd, 2013
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

15GE701 ENGINEERING ECONOMICS 3 0 0 3

Common to CSE,ECE,EEE,EIE,IT (VI Semester) and to AE, AG,AU,CE,ME,MTRS,BT,FT,TT (VII Semester)

Course Objectives

- Provide the theoretical foundations in micro and macro analysis in terms of concepts and theories
- Emphasis the systematic evaluation of the costs and benefits associated with projects
- Enumerate the idea of Balance sheet and Balance of payments

Course Outcomes (COs)

1. Understand the micro economic environment for creating a favourable business environment.
2. Take decision by making use of the major concepts and techniques of engineering economic analysis.
3. Compare the cost of multiple projects by using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
4. Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
5. Examine and evaluate the issues in macro-economic analysis.

UNIT I **9 Hours**

INTRODUCTION

Introduction to Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier - Opportunity Cost - Objective of Organizations - Kinds of Organization.

UNIT II **9 Hours**

DEMAND AND SUPPLY

Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply - Elasticity of Demand - Demand Forecasting Methods - Indifference curve.

UNIT III **9 Hours**

PRODUCTION AND COST

Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-economies of scale - Break Even point.

UNIT IV **9 Hours**

MARKET STRUCTURE

Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methods f Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment - Payback Period.

UNIT V **9 Hours**

INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING

National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct and Indirect Taxes - Fiscal and monetary policies.

FOR FURTHER READING

Nature and characteristics of Indian Economy - Role and functions of Central bank - LPG - GATT - WTO.

Total: 45 Hours

Reference(s)

1. A Ramachandra Aryasri and V V Ramana Murthy, Engineering Economics and Financial Accounting, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. V L Samuel Paul and G S Gupta, Managerial Economics Concepts and Cases, Tata McGraw Hill Publishing Company Limited, New Delhi, 1981.
3. R Kesavan, C Elanchezhian and T Sunder Selwyn, Engineering Economics and Financial Accounting, Laxmi Publication (P) Ltd, New Delhi, 2005.
4. S N Maheswari, Financial and Management Accounting, Sultan Chand
5. V L Samuel Paul and G S Gupta, Managerial Economics-Concepts and Cases

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					8			6											18
2		2					2			8					6				4						22
3			2			2				8								4							16
4	2						2		8						6				4						22
5		2				2				8				6				4							22
																								Total	100

Assessment Questions

Remember

1. Define Economics
2. What is opportunity cost?
3. List the types of Demand.
4. State the law of Demand.
5. Define Elasticity of Demand.
6. State the different degrees of elasticity of Demand.
7. List the factors determining Elasticity of Demand.
8. State the Law Of Diminishing Marginal Utility. 9.
Define Replacement Cost and Historic Cost
10. Define Monopoly.
11. Define Oligopoly
12. Name the two types of Oligopoly.
13. List the objectives of Pricing.
14. Define Accounting
15. Define inflation

Understand

1. Explain the nature and scope of Economics.
2. List and explain the focus areas of Managerial economics.
3. Give reasons why mangers aim to maximize sales even at the cost of a lower profit.
4. Explain the nature of Demand.
5. What are the assumptions made when talking about the Law of Diminishing Marginal Utility?
6. Explain the characteristics of the Indifference Curve with examples
7. Can Demand Forecasting principles be applied to Services? Substantiate your answer with an example
8. What are the characteristic features of an oligopoly industry?

9. What causes Oligopoly?
10. Explain the types and features of Cost Based Pricing.
11. Explain the types and features of Demand Based Pricing.
12. Under what conditions does a company go in for Cross Subsidization pricing?
13. What is the role of the Central bank in controlling inflation?

Apply

1. Explain decisions based on the degree of certainty of the outcome with examples.
2. Give examples of products falling under the various kinds of competition, and the reasons they are able to survive in the market.
3. Give six examples of products that fall under Monopolistic Competitive pricing.
4. Give six examples of products that fall under Oligopolistic pricing
5. Pick any six Consumer Items and based on your knowledge of the markets, explain the pricing method that you think is most likely to have been followed for each of these items.

Analyse

1. Differentiate between Macro and Micro economics
2. Differentiate between Extension and Increase in Demand.
3. Distinguish between Cost and Price
4. Compare the merits and demerits of the Deductive Method and the Inductive Method of Investigation
5. The per-capita income of farmers in the country has to be raised by 20% this year to prevent their migration to cities. Discuss this statement from the point of view of Positive and Normative Economics.
6. Decision making improves with age and experience- Discuss.
7. Do a survey of the automotive (only cars) industry and analyze the reasons and timing for discounts offered from the point of view of elasticity of demand
8. How would you modify a sealed bid pricing system to take care of different technical approaches by different bidders for a project for which bids are called for, given that the cost varies depending on the technical approach?

Create

1. Create a matrix consolidating the definitions of the word? Economics as defined by the leading Economists in the prescribed textbook. Using this define economics the way you understand it, in less than 50 words.
2. Study the price of a commodity over a period of one year and explain the possible reasons for the fluctuations from an economist‘s point of view
3. You are in a job which is paying you adequately. You are called for an interview for a job that double your salary. Unfortunately you miss the only train that will take you in time for the interview. How will you justify the cost of taking a flight considering the cost concepts you have learnt?
4. Due to cancellation of an export order, you are stuck with a huge stock of jeans of international quality. Device a pricing strategy for disposing this stock without incurring a loss, considering that it is a very competitive market.

15BT702 TISSUE CULTURE 3 0 0 3

Course Objectives

- Become Familiar with types and different techniques in tissue culture as these concepts will be a stepping stone for research

Course Outcomes (COs)

1. To gain ample knowledge on different culture types involved
2. To learn the techniques involved in plant and animal tissue culturing
3. To have an exposure on the various real time applications of culturing techniques Course Outcomes (COs)

UNIT I **9 Hours**

INTRODUCTION TO PLANT TISSUE CULTURE

History of plant tissue culture; Laboratory organization and instrumental, set up; Medium components - media preparation; Aseptic techniques for plant tissue culture.

UNIT II **9 Hours**

CULTURE TYPES AND TECHNIQUES

Cellular totipotency; Callus culture; Suspension culture; Micropropagation; Protoplast fusion technology; Somatic embryogenesis.

UNIT III **9 Hours**

INTRODUCTION TO ANIMAL CELL CULTURE

History of animal cell culture; Methods and sterilization; Culture media - types and properties; Serum-free media; Characteristics of cultured cells - adhesion, proliferation, differentiation, metabolism and evolution; Measurement of growth parameters of cultured cells. Senescence and apoptosis

UNIT IV **9 Hours**

CELL LINES AND CELL VIABILITY

Primary cell culture and its techniques; Types, selection, development and maintenance of cell lines; Subculture; Stem cell cultures.

UNIT V **9 Hours**

APPLICATIONS OF TISSUE CULTURE

Application of plant tissue culture in mutant selection, secondary metabolite production, single cell protein and biotransformation.Application of animal cell culture in medicine

FOR FURTHER READING

Quality control in tissue cultureSomaclonal variation; Senescence and apoptosis; Assay for cell vialbility and cytoxicity; Agrobacterium mediated gene transformation

Total: 45 Hours

Reference(s)

1. M. K. Razdon, Introduction to Plant Tissue Culture, Oxford & IBH Publishing Company, 2006.
2. R. Ian Freshney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Wiley-Blackwell Publisher, 2010.
3. S. Narayanaswamy, Plant Cell & Tissue Culture, Tata Mc Graw-Hill, 2008.
4. U. Satyanarayana, Biotechnology, Book & Allied Pvt. Ltd., 2007.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
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3	3					2				6				5									4		20
4	3										6			4				5							18
5	3						4			4									6				5		22
																								Total	100

Assessment Questions

Remember

1. Who proposed single plant cell culture?
2. When did protoplast technique introduced?
3. Give the role of auxin.
4. Give the role of auxin.
5. What is haploid?
6. What is genetic variability?
7. What is the procedure for using plastic glass ware?
8. What is HEPA filter?
9. What is the advantage of working in laminar air flow cabinet?

Understand

1. What is plant tissue culture?
2. Which carbon source is preferred for tissue culture?
3. How activated charcoals stimulate growth?
4. In what ways single cells are isolated from plant?
5. How invitro fusion is done?
6. Explain the types of embryogenic cells.
7. How does the duration of cell culture which influence variation?
8. Why suspension culture is preferred for somatic embryogenesis?
9. What are the problems found in bioreactor cultivation?
10. How cell viability is determined?
11. Explain the precursors for secondary metabolite production.

Apply

1. List out the advantage of using apical meristem.
2. List out the advantage of using apical meristem.
3. How cyanogenic glycosides involve as antimicrobial agent?
4. How variants are isolated?
5. List out the methods used to eliminate virus.

6. Recent advances in vascular differentiation.
7. How do you find out viability?
8. List out the terpenoids with examples.
9. Difference between somatic and zygotic embryo
10. Give some examples for biotransformation.
11. Distinguish selection and without selection.

Analyse

1. List the enzymes used to isolate protoplast.
2. List out the types of ELISA.
3. List out the advantage of using apical meristem.

Evaluate

1. List out the factors involved in tissue culture
2. Explicate the chart for direct embryogenesis.
3. Explain the types of interactions in elicitor production.
4. Explain the methods in invitro conservation.
5. Elucidate the problems in cryopreservation.
6. Explain the common steps in cryopreservation.

Create

1. Describe the micropropogation technique in detail with suitable digram.
2. Elucidate the somatic embrogenesis and somocloal variation techniques

15BT703 DOWNSTREAM PROCESSING 3 2 0 4

Course Objectives

- To provide the fundamentals of downstream processing for biochemical product recovery
- To understand the basic unit operations and their principles for product recovery
- To develop skills of the students in the area of downstream processing with emphasis on purification of products

Course Outcomes (COs)

1. Learn effective strategies of downstream processing based on characteristics of biomolecules and to learn the various techniques of cell disruption
2. Understand techniques of insolubles removal and predict operating optimal parameters for large scale operations
3. Learn various techniques of bulk product isolation
4. Learn techniques of high resolution product purification and design purification strategy based on product characteristics and cost effectiveness
5. Learn various techniques of finishing of final product as per customer requirement and product nature

UNIT I **9 Hours**

DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and Importance of downstream processing in biotechnological processes; Problems and requirements of bioproduct purification; cost -cutting strategies, characteristics of biological mixtures; Cell disruption for product release mechanical, enzymatic and chemical methods; Pretreatment and stabilization of bioproducts

UNIT II **9 Hours**

PHYSICAL METHODS OF SEPARATION

Unit operations for solid - liquid separation; Flocculation and sedimentation; Centrifugation principles - tubular bowl centrifugation, disk centrifuge and ultracentrifugation; Filtration theory conventional filtration, cross flow, Perevaporation

UNIT III **9 Hours**

ISOLATION OF PRODUCTS

Isolation - adsorption, liquid-liquid extraction, aqueous two-phase extraction; Membrane separation - micro, ultra filtration and reverse osmosis, dialysis, Precipitation of proteins by different methods

UNIT IV **9 Hours**

PRODUCT RESOLUTION/ FRACTIONATION

Chromatography - principles, instruments, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, affinity chromatographic techniques; Electrophoretic techniques

UNIT V **9 Hours**

FINISHING OPERATIONS FOR FINAL PRODUCT

Crystallization principles, practices and equipments; Drying principles, practices, and equipments, Lyophilization - principles, practices, and equipments

FOR FURTHER READING

Problem solving on product separation and purification

Total: 45+30=75 Hours

Reference(s)

1. P. A. Belter, E. L. Cussler and Wei-Shou Hu, Bioseparations- Downstream Processing for Biotechnology, Wiley Interscience, 1988
2. B. Sivasankar, Bioseparations - Principles and Techniques, Prentice Hall of India Pvt. Ltd., 2007
3. S. N. Mukhopadhyay, Process Biotechnology Fundamentals, Viva books Pvt. Ltd., 2001
4. R. G. Harrison, P. Todd, S. R. Rudger and D. P. Petrides, Bioseparation Science and Engineering, Oxford University Press, 2003

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3						3				6			4				5							21
5	3									4									6				6		19
																								Total	100

Assessment Questions

Remember

1. Reproduce any two stages in downstream processing and list two unit operations for each stage.
2. Recall the role of osmotic shock in cell disruption.
3. List four uses of filter aids.
4. State Darcy's Law.
5. Reproduce the three adsorption isotherms with its model equation.
6. Define partition coefficient.
7. State partition coefficient in chromatography.
8. Define retention time in a chromatography.
9. Define nucleation in crystallization.
10. State the significance of freeze drying.

Understand

1. Summarize the steps involved in bioproduct recovery.
2. Compare with two advantages and disadvantages of bioprocesses to conventional chemical processes.
3. Infer the importance of gyrotester in scale up of centrifugation.
4. Indicate three types of sedimentation process.
5. Compare flocculation and sedimentation.
6. Explain the principle of extraction.
7. Classify membrane separation process based on principle involved.
8. Classify chromatography technique based on nature of mobile phase.
9. Identify how resolution helps in understanding the efficiency of a chromatography system.
10. Contrast primary and secondary nucleation in crystallization.
11. Formulate the various stages of lyophilization.

Apply

1. Implement the use of gyrotester in selection of centrifuge for separation of a bioproduct.
2. Demonstrate the variation in cell wall structure of a gram positive and gram negative bacteria.
3. Find the ways to stabilize a bioproduct.
4. Predict a method of cell disruption of a compound that is thermolabile.
5. Construct the expression for the determination of volumetric flow rate in a tubular centrifuge.
6. Assess the three unit operations involved for solid liquid separation in downstream processing.
7. Compute the expression for the determination of specific cake resistance in a filtration experiment.
8. Execute for determination of expression for the filter medium resistance in filtration.
9. Assess aqueous biphasic systems. Compute the steps involved in it for the extraction of an enzyme.
10. Demonstrate the separation of charged species by IEC.

Analyse

1. Differentiate biomolecules with other chemicals.
2. Organize are the salient features of bioprocesses.
3. Differentiate between salting-in and salting-out for precipitation of protein.
4. Justify how aqueous biphasic system is useful.
5. Differentiate the processes of osmosis and reverse osmosis.
6. Differentiate between frontal and displacement mode of operating chromatography system.
7. Attribute the theory behind crystal formation.
8. Organize the role of crystallization in biomolecular formulation.

Evaluate

1. Criticize how the chromatogram is used to determine the resolution of chromatographic separation?

Create

1. Generate the steps involved sequentially to separate and purify the enzyme lipase produced during fermentation process by *Pseudomonas aeruginosa*.
2. Plan downstream processing steps involved in citric acid manufacture.

15BT704 BIOINFORMATICS 2 0 2 3

Course Objectives

- To understand the theory and background of commonly available bioinformatics tools, so that they are able to judge the validity of the results provided by these tools.
- To navigate through internet-based biological databases and genomic browsers
- To use online resources to search for biological informations.

Course Outcomes (COs)

1. Acquire in depth knowledge in biological databases, their usage and knowledge.
2. Understand and learn the technical details of several current experiments or technologies used in the field of systems biology.
3. Become acquainted with the nomenclatures and annotation issues in Bioinformatics

UNIT I **6 Hours**

INTRODUCTION TO BIOINFORMATICS

Introduction to bioinformatics, Basics of database, Biological databases, Protein and Nucleic Acid Databases - PDB, NCBI, Swissprot, KEGG, ExPasy.

UNIT II **6 Hours**

SEQUENCE ALIGNMENT

Pairwise sequence alignments - basic concepts of sequence alignment, local and global alignments, Dot plot, Scoring matrices, Multiple Sequence Alignment - CLUSTALW, Genetic Algorithm, Profiles, Blocks, HMM, RNA secondary structure.

UNIT III **6 Hours**

PHYLOGENETIC ANALYSIS

Basic concepts in systematics, taxonomy and phylogeny; molecular evolution; nature of data used in Taxonomy and Phylogeny, Definition and description of phylogenetic trees and various types of trees.

UNIT IV **7 Hours**

INTRODUCTION TO SYSTEMS BIOLOGY

Introduction to systems biology, Systems theory, Advantages over reductionist approach,, Biological networks - metabolic, signaling & regulatory network, Flux analysis â?? MFA & FBA, Bottom-up approach, Top-down approach, Applications - Metabolic engineering, Synthetic biology.

UNIT V **5 Hours**

ADVANCED BIOINFORMATICS

Data mining, Clustering & Classification, Next Generation Sequence Analysis, High Throughput databases, Computer aided drug design, Basic Perl programing Ã¢?? sequence input, analysis.

5 Hours

EXPERIMENT 1

Information retrieval from biological databases

5 Hours

EXPERIMENT 2

PSA using BLAST

5 Hours

EXPERIMENT 3

Molecular phylogenetic analysis

5 Hours

EXPERIMENT 4

Gene annotation and gene finding

5 Hours

EXPERIMENT 5

Molecular modeling of protein and its visualization

5 Hours

EXPERIMENT 6

Simple perl/python codes for sequence analysis

Total: 60 Hours

Reference(s)

1. David B. Mount: Bioinformatics. Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York, 2001.
2. Andreas D. Baxevanis, B. F. Francis Ouellette: Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Volume 39, John Wiley, 1998
3. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall, 2006.
4. James Tisdall, Beginning Perl for Bioinformatics. O'Reilly & Associates, 2000.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					6			3											18
2	3					4				3									5			3			18
3	3					4				4				4									5		20
4	3					3					6			5				5							22
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. What is bioinformatics?
2. Expand NCBI, EMBJ, DDBJ, and PIR.
3. Differentiate PAM and BLOSUM Matrices
4. Differntiate Global and Local alignment
5. Define the terms;Shell, Homologus and Orthologus
6. Enlist the three methods by which you can align a pair of sequence?
7. Define gap penalty
8. Define genetic distance and State two distances based phylogenetic tree prediction methods.
9. Define an OTU.
10. Define genetic distance
11. Give a two phylogenetic tree building tools and the method used in them.

Understand

1. Explain the role of microarray in bioinformatics
2. Define Bootstrap value
3. Explain an operating system with couple of examples.
4. Mention two other type of substitution matrix than PAM and BLOSUM.
5. Expand and explain what is HTTP
6. Mention the significance of system biology.
7. Explain how will you choose the best PAM scoring matrix for detecting sequence similarity
8. Explain how irrelevant mutations affect the phylogenetic tree
9. Differentiate BLAST and Smith-waterman algorithm.
10. Define cellular computing

Apply

1. Describe SNP microarray technology and its role in disease diagnosis
2. In a parsimony method of tree predictions what does informative site refer to?
3. Define 5th order HMM why it is called so? Which programme uses it?
4. Explain how distance based trees are constructed?
5. How will you choose the best PAM scoring matrix for detecting sequence similarity?
6. Explain the different methods of connecting to internet.
7. Illustrate the steps involved in FASTA search.
8. Explain how is hashing exploited in FASTA database algorithms
9. Comment on Database Management System with its significance.
10. Illustrate the steps in data mining technology

Analyse

1. Explain how do search engines rank pages
2. Explain how databases are searched using Smith Waterman Algorithm and Bayes Block Aligner
3. Explain the entrez‘s role in linking the different database resources
4. Differentiate BLAST and Smith-waterman algorithm.
5. Discriminate global alignment and local alignment.

Evaluate

1. Justify the statement – Transport layer is the heart of the OSI model.
2. 'The cost and security of glass fiber was higher than the ether‘– validate

3. A study on blood types in a population found the following genotypic distribution among the people sampled: 1101 were MM, 1496 were MN and 503 were NN. Calculate the allele Frequencies of M and N, the expected numbers of the three genotypic classes.
4. MEGABLAST program uses greedy algorithm for nucleotide sequence alignment search-Authenticate.
5. Rationalize the statement –'Transport layer is the heart of the OSI model'.

Create

1. Describe the types of biocomputers. Indicate the possibilities of DNA computing to take over the traditional computers.
2. Comment on Database Management System with its significance.

15BT707 TISSUE CULTURE LABORATORY 0 0 2 1

Course Objectives

- Imparts hands on training in the aseptic techniques and operation of equipment
- Develops skills in plant tissue culture
- To study the different techniques involved in plant tissue culture.

Course Outcomes (COs)

1. Acquire in depth knowledge in plant tissue culture.
2. Design optimized media for various invitro regenerated plants
3. Identify the methods suitable for invitro regenerated plants.

4 Hours

EXPERIMENT 1
Organizing Plant tissue culture laboratory

4 Hours

EXPERIMENT 2
Preparation of tissue culture medium

4 Hours

EXPERIMENT 3
Preparation of explants

4 Hours

EXPERIMENT 4
Shoot induction from explant

4 Hours

EXPERIMENT 5
Callus induction from explant

10 Hours

EXPERIMENT 6
Design oriented experiment Synthetic seed preparation

Total: 30 Hours

Reference(s)

1. M. K. Razdon, Introduction to Plant Tissue Culture, Oxford & IBH Publishing Company, 2006
2. U. Satyanarayana, Biotechnology, Book & Allied Pvt. Ltd., 2007.

15BT708 DOWNSTREAM PROCESSING LABORATORY 0 0 2 1

Course Objectives

- To impart skills in various cell disruption methods
- To understand the concept of resistance factor in involved in filtration processes
- To learn the techniques involved in different types of chromatography

Course Outcomes (COs)

1. Acquire in depth knowledge in product recovery and its instrumentation
2. Design downstream processing with various unit operations for product recovery
3. Identify right method of unit operations for processing based on the nature of product

4 Hours

EXPERIMENT 1
Cell disruption techniques - Physical, Chemical and Mechanical

4 Hours

EXPERIMENT 2
Microfiltration using tangential flow separation

4 Hours

EXPERIMENT 3
Precipitation of proteins

4 Hours

EXPERIMENT 4
Aqueous two phase extraction of biological molecules

4 Hours

EXPERIMENT 5
High resolution purification

4 Hours

EXPERIMENT 6
Design experiment on downstream processing

6 Hours

EXPERIMENT 7
Application oriented experiment in downstream processing

Total: 30 Hours

15BT709 MINI PROJECT V **0 0 2 1**

Course Objectives

1. To develop knowledge to formulate a real world problem and project's goals.
2. To identify the various tasks of the project to determine standard procedures.
3. To identify and learn new tools, algorithms and techniques.
4. To understand the various procedures for validation of the product and analysis the cost effectiveness.
5. To understand the guideline to Prepare report for oral demonstrations.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations

Total: 30 Hours

15GE710 LIFE SKILLS : COMPETITIVE EXAMS **0 0 2 -**

Course Objectives

- Understand the subject from the perspective of appearing the competitive exams.
- Familiar with the principle shortcut methods and key features to score more marks.

Course Outcomes (COs)

1. Explore the concepts of general biotechnology including science topics.
2. Elucidate the concepts of analytical procedures including problems and calculations.
3. Explain the concepts of upstream and downstream techniques.

10 Hours

UNIT 1

Biosciences

Biochemistry: Biomolecules-structure and functions; Biological membranes, structure, action potential and transport processes; Enzymes- classification, kinetics and mechanism of action; Basic concepts and designs of metabolism (carbohydrates, lipids, amino acids and nucleic acids) photosynthesis, respiration and electron transport chain; Bioenergetics Microbiology: Viruses- structure and classification; Microbial classification and diversity(bacterial, algal and fungal); Methods in microbiology; Microbial growth and nutrition; Aerobic and anaerobic respiration; Nitrogen fixation; Microbial diseases and host-pathogen interaction Cell Biology: Prokaryotic and eukaryotic cell structure; Cell cycle and cell growth control; Cell-Cell communication, Cell signaling and signal transduction Molecular Biology and Genetics: Molecular structure of genes and chromosomes; Mutations and mutagenesis; Nucleic acid replication, transcription, translation and their regulatory mechanisms in prokaryotes and eukaryotes; Mendelian inheritance; Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extra chromosomal inheritance; Microbial genetics (plasmids, transformation, transduction, conjugation); Horizontal gene transfer and Transposable elements; RNA interference; DNA damage and repair; Chromosomal variation; Molecular basis of genetic diseases

10 Hours

UNIT 2

Analytical Techniques: Principles of microscopy-light, electron, fluorescent and confocal; Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, CD, IR, FTIR, Raman, MS,NMR; Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, affinity, GC,HPLC, FPLC; Electrophoresis; Microarray Immunology: History of Immunology; Innate, humoral and cell mediated immunity; Antigen; Antibody structure and function; Molecular basis of antibody diversity; Synthesis of antibody and secretion; Antigen-antibody reaction; Complement; Primary and secondary lymphoid organ; B and T cells and macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Polyclonal and monoclonal antibody; Regulation of immune response; Immune tolerance; Hypersensitivity; Autoimmunity; Graft versus host reaction.

Bioinformatics: Major bioinformatic resources and search tools; Sequence and structure databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny);Data mining and analytical tools for genomic and proteomic studies; Molecular dynamics and simulations (basic concepts including force fields, protein-protein, protein-nucleic acid, protein-ligand interaction)

Recombinant DNA Technology: Restriction and modification enzymes; Vectors; plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; mammalian and plant expression vectors; cDNA and genomic DNA library; Gene isolation, cloning and expression ; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD, RFLP; Site-directed mutagenesis; Gene transfer technologies; Gene therapy

Plant and Animal Biotechnology: Totipotency; Regeneration of plants; Plant growth regulators and elicitors; Tissue culture and Cell suspension culture system: methodology, kinetics of growth and, nutrient optimization; Production of secondary metabolites by plant suspension cultures; Hairy root culture; transgenic plants; Plant products of industrial importance Animal cell culture; media composition and growth conditions; Animal cell and tissue preservation; Anchorage and non-anchorage dependent cell culture; Kinetics of cell growth; Micro & macro-carrier culture; Hybridoma technology; Stem cell technology; Animal cloning; Transgenic animals

10 Hours

UNIT 3

Bioprocess Engineering and Process Biotechnology: Chemical engineering principles applied to biological system, Principle of reactor design, ideal and non-ideal multiphase bioreactors, mass and heat transfer; Rheology of fermentation fluids, Aeration and agitation; Media formulation and optimization; Kinetics of microbial growth, substrate utilization and product formation; Sterilization of air and media; Batch, fed-batch and continuous processes; Various types of microbial and enzyme reactors; Instrumentation control and optimization; Unit operations in solid-liquid separation and liquid-liquid extraction; Process scale-up, economics and feasibility analysis Engineering principle of bioprocessing- Upstream production and downstream; Bioprocess design and development from lab to industrial scale; Microbial, animal and plant cell culture platforms; Production of biomass and primary/secondary metabolites; Biofuels, Bioplastics, industrial enzymes, antibiotics; Large scale production and purification of recombinant proteins; Industrial application of chromatographic and membrane based bioseparation methods; Immobilization of biocatalysts (enzymes and cells) for bioconversion processes; Bioremediation-Aerobic and anaerobic processes for stabilization of solid / liquid wastes

Total: 30 Hours

Reference(s)

1. Biotechnology Gate material by Prabhanshu kumar, 2016 (latest)

- - - 9

15BT804 PROJECT WORK

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

15LE101 BASIC ENGLISH I

3 0 0 3

Course Objectives

- To offer students the basics of the English Language in a graded manner.
- To promote efficiency in English Language by offering extensive opportunities for the development of all the four language skills (LSRW) within the classroom.
- To focus on improving and increasing vocabulary.
- To improve spelling and pronunciation by offering students rigorous practice and exercises.

Course Outcome (COs):

1. Converse in English with more confidence.

UNIT I **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
1	Basic words- 12 most used words in English, usage and pronunciation	Starting a conversation and talking about what one does	Sentence construction bolstered by mother tongue
2	Basic words- 20 often used words, usage and pronunciation	Analysing an action plan	Creating and presenting one’s own action plan
3	Basic words with a focus on spelling	Discriminative listening	Informal conversation
4	Basic words- 10 oft used words, usage and pronunciation	Content listening and Intonation	Reading comprehension
5	Unit Test I		

UNIT II **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
6	Basic words + greetings to be used at different times of the day	Formal conversation	Intonation to be used in formal address
7	Last 28 of the 100 most used words	Informal conversation between equals	Reading practice and peer learning
8	Using the 14 target words to form bigger words	Informal dialogues using contracted forms	Guided speaking- talking to peers using contracted forms
9	Palindromes, greetings- good luck, festivals	Placing a word within its context- culling out meaning	Offering congratulations
10	Unit Test II		

UNIT III **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
11	Homophones	Formal and informal methods of self-introduction	Let’s Talk is a group activity that gives them some important pointers of speech
12	Homophone partners, matching words with their meanings	Contracted forms of the – be verbs, ‘ve and ‘s	Translating English sentences to Tamil
13	Briefcase words- finding smaller words from a big word	Formal and informal ways of introducing others	Team work- speaking activity involving group work, soft skills
14	Compound words and pronunciation pointers	Giving personal details about oneself	Using the lexicon
15	Unit Test III		

UNIT IV **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
16	Proper and common nouns	Asking for personal information and details	Pronunciation pointers- an informal introduction to the IPA
17	Pronouns	Telephone skills and etiquette	Reading aloud and comprehension
18	Abstract and common nouns	Dealing with a wrong number	Reading practice and comprehension
19	Group names of animals, adjectives	Taking and leaving messages on the telephone	Pronunciation pointers
20	Unit Test IV		

UNIT V **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
21	Determiners	Interrupting a conversation politely- formal and informal	Pair work reading comprehension
22	Conjugation of the verb ‘to be’-	Thanking and responding	Comprehension

	positive and negative forms	to thanks	questions that test scanning, skimming and deep reading
23	Am/is/are questions	Giving instructions and seeking clarifications	Small group activity that develops dialogue writing
24	Present continuous tense-form and usage	Making inquiries on the telephone	Finishing sentences with appropriate verbs
25	Unit Test V		

UNIT VI **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
26	Words with silent 'b' Present continuous questions	Calling for help in an emergency	Dialogue writing
27	Words with silent 'c' Simple present tense- form and usage	Making requests and responding to them politely	Identifying elements of grammar in text extract
28	Simple present tense- rules	Describing people	Guided writing
29	Words with silent 'g' Questions in the simple present tense	Describing places	Filling in the blanks with correct markers of tense
30	Unit Test VI		

Total: 45 Hours

Reference(s)

1. Basic English Module, L&L Education Resources, Chennai, 2011.

3 0 0 3

15LE102 COMMUNICATIVE ENGLISH I

Course Objectives

- To acquire effective listening and reading skills
- To develop speaking and writing skills
- To improve their understanding of grammar, vocabulary and pronunciation

Course Outcomes (COs)

1. Develop their fluency and language competency in English

UNIT I **9 Hours**

GRAMMAR

Content words- Structural words - Subject - Verbs and verb phrase - Subject - Verb agreement - Tenses - Active voice and passive voice - Sentence types (declarative, imperative, exclamatory & interrogative) - Framing questions - Comparative adjective

UNIT II **9 Hours**

LISTENING

Listening for specific information: Short conversations / monologues - Gap filling - Telephone conversations - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Word stress - Telephone etiquette

UNIT III **9 Hours**

READING

Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure

UNIT IV **9 Hours**

WRITING

Short documents: E-mail - memo - note - message- notice -advertisement -Short reports / proposals - Principles of writing a good paragraph: Unity, cohesion and coherence -Identifying the topic sentence and controlling ideas - Paragraph writing (descriptive, narrative, expository & persuasive)

UNIT V **9 Hours**

SPEAKING

Self-introduction -Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Agreement / disagreement - Likes and dislikes - Speculation - Tongue twisters

FOR FURTHER READING

Self-Study: Novel Reading -Book Review

Total: 45 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use - A Self-Study Reference and Practice Book for Intermediate Learners of English .IVed. United Kingdom: Cambridge University Press. 2012.
2. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.
3. 3. Anderson, Kenneth etal. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press. 2004.

15LE201 BASIC ENGLISH II

3 0 0 3

Course Objectives

- To give room for a natural acquisition of Basic English Grammar through ample listening, reading and writing inputs
- To specifically focus on speaking and conversation skills with an aim to increase speaking ability
- To improve Spelling and Pronunciation by offering rigorous practice and exercises

Course Outcome (COs):

The students will be able to

1. Communicate better with improved fluency, vocabulary and pronunciation.

UNIT I **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
31	Difference between Present Continuous and Simple Present tense.	Calling for help in an emergency	Reporting an event- journalistic style
32	Verbs 'have' and 'have got'	Describing animals	Asking for and giving directions
33	Simple Past Tense	Inviting people, accepting and declining invitations	Self- enquiry and offering one's opinion on a given topic.
34	Spelling rules & table of Irregular Verbs	Refusing an invitation	Reading and practicing pre-written dialogues
35	Unit Test I		

UNIT II **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
36	Questions and the negative form of the simple past tense	Apologizing and responding to an apology	(Reading) conversation practice
37	Asking questions in the simple past tense	Reading comprehension	Seeking, granting and refusing permission
38	Past continuous tense	Paying compliments and responding to them	Pair work: writing dialogues and presenting them

39	Difference between simple past and past continuous- when and where to use each	Describing daily routines	Reading and comprehension skills
40	Unit Test II		

UNIT III **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
41	Simple future tense	Talking about the weather	Making plans- applying grammar theory to written work
42	Simple future tense- more aspects, possessive pronouns	Talking about possessions	Opening up and expressing one's emotions
43	Future continuous tense	Talking about current activities	Listening comprehension
44	Revision of future tense- simple and continuous forms, prepositions used with time and date	Asking for the time and date	Discussion- analyzing and debating a given topic
45	Unit Test III		

UNIT IV **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
46	Articles a/an	Writing, speaking and presentation skills	Transcribing dictation
47	Singular- Plural (usage of a/an)	Reading practice- independent and shared reading	Comprehension –logical analysis, process analysis and subjective expression
48	Countable and uncountable nouns- a/an and some	Listening comprehension	Vocabulary: using context tools to decipher meaning
49	Articles- the	Sequencing sentences in a paragraph	Listening to a poem being recited, answer questions on it and practice reciting the same
50	Unit Test IV		

UNIT V **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
51	Articles- the: usage and avoidance	Speaking: sharing stories about family, village/town, childhood, etc. 10 students	Listening: comprehend and follow multiple step instructions read out by the teacher
52	Articles- the: usage and avoidance with like and hate	Speaking: sharing stories about family, village/town, childhood, etc. 10 students	Reading: make inferences from the story about the plot, setting and characters
53	Articles- the: usage and avoidance with names of places	Speaking: sharing stories about family, village/town, childhood, etc. 10 students	Comprehension passage
54	This/ that/ these and those	Writing a notice- announcement	Speaking: Debate
55	Unit Test V		

UNIT VI **7.5 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
56	One and ones	Collaborative learning- problem solving	Writing short answers to questions based on reading
57	Capitalization and punctuation	Controlled writing	Listen to a story and respond to its main elements
58	Syntax and sentence construction- rearrange jumbled sentences	Guided writing	Listen to a poem and discuss its elements
59	Cloze	Free writing	Frame simple yet purposeful questions about a given passage
60	Unit Test VI		

Total: 45 Hours

Reference(s)

1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE202 COMMUNICATIVE ENGLISH II 3 0 0 3

Course Objectives

- To acquire skills for using English in workplace effectively
- To communicate for essential business needs
- To prepare students for taking BEC Vantage level examination which is an International Benchmark for English language proficiency of Cambridge English Language Assessment (CELA)
- To enhance the communicative ability from Intermediate to Upper Intermediate level

Course Outcomes (COs)

1. Get International recognition for work and study.
2. Use English confidently in the International business environments.
3. Take part in business discussion, read company literature, write formal and informal business correspondences and listen and understand business conversations.

UNIT I **9 Hours**

GRAMMAR AND VOCABULARY

Simple, compound and complex sentences - Direct and indirect speech - Conditionals - Business vocabulary - Collocations -Discourse markers

UNIT II **9 Hours**

LISTENING

Listening to identify topic, content, function - Sentence stress - Rhythm - Intonation

UNIT III **9 Hours**

READING

Reading graphs and charts - Skimming and scanning texts - Job advertisements - Read business articles for specific information - Understanding the structure of a text - Error identification

UNIT IV **9 Hours**

WRITING

Formal and Informal English - Longer Documents: writing individual paragraphs to longer text, Business Correspondence, Reports and Proposals - Transcoding

UNIT V **9 Hours**

SPEAKING

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging information - Language Functions: suggesting - comparing and contrasting - expressing - Finding out facts, attitudes and opinions - Commonly mispronounced words

FOR FURTHER READING

Reading Novels (The Monk Who Sold His Ferrari by Robin Sharma; Three Mistakes of my Life by Chetan Bhagat; The Fountainhead by Ayn Rand)

Total: 45 Hours

Reference(s)

1. Jeremy Comfort, Pamela Rogerson, Trish Stott, and Derek Utley, Speaking Effectively Developing Speaking Skills for Business English, Cambridge: Cambridge University Press, 2002.
2. Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course In Reading for Academic Purposes.United Kingdom: Cambridge University Press, 2004.

15LC203 CHINESE

3 0 0 3

Course Objectives

- To help students acquire the basics of Chinese language
- To teach them how to converse in Chinese in various occasions
- To teach the students the Chinese cultural facets and social etiquettes

Course Outcomes (COs):

An ability to communicate effectively

1. Improve fluency in Chinese
2. Clarity on the basic sounds of the Chinese Language

Unit I **9 Hours**

Nǐ hǎo - 你 好

Xuéhuì wènhòu de jīběn biǎodá yòngyǔ - 学会问候的基本表达用语 ; Xuéhuì jièshào zìjǐ de xìngmíng, guójí - 学会介绍自己的姓名，国际 ; Xuéhuì hànyǔ pīnyīn de shèngmǔ - 学会汉语拼音的圣母 ; yùnmǔ hé shēngdiào - 韵母和声调 ; Pīn dú hé shēngdiào liànxí - 拼 读 和 声调 练习

Unit II **9 Hours**

Xiànzài jǐ diǎn - 现在 几 点

Xuéhuì shíjiān, rìqí de biǎodá - 学会时间，日期的表达 ; Rèshēn - 热身 ; Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ;Huódòng - 活动 ; Kàn tú wánchéng huìhuà - 看 图 完成 会话 ; Xué cíyǔ shuō shíjiān ; Tìhuàn liànxí - 替换练习Dú yī dú ránhòu lián xiàn - 读一读然后连线 ; Bǎ xiàmiàn de cí àn zhèngquè de shùnxù páiliè chéngjù - 把下面的词 按 正确的 顺序排列成句

Unit III **9 Hours**

Nà jiàn máoyī zěnme mài? - 那件毛衣 怎么卖 ?

Xúnwèn jiàqián jí qián de biǎodá - 询问价钱及钱的表达 ; Tǎojiàhuánjià - 讨价还 价 ; Tíchū duì suǒ mǎi dōngxī dàxiǎo, yánsè děng děng jùtǐ yāoqiú - 提出 对所买 东西大小， 颜色 等等具体要求 ; Shēngcí Huódòng - 活动 ; Kàn tú wánchéng huìhuà - 看 图 完成 会话 ; Xué cíyǔ shuō shíjiān ;Dú yī dú ránhòu lián xiàn - 读一读然后连线 ;Tīng lùyīn xuǎnzé zhèngquè dá'àn - 听 录音选择正确答 案 ; Bǔchōng cíyǔ biǎo - 补充词语表

Unit IV **9 Hours**

Xuéhuì xúnwèn jiātíng qíngkuàng, zhíyè hé niánlíng - 学会询问家庭情况， 职业和年龄

Xuéhuì diǎn cài tí yāoqiú jiézhàng - 学会点菜 提要求结账 ; Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ;Huódòng - 活动 ; Kàn tú wánchéng huìhuà - 看 图 完成 会话 ; Xué cíyǔ shuō shíjiān ;Dú yī dú ránhòu lián xiàn - 读一读然后连线 ;Tīng lùyīn xuǎnzé zhèngquè dá'àn - 听 录音选择正确答 案 ; Bǔchōng cíyǔ biǎo - 补充词语表Juésè bànyǎn - 角色 扮演 ; Tīng lùyīn pànduàn duì cuò - 听录音判断对错

Unit V **9 Hours**

Nǐ zài nǎ'er gōngzuò - 你 在 哪儿 工作

Xuéhuì xúnwèn jiātíng qíngkuàng, zhíyè hé niánlíng - 学会询问家庭情况， 职业和年龄 Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ; Huódòng - 活动 ; Kàn tú wánchéng huìhuà - 看 图 完成 会话 ;Tīng lùyīn xuǎnzé zhèngquè dá'àn - 听 录音选择正确答 案 ; Bǔchōng cíyǔ biǎo - 补充词语表 - Tīng lùyīn xuǎnzé zhèngquè dá'àn - 听 录音选择正确答 案 ; Bǔchōng cíyǔ biǎo - 补充词语表

Total: 45 Hours

Reference(s)

1. Tiyan Hanyu Shenghuo Pian *"Experiencing Chinese*" Ying Yu Ban Di 1 Ban. Beijing: Higher Education Press: Gao deng jiao hu chu ban she. 2011
2. Mandarine Day - *Hancel Don :* Chinese learning Software
3. My Chinese Classroom - *David J. White*

Websites:

www.chinesexp.com.cn
www.yiwen.com.cn

15LF203 FRENCH 3 0 0 3

Course Objectives

- To help students acquire the basics of French language
- To teach them how to converse in French in various occasions

Course Outcomes (COs)

1. Become familiar with the basics of French language and start conversing in French.

6 Hours

UNIT I

Alphabet Français (alphabets) - Les Accents Français (the accents in French) - aigu - grave - circonflexe - tréma cédille - écrire son nom dans le français (spellingone-sname in French) - Les noms de jours de la semaine (Days of the week)

6 Hours

UNIT II

Les noms de mois de l'année (Months) - Numéro 1 à 100 (Numbers 1 to 100) GRAMMAIRE :Conjugaison

10 Hours

UNIT III

Moyens de transport (Transport) - Noms de Professions (Professions) - Noms d'endroits communs (Places) - Nationalités (Nationalities)ECOUTER : (Listening) Écouter l- alphabet associéà des prénoms français - Écouter et répondre PARLER (Speaking)Présntation - même /Présentez- Vous (Introducingoneself)LIRE :Lireles phrases simples

12 Hours

UNIT IV

Pronoms (Pronouns) - Noms communs masculins et de femme (Common masculine and Femininenouns) - Verbes communs (Common verbs)COUTER :couter et crier les prnoms - Observer les dessins et couter les dialogues LIRE : Lire les profils d'utilisateurs d'interlingua (alter ego)PARLER :Parler de sa ville - Parler de sa profession

11 Hours

UNIT V

Narration de son nom et l'endroit où on vit - Son âge et date de naissance - Numéro de téléphone et'dresse - Narration du temps - La France en Europe PARLER :Conversation entre deux amis - Jouer la scène ÉCOUTER :Ecouter les conversations (CD alter ego)ÉCRIRE :Écrireune carte postale

Total: 45 Hours

Reference(s)

1. Alter ego+ Niveau a1 ,Catherine Hugot,, HACHETTE LIVRE 2012
2. 2. Cahier alter ego+
3. Grammaire Progressive du Français, CLE international, 2010
4. Collins Easy Learning French Verbs& Practice, Harpercollins, 2012
5. Barron's Learn French, 3rd edition
6. FrançaisLinguaphone, Linguaphone Institute Ltd., London, 2000. FrançaisI.Harrisonburg: The Rosetta Stone: Fairfield Language Technologies, 2001.

15LG203 GERMAN 3 0 0 3

Course Objectives

- To help students acquire the basics of German language
- To teach them how to converse in German in various occasions

Course Outcomes (COs)

1. An ability to communicate effectively with: (a) Clarity on the basic sounds of the German language (b) Improved fluency in German (c) Proper vocabulary

UNIT I **9 Hours**

GRAMMAR

Introduction to German language: Alphabets, Numbers - Nouns - Pronouns Verbs and Conjugations - definite and indefinite article - Negation - Working with Dictionary - Nominative - Accusative and dative case - propositions - adjectives - modal auxiliaries - Imperative case - Possessive articles.

UNIT II **9 Hours**

LISTENING

Listening to CD supplied with the books, paying special attention to pronunciation: Includes all lessons in the book - Greetings - talking about name - country - studies - nationalities - ordering in restaurants - travel office - Interaction with correction of pronunciation.

UNIT III **9 Hours**

SPEAKING

Speaking about oneself - about family - studies - questions and answers - dialogue and group conversation on topics in textbooks - talks on chosen topics.

UNIT IV **9 Hours**

READING:

Reading lessons and exercises in the class - pronunciation exercises: Alphabet : name, country, people, profession, family, shopping, travel, numbers, friends, restaurant,studies - festivals

UNIT V **9 Hours**

WRITING

Alphabets, numbers - words and sentences - Exercises in the books - control exercises - writing on chosen topics such as one self, family,studies - country.

Total: 45 Hours

Reference(s)

1. Grundkurs DEUTSCH A Short Modern German Grammar Workbook and Glossary, VERLAG FUR DEUTSCH, Munichen, 2007.
2. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.
3. Cassel Language Guides - German: Christine Eckhard, Black & Ruth Whittle, Continuum, London / New York, 1992.

15LH203 HINDI 3 0 0 3

Course Objectives

- To help students to acquire the basics of Hindi
- To teach them how to converse in Hindi on various occasions
- To help learners acquire the ability to understand a simple technical text in Hindi

Course Outcomes (COs)

1. An ability to communicate effectively with: (a) Improved fluency in Hindi (b) Clarity on the basic sounds of the Hindi language (c) Proper vocabulary

UNIT I **9 Hours**

HINDI ALPHABET

Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu&Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS IN HINDI

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

PRONOUNS AND TENSES

Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Parts of body - Relatives - Spices- Eatables- Fruit & Vegetables - Clothes - Directions-Seasons - Professions.

UNIT V **9 Hours**

SPEAKING

Model Sentences - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. B. R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009
2. Syed, PrayojanMulak Hindi, RahamathullahVaniPrakasan, New Delhi, 2002.
3. Ramdev, VyakaranPradeep, SaraswathiPrakasan, Varanasi, 2004.

15LJ203 JAPANESE 3 0 0 3

Course Objectives

- To help students acquire the basics of Japanese language
- To teach them how to converse in Japanese in various occasions
- To teach the students the Japanese cultural facets and social etiquettes

Course Outcomes (COs)

1. An ability to communicate effectively with: (a) Improved fluency in Japanese (b) Clarity on the basic sounds of the Japanese language (c) Proper vocabulary

9 Hours

UNIT I

Introduction to Japanese - Japanese script - Pronunciation of Japanese(Hiragana) - Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 des - N1 wa N2 ja arimasen - S ka - N1mo - N1 no N2 - .san - Kanji - Technical Japanese Vocabulary (25 Numbers) - Phonetic and semantic resemblances between Tamil and Japanese

9 Hours

UNIT II

Introduction - Kore - Sore - are - Kono N1 - Sono N1 - ano N1 - so des - so ja arimasen - S1 ka - S2 ka - N1 no N1 - so des ka ' koko - soko - asoko - kochira - sochira - achira - N1 wa N2 (Place) des - dhoko-N1 no N2 - Kanji-10 - ima-.ji-fun des - Introduction of verb - V mas - V masen - V mashitha - V masen deshitha - N1(Time) ne V - N1 kara N2 des - N1 tho N2 / S ne Kanji-10 - Technical Japanese Vocabulary (25 Numbers) - Dictionary Usage.

9 Hours

UNIT III

- N1(Place) ye ikimas - ki mas - kayerimasu - Dhoko ye mo ikimasen - ikimasendheshitha - N1(vehicle) de ikimasu - kimasu - kayerimasu - N1(Personal or Animal) tho V ithsu - S yo. - N1 wo V (Transitive) - N1 wo shimus - Nani wo shimasu ka - Nan & Nani - N1(Place) de V - V masen ka - V masho - Oo. Kanji-10 , N1(tool - means) de V - Word / Sentence wa go nan des ka - N1(Person) ne agemus - N1(Person) ne moraimus - mo V shimashitha - , Kanji-10 - Japanese Typewriting using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

9 Hours

UNIT IV

Introduction to Adjectives - N1wanaadj des. N1 wa ii adj des - naadjna N1 - ii adj ii N1 - Thothemo - amari - N1 wadho des ka - N1 wadhonna N2 des ka - S1 ka S2 - dhore - N1 gaarimasu - wakarimasu - N1 ga suki masu - N1 gakiraimasu - jozu des - hetha des - dhonna N1 - Usages of yoku - dhaithai - thakusan - sukoshi - amari - zenzen - S1 kara S2 - dhoshithe, N1 gaarimasu - imasu - N1(Place) ne N2 gaarimasu - iimasu - N1 wa N2(Place) ne arimasu - iimasu - N1(Person,Place,or Thing) no N2 (Position) - N1 ya N2, Kanji-10 - Japanese Dictionary usage using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

9 Hours

UNIT V

Saying Numbers , Counter Suffixes , Usages of Quantifiers -Interrogatives - Dhonokurai - gurai - Quantifier-(Period) ne -.kai V - Quantifier dhake / N1 dhake Kanji - Past tense of Noun sentences and na Adjective sentences - Past tense of ii-adj sentences - N1 wa N2 yoriadj des - N1 tho N2 tho Dhochiragaadj des ka and its answering method - N1 [no naka] de {nani/dhoko/dhare/ithsu} ga ichiban adj des ka - answering -N1 gahoshi des - V1 mas form dhake mas - N1 (Place) ye V masu form ne ikimasu/kimasu/kayerimasu - N1 ne V/N1 wo V - Dhokoka - Nanika - gojumo - Technical Japanese Vocabulary (25 Numbers)

Total: 45 Hours

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007
2. Software 1. Nihongo Shogo-1 2. Nihongo Shogo-2 3. JWPCE Software
3. www.japaneselifestyle.com
4. www.learn-japanese.info/
5. www.kanjisite.com/
6. www.learn-hiragana-katakana.com/typing-hiragana-characters/

15PH201 PHYSICS OF MATERIALS 3 0 2 4

Course Objectives

- To understand the physical properties of conductors, semiconductors and superconductors
- To recognize the basic principles of interaction of light with matter and working of optical devices
- To classify the types of dielectric, magnetic materials and polarization mechanisms with their properties

Course Outcomes (COs)

1. Exemplify the physical properties of conductors, superconductors and semiconductors with applications
2. Identify the suitable semiconducting material for solar cell applications
3. Select the suitable materials for insulating and dielectric applications
4. Compare the optical properties of display devices
5. Analyze the properties of magnetic materials for practical applications

UNIT I **9 Hours**

CONDUCTING AND SUPERCONDUCTING MATERIALS

Electrical and thermal conductivity of metals - Wiedemann Franz law - band theory of metals - density of states. Superconductors: properties - types - High Tc superconductors- applications.

UNIT II **10 Hours**

SEMICONDUCTORS

Elemental and compound semiconductors - intrinsic semiconductors: carrier concentration - electrical conductivity- band gap. Extrinsic semiconductors: carrier concentration - variation of Fermi level. Hall effect: theory and experimental determination -applications:Solar cells

UNIT III **9 Hours**

DIELECTRIC MATERIALS

Types of polarization: electronic, ionic, orientation and space charge polarization mechanisms - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric strength and loss -dielectric breakdown mechanisms - active dielectric materials: pizo, pyro and ferroelectricity - applications.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Interaction of light with materials - optical absorption - transmission - Luminescence in solids - Fluorescence and Phosphorescence - Optical band gap - LED ,LCD.

UNIT V **8 Hours**

MAGNETIC MATERIALS

Classification and properties - domain theory - hard and soft magnetic materials - anti-ferro and ferri magnetic materials - applications: magnetic recording and memories.

FOR FURTHER READING

Photonic crystals - LIFI

2 Hours

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

4 Hours

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

4 Hours

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 Hours

EXPERIMENT 3

With the aid of travelling microscope, find the refractive index of a transparent solid and liquid material.

4 Hours

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

4 Hours

EXPERIMENT 5
Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

4 Hours

EXPERIMENT 6
Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

4 Hours

EXPERIMENT 7
Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13th revised edition, Meerut, India, 2013.
2. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
3. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
4. M.A. Wahab, N.K. Mehta, Solid state physics-structure and properties of materials, Narosa publishing house Pvt. Ltd, 6th edition, 2010.
5. Semiconductor Physics and Devices, Donald A. Neamen , Mc Graw-Hill, 2011.
6. P.K. Palanisamy, Materials Science, Scitech Publications India Pvt. Ltd, 2014.

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	4	2		1	4	2		1	2			1	1											20
2	2		2		2		4		5	3			4												22
3	1	2	1		3	4			3	4			2												20
4	2	2			2	5			2	5			2												20
5	1	3			3	2	3		3	1			2												18
																								Total	100

Assessment Questions
Remember

1. State Meissner effect
2. List six properties of superconducting materials
3. Define photovoltaic effect
4. List the six common applications of dielectric materials
5. Retrieve optical absorption in metals
6. Reproduce the principle of LCD in display devices
7. Recall the term hysteresis in ferromagnetic materials
8. List four applications of magnetic materials
9. Recognize the need of optical band gap in differentiating the materials
10. Reproduce five applications of hard magnetic materials in day to day life

Understand

1. Explain the principle, construction and working of LED
2. Classify the three types of materials based on band gap energy
3. Interpret the working mechanism and characteristics of a solar cell
4. Illustrate Hall effect experiment used to find the concentration of charge carriers in n- type semiconductors and hence explain the necessary theory
5. Summarize the various dielectric breakdown mechanisms observed in dielectric materials
6. Infer the principle involved in working of magnetic levitation
7. Classify the two types of luminescence in solids with appropriate energy level diagrams
8. Subsume the four types of polarization mechanisms involved in dielectric materials
9. Illustrate the V-I characteristics of a solar cell
10. Extrapolate the Clausius Mosotti equation for the dielectric material which is subjected to external electric field

Apply

1. Free electron density of aluminum is 18.10x1028 m-3. Calculate its Fermi energy at 0K. Planck's constant and mass of free electron are 6.62x10-34 Js and 9.1x10-31 Kg
2. Compute the relation between Remanence and Coercivity
3. Demonstrate the domain theory of ferromagnetism
4. Derive the expressions for electrical and thermal conductivity of metals and hence compute the Wiedemann Frantz law
5. Compute the carrier concentration in intrinsic and extrinsic semiconductors
6. Calculate the number of free electrons per unit volume in a metal in terms of Fermi energy
7. Assess the Magnetic levitation and SQUIDS in day to day life
8. Show the importance of dielectric breakdown mechanisms in dielectrics
9. Implement the applications of dielectric materials in real world problems
10. Compute the relation between polarization vector (P) and electric field (E)

Analyse

1. Differentiate Phosphorescence and Fluorescence
2. Can we increase the orientation polarization with increase in temperature? Justify
3. Justify the principle, construction, working, advantages and disadvantages of LCD
4. Compare hard and soft magnetic materials
5. Differentiate the ferromagnetic and anti-ferromagnetic materials with examples
6. Compare dia, para and ferromagnetic materials
7. Distinguish between polarization and polarizability
8. Differentiate elemental and compound semiconductors
9. Compare type I and type II superconductors
10. Compare LED and LCD

15PH202 APPLIED PHYSICS 3 0 2 4

Course Objectives

- To understand conducting, semiconducting, dielectric and magnetic properties of materials and exemplify their applications
- To analyze the basic concepts of thermodynamics and heat transfer with illustrations
- To gain knowledge about acoustical standards of buildings

Course Outcomes (COs)

1. Differentiate the materials based on their properties and suit them for appropriate applications
2. Select the suitable materials for insulating and dielectric applications
3. Investigate the working mechanisms and efficiency of heat engines by applying the laws of thermodynamics
4. Compare the different heat transfer mechanisms and its applications
5. Choose the proper acoustic materials for the construction of buildings

UNIT I **11 Hours**

CONDUCTORS AND SEMICONDUCTORS

Conductors: Classical free electron theory - electrical and thermal conductivity- Wiedemann - Franz law - merits and demerits of classical free electron theory - band theory - density of states. Semiconductors: Elemental and compound semiconductors - intrinsic semiconductors -Fermi level and electrical conductivity - band gap energy - extrinsic semiconductors - n-type and p-type semiconductors: variation of Fermi level with temperature (qualitative) - Hall effect - applications.

UNIT II **9 Hours**

DIELECTRIC AND MAGNETIC MATERIALS

Dielectrics: Fundamental terminologies - electronic and ionic polarizations - orientation polarization mechanism (qualitative) - space charge polarization - Langevin -Debye equation - dielectric loss - applications of dielectric and insulating materials. Magnetic Materials: Properties of dia, para and ferromagnetic materials - domain theory of ferromagnetism - hysteresis curve - hard and soft magnetic materials - applications

UNIT III **9 Hours**

THERMODYNAMICS

Zeroth law of thermodynamics - Heat - equilibrium and quasistatic process - path functions -comparison between heat and work - internal energy - first law of thermodynamics - isothermal and adiabatic process - work done - reversible and irreversible process - second law of thermodynamics - entropy - enthalpy - Carnot ideal engine and its efficiency - Carnot's theorem-actual heat engine: Diesel engine and its efficiency

UNIT IV **9 Hours**

HEAT TRANSFER

Modes of heat transfer - thermal conductivity - heat capacity and diffusivity - rectilinear flow of heat - conduction through bodies in series and parallel - determination of thermal conductivity: good conductor: Searle's method - bad conductor: Lee's disc method - applications of heat transfer: formation of ice in ponds - conductivity of earth's crust and age of earth - practical applications

UNIT V **7 Hours**

ACOUSTICS

Classification of sound based on frequency - characteristics of audible sound - reverberation time: Sabine's formula - determination of absorption coefficient - Erying's formula (qualitative). Sound insulation - sound absorbing materials - factors affecting the acoustics of building - remedies

FOR FURTHER READING

Nanomaterials and its applications

2 Hours

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

4 Hours

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

4 Hours

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 Hours

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material

4 Hours

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer

4 Hours

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

4 Hours

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

4 Hours

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons,Inc, 2010
2. BrijLal, N. Subrahmanyam and P. S. Hemne, Heat, Thermodynamics & Statistical Physics, S. Chand & Company Ltd., New Delhi, 2012
3. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13threvised edition, Meerut, India, 2013
4. P.K. Mittal, Applied Physics, I.K. International Publishing House Pvt. Ltd, 2008
5. Donald A. Neamen, Semiconductor Physics and Devices,McGraw-Hill, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	4				3				4	4			2					4						24
2	2	2				4	2			2	4			4											20
3	2	4				4	2			4	2			2											20
4	2	2				4	2			2	4			4											20
5	2	2				2	2			4					4										16
																								Total	100

Assessment Questions

Remember

1. State Ohm's law.
2. Define drift velocity.
3. List the two drawbacks of classical free electron theory.
4. State Wiedemann-Franz law.
5. Mention the practical unit used for electron's magnetic moment.
6. Recall the term hysteresis in ferromagnetic materials.
7. List the four uses of magnetic materials.
8. State Zeroth law of thermodynamics.
9. State the Kelvin's statement of second law of thermodynamics.
10. Name the threeÂ modes of heat transfer.
11. State Echelon effect.

Understand

1. Illustrate the significance of Fermi energy.
2. Why indirect gap semiconductors are preferred in fabricating transistors?
3. Classify the types of magnetic materials.
4. Outline the term retentivity and coercivity.
5. Compare dia, para and ferro magnetic materials.
6. Point out the ideal conditions required for diesel cycle.
7. Sketch the isothermal and adiabatic processes in P-V diagram.
8. Is it possible for a practical engine to have 100% efficiency? Justify.
9. Ice kept in saw dust or wrapper in a blanket will not melt. Why?
10. Classify the types of sound waves.
11. Explain the three characteristics of musical sound.

Apply

1. The average energy of a conduction electron in copper at 300 K is 4.23 eV. Calculate the Fermi energy of copper at 300 K.
2. Determine the carrier concentration of *p*-type semiconductor whose hall coefficient is 3.6610-4 m3/C.
3. Compute the efficiency of Carnot's engine operating between the temperatures 3270C and 270C.
4. Point out practical applications of heat conduction.
5. Compute the efficiency of Carnot's engine working the steam point and the ice point.
6. Assess the reason for the formation ice on pond surface.
7. The intensity of sound produced by thunder is 0.1 Wm-2.Calculate the intensity level in decibels.
8. Calculate Sabine's mathematical relation for reverberation time of the hall.
9. Compute the minimum wavelength of audible sound at zero degree centigrade.

Analyse

1. Distinguish between relaxation time and collision time.
2. Differentiate between electrical and thermal conductivity.
3. List the various applications of soft and hard magnetic materials for day to day life.
4. Analysis the six properties of hard and soft magnetic materials.
5. If the system and surrounding are in thermal equilibrium, is it necessary they are in same state? Comment the statement.
6. Differentiate isothermal and adiabatic process.
7. Entropy remains constant in an adiabatic process. Justify the statement.
8. Compare Carnot's cycle and diesel cycle.
9. Distinguish between loudness and intensity of sound.
10. Compare reverberation and echo.
11. How do you maintain optimum reverberation in a hall? Justify.

15PH203 MATERIALS SCIENCE 3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To impart fundamental knowledge in optical materials
- To understand the nature and applications of different magnetic materials

Course Outcomes (COs)

1. Distinguish electrical properties of different kinds of conducting materials
2. Identify the different types of semiconductors and its applications
3. Categorize the various polarization mechanisms in dielectrics
4. Choose the suitable material for the construction of display devices
5. Select appropriate magnetic materials for magnetic storage devices

UNIT I **8 Hours**

ELECTRICAL PROPERTIES OF METALS

Quantum free electron theory: Fermi-Dirac distribution function - Fermi energy and its variation with temperature - density of energy states - calculation of density of electrons and fermi energy at 0K - mean energy of electrons at 0K - problems.

UNIT II **10 Hours**

SEMICONDUCTING MATERIALS

Introduction - elemental and compound semiconductors - intrinsic semiconductors: expressions for number of electrons and holes - determination of carrier concentration and position of Fermi energy - electrical conductivity - band gap energy determination - carrier concentration in extrinsic semiconductors. Hall effect: theory and experimental determination - uses - problems.

UNIT III **9 Hours**

DIELECTRICS

Introduction - fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin - Debye equation - frequency and temperature effects on polarization - internal field - expression for internal field (cubic structure) - Clausius-Mosotti equation and its importance - applications of dielectric materials - problems.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Introduction - optical absorption in metals, semiconductors and insulators. Fluorescence and phosphorescence. Light emitting diode: principle, construction, working and applications. Liquid crystal display: general properties - dynamic scattering display - twisted nematic display - applications - comparison between LED and LCD. Blue ray disc - principle - working.

UNIT V **9 Hours**

MAGNETIC MATERIALS

Introduction - orbital and spin magnetic moments - Bohr magneton - basic definitions - classification of magnetic materials - domain theory of ferromagnetism - process of domain magnetization - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials.

FOR FURTHER READING

Optical data storage and Giant magnetoresistance

2 Hours

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

4 Hours

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

4 Hours

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 Hours

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

4 Hours

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

4 Hours

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

4 Hours

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

4 Hours

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons, Inc, 2010.
2. S.O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2014.
3. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
4. P.K. Palanisamy, Physics For Engineers, Scitech Publications (India) Pvt. Ltd., Chennai, 2010.
5. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, New Delhi, 2010.
6. R.K.Gaur and S.L.Gupta, Engineering Physics, Dhanpat Rai publications, New Delhi, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	5	2		1	5	2		1																18
2	2		2		2	3	2		5		2		4												22
3	1	2	1		3	3			3	5			2												20
4	2	3			3	3			2	5			2												20
5	1	3			3	2	5		3	1			2												20
																								Total	100

Assessment Questions

Remember

1. Define density of electron energy states in metals.
2. Recall Fermi energy.
3. State Hall Effect.
4. List out the four advantages of semiconductors.
5. Define dielectric constant
6. Recall electric polarization.
7. Define Fluorescence.
8. Recognize hard and soft magnetic materials.
9. State the working principle of LED.
10. Define Bohr magnetron.

Understand

1. Classify three types of free electron theory
2. Represent the variation of Fermi level with temperature
3. Explain Clausius-Mosotti relation.
4. Compare element and compound type semiconductors.
5. Illustrate the variation of Fermi level with temperature in n-type semiconductors.
6. Distinguish between a dielectric and insulator.
7. Mention the technique to increase the emission time in phosphorescence.
8. Exemplify hysteresis on the basis of domain theory of ferromagnetism.
9. Identify four examples for hard magnetic materials.
10. Identify four properties of ferromagnetic materials.

Apply

1. Compute the Fermi direc function for energy kT above the Fermi energy.
2. Asses the Fermi-Dirac distribution function.
3. Energy level of p-type and n-type semiconductors and justify the results
4. Compute the carrier concentration of intrinsic semiconductors
5. Explain the principle, construction and working of Hall Effect
6. Show that electronic and ionic polarizabilities are independent of temperature.
7. Calculate the polarization of an atom above value five.
8. Differentiate the dia, para and ferromagnetic materials.
9. Compute the B-H Hysteresis curve on the basis of domain theory.

Analyse

1. Discriminate drift velocity and thermal velocity of an electron
2. Difference between p-type and n-type semiconductors.
3. Obtain the expression for concentration of charge carriers in p-type semiconductor.
4. In practical dielectrics, the current does not exactly lead the voltage by 90?. Justify.
5. Local field is the space and time average of the electric field acting on a particular molecule Justify the result.
6. Justify the special features of magnetic blue ray disks.
7. Analyze the role of energies in the domain growth.
8. Explain the roll of activators in optical materials
9. Describe the working of twisted pneumatic display device.
10. Compare LED and LCD.

15PH204 PHYSICS OF ENGINEERING MATERIALS 3 0 2 4

Course Objectives

- To familiarize with the physical properties of materials
- To gain practical applications of modern spectroscopy and microscopy techniques
- To understand the preparation of bio and nanomaterials

Course Outcomes (COs)

1. Identify the electrical and thermal properties of conducting and semiconducting materials
2. Analyze the various polarization mechanisms in dielectrics
3. Choose specific materials for optical and magnetic data storage devices
4. Investigate the specimen with the aid of suitable spectroscopic techniques
5. Realize the methods adopted for preparing nano materials

UNIT I **10 Hours**

CONDUCTING AND SEMICONDUCTING PROPERTIES

Quantum free electron theory - Fermi-Dirac distribution function - effect of temperature on Fermi function - density of energy states - calculation of density of electrons and Fermi energy at 0 K. Intrinsic semiconductors: expressions for density of electrons and holes - intrinsic carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in n-type and p-type semiconductors - variation of Fermi level with temperature and impurity concentration - problems.

UNIT II **9 Hours**

DIELECTRIC PROPERTIES

Introduction: fundamental definitions in dielectrics - types of polarization - expressions for electronic and ionic polarization mechanisms - orientation polarization (qualitative) - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric loss - dielectric breakdown mechanisms - active dielectric materials - applications of dielectric materials - problems.

UNIT III **10 Hours**

OPTICAL AND MAGNETIC PROPERTIES

Optical properties: introduction - light interaction with solids - atomic and electronic interactions - optical properties of metals, semiconductors and insulators - reflection - refraction - absorption - transmission - luminescence and photoconductivity. Magnetic properties: introduction - origin of magnetic moment - properties of dia, para and ferro magnetic materials - domain theory and hysteresis effect - hard and soft magnetic materials - problems.

UNIT IV **8 Hours**

SPECTROSCOPY AND MICROSCOPY TECHNIQUES

Introduction: different types of spectroscopy techniques - basic principle of FTIR spectroscopy and X-ray Photoelectron Spectroscopy (XPS). Basic principle and working mechanisms of Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - Atomic Force Microscope (AFM).

UNIT V **8 Hours**

BIO AND NANO MATERIALS

Biomaterials: classification of biomaterials - development of biomaterials - applications. Nanomaterials: properties - synthesis of nanomaterials - top-down approach: ball milling technique - bottom-up approach: Chemical Vapour Deposition (CVD) - uses of nanomaterials. Carbon nanotubes: properties and applications.

FOR FURTHER READING

Health and environmental impacts

2 Hours

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

4 Hours

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

4 Hours

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 Hours

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

4 Hours

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

4 Hours

EXPERIMENT 5
Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

4 Hours

EXPERIMENT 6
Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

4 Hours

EXPERIMENT 7
Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering An Introduction, John Wiley and Sons, Inc, 2010.
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
3. Jacob Milliman, Christos Halkias, Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
4. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
5. Subbiah Pillai, Nanobiotechnology, MJP Publishers, 2010.
6. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley-VCH, 2013.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	4	2		2	5	2		2	2			1	1											22
2	2		2		2		2		5	3			4												20
3	2		2		3	3	2		3	3			2	2											22
4	1	2	1		3	3			3	3			2												18
5	2	2			3	2	3		2				2	2											18
																								Total	100

Assessment Questions

Remember

1. Recall the merits of quantum free electron theory over classical free electron theory
2. Define carrier concentration
3. Recall Fermi energy
4. List the four types of polarization mechanisms.
5. Recognize polar and non-polar molecules
6. Define Bohr magneton
7. Recall coercivity and retentivity
8. Point out the four salient features of biomaterials
9. Define bioactive materials
10. State the working principle of FTIR spectroscopy

Understand

1. Classify three types of materials based on bandgap energy
2. Explain fermi-distribution function and effect of temperature on Fermi function
3. Represent the variation of Fermi level with temperature
4. Explain intrinsic and thermal breakdown mechanisms
5. Infer the importance of Fermi level in a semiconductor
6. Illustrate the phenomenon of B-H hysteresis on the basis of domain theory
7. Classify four types of biomaterials
8. Represent the scanning electron microscope to determine the grain size of the nanomaterials
9. Explain the principle, construction and working of Scanning electron microscope
10. Explain the principle and working mechanism of X – ray photoelectron spectroscopy (XPS)

Apply

1. Find the variation of Fermi level with temperature and impurity concentration in n-type semiconductors
2. Show that electronic and ionic polarizabilities are independent of temperature
3. Show that the position of Fermi level is exactly at the midpoint of forbidden energy gap in intrinsic semiconductor
4. Compute the relationship between polarizability and electric flux density.
5. Assess the properties of dia, para and ferromagnetic materials
6. Show that top down method is inferior to bottom up method
7. Construct B-H Hysteresis curve on the basis of domain theory
8. Design the principle, construction and working of chemical vapour deposition.
9. Show that the electronic polarizability is directly propotional to the volume of an atom
10. Compute the expression for carrier concentration in intrinsic semiconductors

Analyse

1. Extrinsic semiconductors possess high electrical conductivity than intrinsic semiconductors. Justify
2. Silver is the best conductor of electricity. But gold is used in high-end electronic connectors. Justify.
3. Identify the role of impurity concentration in the variation of Fermi level in the case of p-type semiconductors.
4. Compare polar dielectrics with non-polar dielectrics.
5. Analyse the features of hard and soft magnetic materials.
6. Compare the six properties of dia, para and ferro magnetic materials
7. Differentiate top down approach from bottom up approach.
8. Select the four important features of TEM
9. Justify the electronic polarizability of Argon is much greater than that of Helium.
10. Intrinsic semiconductors are insulators at 0K. Justify.

15PH205 SOLID STATE PHYSICS

3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To understand the working mechanism of junction diodes
- To impart knowledge in optical and magnetic materials

Course Outcomes (COs)

1. Identify different types of emission of electrons and significance of Fermi function
2. Explore the carrier concentration and its variation with temperature of different semiconducting materials
3. Analyze the I-V characteristics of a junction diode
4. Investigate the various polarization mechanisms in dielectrics
5. Select appropriate optical and magnetic materials for data storage devices

UNIT I **10 Hours**

EMISSION PROPERTIES AND QUANTUM THEORY OF SOLIDS

Emission of electrons: types thermionic emission-principle- Richardson equation- secondary emission-principle- work function- Fermi-Dirac distribution function and its temperature dependence significance of Fermi energy- density of energy states- calculation of density of electrons and Fermi energy at 0K-average energy of electrons at 0K problems.

UNIT II **9 Hours**

SEMICONDUCTOR PHYSICS

Intrinsic semiconductors: the law of mass action - expressions for density of electrons and holes - determination of carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in p-type and n-type semiconductors. Hall effect: theory - experimental determination of Hall voltage - applications - problems.

UNIT III **9 Hours**

JUNCTION DIODE CHARACTERISTICS

Introduction - pn junction diode - volt-ampere characteristics - diode current equation - static and dynamic resistances - space charge - diffusion capacitance - junction diode switching times. Diode circuit with DC voltage source. Applications: full wave rectifier - capacitor filters - clamper circuits.

UNIT IV **9 Hours**

DIELECTRICS

Introduction: fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin Debye equation - frequency and temperature effects on polarization - expression for internal field (cubic structure) - Clausius-Mosotti equation - dielectric loss - applications of dielectrics - problems.

UNIT V **8 Hours**

OPTOELECTRONICS AND MAGNETIC MATERIALS

Principle, working and characteristics of LED and LCD - blue ray disc. Magnetic materials: basic definitions - properties of dia, para and ferro magnetic materials - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials. Magnetic storage device: principle - working - giant magnetoresistance.

FOR FURTHER READING
Motion of an electron in uniform and non-uniform magnetic fields - electric and magnetic fields in a crossed configuration.

2 Hours

INTRODUCTION
Exposure to Engineering Physics Laboratory and precautionary measures

4 Hours

EXPERIMENT 1
Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

4 Hours

EXPERIMENT 2
Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 Hours

EXPERIMENT 3
With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

4 Hours

EXPERIMENT 4
Determine the wavelength of polychromatic source in the visible region using spectrometer.

4 Hours

EXPERIMENT 5
Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

4 Hours

EXPERIMENT 6
Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

4 Hours

EXPERIMENT 7
Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Jacob Millman, Christos Halkias and Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
2. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and sons, Inc, 2010.
3. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
4. R. S. Sedha, A textbook of Applied Electronics, S. Chand & Company Ltd., New Delhi, 2010.
5. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010
6. M. N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	1	2	2		2	4	2		2	5			2												22
2	2	2			2		3		2	3					6										20
3	2		1		3		2		5				2	2				3							20
4	2	2	2		2	3			2	5			2												20
5	2	2			3	2	2		2				5												18
																								Total	100

Assessment Questions

Remember

1. Recall the Richardson equation.
2. Define dynamic resistance.
3. State the law of mass action.
4. Define Hall Effect.
5. List the three practical applications of p-n junction diode.
6. List the three practical applications of p-n junction diode.
7. List the four types of polarizations in dielectrics
8. Reproduce the expressions for electronic and ionic polarization.
9. State the working principle of LED.
10. Define retentivity and coercivity.

Understand

1. Explain the variation of Fermi-Dirac distribution function with temperature.
2. Indicate the importance of Fermi level.
3. Indicate the reason for preferring extrinsic semiconductors over intrinsic semiconductors.
4. Represent four applications of Hall Effect.
5. Represent the switching action of a diode.
6. Interpret the relation between polarization and polarisability in dielectrics.
7. All the dielectrics are insulators but all the insulators are not dielectrics. Illustrate with examples.
8. Interpret the relation between the dielectric constant and electric susceptibility.
9. Explain the phenomenon of electroluminescence in LED.
10. Summarize the working principle of giant magnetoresistance.

Apply

1. Find the expression for density of electrons and Fermi energy at 0 K.
2. Using the Fermi function, compute the temperature at which there is 1% probability that an electron in a solid will have energy 0.5 eV above EF of 5 eV.
3. Explain how phosphorous atoms donate electrons to the conduction band.
4. Apply the law of mass action to determine the carrier concentration of intrinsic semiconductors.
5. Construct a circuit using p-n junction diode and execute its V-I characteristics.
6. Construct a diode circuit with DC voltage source and demonstrate its working conditions.
7. Show that electronic polarizability is independent of temperature.
8. Explain frequency dependence of dielectrics with a neat sketch.
9. Apply the domain theory to the hysteresis effect observed in ferromagnetic materials.
10. Compute the wavelength of light emitted by an LED with band gap energy of 1.8 eV.

Analyse

1. The average energy of electrons at 0 K depends on Fermi level. Justify.
2. Differentiate p-type and n-type semiconductors.
3. Outline the working principle of full wave bridge rectifier.
4. At optical frequencies the total polarization is less. Justify.
5. Outline the causes for dielectric loss in dielectric materials.
6. Analyze the magnetic behavior of dia, para and ferromagnetic materials.
7. Compare the properties of LED and LCD.
8. Outline the difference between hard and soft magnetic materials.

Evaluate

1. Evaluate the resistance value using V-I characteristics of a p-n junction diode.
2. Evaluate the value of Fermi distribution function for an energy kT above the Fermi energy at that temperature and comment on the answer.

15CH201 ENGINEERING CHEMISTRY 3 0 2 4

Course Objectives

1. Recall the terminologies of electrochemistry and explain the function of batteries and fuel cells with its electrochemical reactions.
2. Understand the fundamentals of corrosion, its types and polymers with its applications.
3. Choose appropriate instrumentation technique for interpreting analytical data.

Course Outcomes (COs)

1. Construct an electrochemical cell and measure its potential.
2. Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.
3. Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.
4. Differentiate the polymers used in day to day life based on its source, properties and applications.
5. Identify the applications of analytical methods for the estimation of elements in aqueous media.

UNIT I 10 Hours

INTRODUCTION TO ELECTROCHEMISTRY

Types of electrodes - electrode potential - salt bridge - cell reaction - cell representation - silver-silver chloride electrode - calomel electrode - determination of single electrode potential - electrochemical series and its importance. Ion-selective electrode: glass electrode - measurement of pH using glass electrode. Concentration cells (electrode and electrolyte). Potentiometry - potentiometric titrations (redox titration). difference between electrochemical and electrolytic cells

UNIT II 9 Hours

ENERGY STORAGE DEVICES

Batteries - characteristics of battery - types of batteries. construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Comparison with conventional galvanic cells. Fuel cells - Types of fuel cells: solid polymer electrolyte fuel cell - solid oxide fuel cells - microbial fuel cell. Hydrogen-oxygen fuel cell - construction, working, advantages and limitations

UNIT III **8 Hours**

CORROSION SCIENCE

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion - Pilling-Bedworth ratio - types of oxide layer (stable, unstable, volatile, porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current cathodic protection method - electroplating - electroless plating

UNIT IV **10 Hours**

POLYMERS AND ITS PROCESSING

Advantages of polymers over metals. Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications - Molecular weight determination. Types of polymerization: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (polyvinyl chloride and polytetrafluoroethylene). Compounding of plastics - injection and extrusion moulding methods

UNIT V **8 Hours**

INSTRUMENTATION TECHNIQUES FOR CHEMICAL ANALYSIS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of a transition metal) - Flame photometry (estimation of an alkali metal).

FOR FURTHER READING

Nobel prize winners in chemistry over past 5 years

2 Hours

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

4 Hours

EXPERIMENT 2

Determination of amount of hydrochloric acid present in the given sample using pH meter

4 Hours

EXPERIMENT 3

Determination of strength of a commercial mineral acid by conductometric titration.

4 Hours

EXPERIMENT 4

Conductometric titration of mixture of acids

4 Hours

EXPERIMENT 5

Electro analytical determination of strength of iron in the given sample by potentiometric method using saturated calomel electrode.

4 Hours

EXPERIMENT 6

Measurement of rate of corrosion on zinc/mild steel in aerated neutral/acidic/alkaline solution by weight loss measurements / Tafel polarization method

4 Hours

EXPERIMENT 7

Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

4 Hours

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008.
5. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		3	4	2			4	4				1			2							23
2	1	1	1		4	4	3		1	2				1	2										20
3	1	1	1		2	2	1			2	2			2	1			1				1			17
4	5	3	2		3	1	1		1				1	2	2		1	1							23
5	1					3					3				7			2				1			17
																								Total	100

Assessment Questions

Remember

1. List any four significances of EMF series.
2. Define the term single electrode potential.
3. Recall four advantages of H2-O2 fuel cell.
4. Define the term functionality of a monomer.
5. State Pilling-Bedworth rule.
6. Name two monomers used for the preparation of epoxy resin.
7. Label the parts and charge carried by electrodes in electrochemical and electrolytic cells.
8. List any two significances of monomer functionality.
9. State Beer - Lamberts law.
10. Define concentration cell.

Understand

1. Classify two types of polymers based on source.
2. Compare electrochemical cell and electrolytic cell with suitable diagrams.
3. Illustrate the mechanism involved in electrochemical corrosion.
4. Explain the principle and five components of UV-visible spectrophotometer.
5. Outline the mechanism for the synthesis of –(CF2-CF2)n– polymer.
6. Identify any two analytical methods to estimate sodium present in aqueous media.
7. Illustrate the injection molding process with a necessary explanation and two advantages.
8. Indicate any two importance of salt bridge in an electrochemical cell.

9. Illustrate the route to synthesis epoxy resin from its two monomers.
10. Summarize any four advantages of polymers over metals in everyday life.

Apply

1. Calculate the single electrode potential value zinc half-cell dipped in a 0.01M $ZnSO_4$ solution at 25°C, ΔE° of Zn/Zn^{2+} = 0.763V, R=8.314 JK^{-1} Mol^{-1}, F= 96500 Coulombs.
2. Identify the two advantages of degree of polymerization.
3. Find the concentration of given solution using spectrophotometer, if %T, bath length and molar adsorption coefficient are 18, 1 cm and 6000 L/mol. cm.
4. Derive an equation for determination pH of unknown solution using glass electrode.
5. Elaborate the six applications of electrochemical series.
6. Select and explain suitable potentiometric titration to estimate the amount of ferrous ion in the given solution.
7. Discuss the construction and working of electrolyte concentration cell with suitable example.
8. Assess the significances of monomer functionality in the properties and structure of polymer.

Analyse

1. Outline any two methods for preventing chemical and electrochemical corrosion.
2. Compare the advantages and limitations of electro and electroless plating of nickel.
3. The statement "prevention is better than cure" is not suitable for corrosion science and engineering-Justify the answer in your own words.
4. Differentiate the addition and condensation polymers based on their synthesis.
5. Arrange the following polymer based on the increasing order of resistance towards chemical
   1. poly(ethylene) 2. Starch 3.Baklite 4.Teflon

Evaluate

1. Calculate the electrode potential of zinc metal if EMF of the cell is 1.10 V (Sat. Calomel electrode was used for complete cell formation.
2. Electrode potentials of A and B are E 0 A/A+ = +0.76 V and E 0 B/B+ = -0.34 V respectively. Choose the appropriate anode half-cell and cathode half-cell by giving the cell representation
3. Find out the degree of polymerization for a low density polytetrafluoroethylene with a molecular weight of 10002 amu. (Atomic weights of F=18.9; C=12)
4. The standard reduction potentials of metals Ag, Fe, Cu and Zn are +0.80v,-0.44v, +0.34v and -0.76v respectively. Arrange the metals in the increasing order of their ability to undergo corrosion.

Create

1. A ship hull in ocean is safe against corrosion under any circumstance - Argue.
2. Derive the probable reason and possible solution for the following:
   i. Stainless steel should not be used to build ship hull.
   ii. Small anodic area results in intense corrosion.
   iii. Metal under water drop undergoes accelerated corrosion.

15CH202 APPLIED CHEMISTRY 3 0 2 4

Course Objectives

1. Understand the necessity of water softening processes.
2. Recognize the fundamentals of corrosion, alloys, phase rule and fuels with its applications.
3. Characterize the chemical compounds using analytical techniques.

Course Outcomes (COs)

1. Identify the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Understand the type of corrosion and its mechanism which will help to develop the corrosion control methods.
3. Apply the applications of alloying and phase rule in the field of metallurgy.
4. Analyse the three types of fuels based on calorific value for selected applications.
5. Recognize the applications of analytical methods in characterizing the chemical compounds.

UNIT I **10 Hours**

WATER PURIFICATION

Hardness of water - classification of hardness (temporary and permanent) - units of hardness (ppm, mg/l, degree Clark, degree French) - expression of hardness in terms of calcium carbonate equivalence - estimation of hardness by EDTA Method - Uses of water for industrial purpose - requirements of boiler feed water - disadvantages of using hard water in industrial boilers: scale - sludge - priming - foaming - caustic embrittlement. Removal of dissolved salts from hard water: Internal conditioning (phosphate, carbonate, calgon and colloidal methods) - external conditioning: ion exchange process, reverse osmosis, electrodialysis. Uses of water for domestic purpose - municipal water purification (screening, aeration, coagulation, sedimentation, filtration and disinfection of water- break point chlorination).

UNIT II **8 Hours**

CORROSION SCIENCE

Corrosion - chemical and electro chemical corrosion -Pilling Bedworth rule - Mechanism (type of oxide layer, oxygen absorption - hydrogen evolution) - Galvanic series - types of electrochemical corrosion: galvanic corrosion - differential aeration corrosion (pitting, pipeline and waterline corrosion) - Factors influencing corrosion (nature of metal & environment). Corrosion control: sacrificial anode - impressed current method. Protective coatings - paints - constituents and functions.

UNIT III **9 Hours**

ALLOYS AND PHASE RULE

Alloys: purpose of alloying - function and effects of alloying elements -properties of alloys - classification of alloys. Ferrous alloys: nichrome and stainless steel. Non-ferrous alloys: brass and bronze. Heat treatment of steel (Annealing, hardening, tempering, normalising, carburizing and nitriding). Phase rule: Phase - component - degree of freedom - phase rule - phase diagram - Applications - one component system (water system). Reduced phase rule - two component system (lead and silver system).

UNIT IV **10 Hours**

FUELS

Classification - characteristics - calorific value - solid fuel - coal - types - analysis of coal (proximate and ultimate analysis) - processing of coal to coke - carbonization - types (low temperature and high temperature carbonization) - manufacture of metallurgical coke (Otto Hoffmann method). Liquid fuels - petroleum - refining of crude oil - knocking - octane number - cetane number. Liquid fuel from coal (Bergius process). Gaseous fuels - natural gas (CNG) - coal gas - producer gas - syn gas - shale gas.

UNIT V **8 Hours**

INSTRUMENTAL METHODS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - Infrared spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of transition metal) - Flame photometry (estimation of alkali metal).

FOR FURTHER READING

Synthesis and applications of bio-fuels.

2 Hours

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

4 Hours

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH.

4 Hours

EXPERIMENT 3

Conductometric titration of mixture of acids.

4 Hours

EXPERIMENT 4

Determination of strength of hydrochloric acid in a given solution using pH meter.

4 Hours

EXPERIMENT 5

Determination of the strength of Fe(II) in the given sample by potentiometric method.

4 Hours

EXPERIMENT 6

Measurement of rate of corrosion on mild steel in aerated, neutral, acidic and alkaline medium by Tafel polarization method/ weight loss method.

4 Hours

EXPERIMENT 7

Estimation of copper content in brass by EDTA method.

4 Hours

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method.

Total: 75 Hours

Reference(s)

1. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
2. M. Munjal et.al., Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
3. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		3	4	2		1	4	4				1			1				1			23
2	1	1	1		2	2	1		1	2	2			2	1			1				1			17
3	1	1	1		4	4	3		1	2					2							1			20
4	5	3	2		3	1	1		1	1			1	2	1		1	1				1			23
5	1					3					3				7			2				1			17
																								Total	100

Assessment Questions

Remember

1. Define the term hardness of water.
2. List any two internal conditioning methods to convert hard water to soft water.
3. List the two types of electrochemical corrosion.
4. Recall any two reasons for galvanic corrosion.
5. List the four major objectives of alloying steel.
6. State Gibbs phase rule.
7. Define octane number.
8. State Beer-Lambert's law.
9. Recall any four applications of colorimetry.

Understand

1. Compare temporary and permanent hardness in water.
2. Illustrate the estimation of carbonate, non-carbonate and total hardness by EDTA method.
3. Identify the needs of corrosion control methods with suitable examples.
4. Indicate the two suitable conditions for electrochemical corrosion to occur.
5. Classify the three types of alloys based on metal composition.
6. For one component water system, the triple point is an invariant point. Reason out.
7. Distinguish between syn gas and coal gas.
8. With a neat diagram, explain the processes involved in Bergius process to get synthetic petrol.
9. Differentiate chromophore and auxochrome with an example..
10. Infer the role of ammonium thiocyanate in the colorimetric estimation of iron.

Apply

1. Illustrate the necessary steps involved in municipal water treatment..
2. Suggest a suitable laboratory method to estimate carbonate, non-carbonate and total hardness of water.
3. Sketch a suitable protection method to prevent ship's hull made of iron from corrosion.
4. Assess the effects of alloying elements.
5. Apply Gibbs phase rule for one component water system with a neat diagram.
6. Find the combusted products of the following components. (i) 2H2 (ii) CH4
7. Find the application of colorimetry for the estimation of iron.
8. Calculate the number of the modes of vibrations for the following molecules. (i) C6H6 (ii) CO2

Analyse

1. How can the effect of caustic embrittlement in boiler be resolved?
2. Identify the problems created in boilers if priming and foaming takes place.
3. Increase in temperature increases corrosion rate. Justify.
4. Zinc is more corroded when coupled with copper than lead – Reason out.
5. Distinguish ferrous and non-ferrous alloys with examples.
6. Arrange the following materials based on their increasing calorific value.
   peat, lignite, bituminous, wood, anthracite and sub-bituminous.

Evaluate

1. Bolt and nut made of the same metal is preferred in practice. Give reason.
2. Support the statement "Coke is a better fuel than coal".
3. Calculate the absorbance if 10% of light is transmitted.
4. Determine the effect of pH of the conducting medium on corrosion.
5. Determine the number of phases present in the following systems.
   (i) Two miscible liquids (alcohol & water)
   (ii) Two immiscible liquids (benzene & water)

Create

1. Derive the probable reason and possible solution for the following:
   i) Stainless steel should not be used to build ship hull.
   ii) Small anodic area results in intense corrosion.
   iii) Metal under water drop undergoes accelerated corrosion.

2. AAS is a better method for environmental analysis than calorimetric analysis. Justify.

15CH203 APPLIED ELECTROCHEMISTRY 3 0 2 4

Course Objectives

- Understanding the basic concepts of electrochemistry and their application
- Expanding knowledge about corrosion and methods of control
- Gaining information regarding principle, working and application of batteries and fuel cells

Course Outcomes (COs)

1. Construct an electrochemical cell and measure its potential.
2. Measure the emf of a cell using different electrodes.
3. Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.
4. Differentiate types of corrosion and its prevention by suitable techniques.
5. Recognize the importance of fuel cells and solar battery.

UNIT I 9 Hours

FUNDAMENTALS OF ELECTROCHEMISTRY

Introduction - electrical conductance in solution - electrical double layer - electrode potential - importance of electrode potential. Electrochemical cell - standard cell: Weston cadmium cell - Concentration cell: electrode and electrolyte - applications. Applications of electrolytic cells: electrolysis of water, electrolysis of brine and electroplating of copper and gold

UNIT II **9 Hours**

REFERENCE ELECTRODES

Primary and secondary reference electrodes - metal-metal ion electrode, metal-metal insoluble salt electrodes: silver-silver chloride electrode, calomel electrode - ion-selective electrode: glass electrode - measurement of pH of a solution using glass electrode. Quinhydrone electrode: construction - advantages - limitations. Applications of EMF measurements: Potentiometric titrations: acid-base titration - oxidation-reduction titration - precipitation titration

UNIT III **10 Hours**

ENERGY STORING DEVICES

Types of batteries - alkaline, lead-acid, nickel-cadmium and lithium batteries - construction, working and commercial applications. Electrochemical sensors. Decomposition potential: variation of decomposition potential for different metals - importance of decomposition potential. Over voltage: factors affecting over voltage value. Maintenance and precautions in battery handling

UNIT IV **10 Hours**

CORROSION SCIENCE

Corrosion - causes - dry and wet corrosion - Pilling-Bedworth rule - mechanism (hydrogen evolution and oxygen absorption) - rusting of iron. Galvanic series - applications. Galvanic corrosion - differential aeration corrosion (pitting, waterline and stress) - factors influencing corrosion. Corrosion control - sacrificial anode and impressed current cathodic protection methods - Metallic coatings: chromium plating - nickel plating - galvanizing and tinning

UNIT V **7 Hours**

FUEL CELL AND SOLAR BATTERY

Introduction - types of fuel cell: low, medium and high temperature fuel cell. Hydrogen-Oxygen fuel cell - advantages. Solid polymer electrolyte fuel cell, solid oxide fuel cells, biochemical fuel cell. Solar battery - domestic, industrial and commercial applications. Environmental and safety issues

FOR FURTHER READING

Document the various batteries with its characteristics used in mobile phones and laptops Maintenance free batteries, Battery recycling

2 Hours

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions.

4 Hours

EXPERIMENT 2

Determination of strength of a commercial mineral acid by conductometric titration.

4 Hours

EXPERIMENT 3

Electroplating of copper onto a stainless steel object.

4 Hours

EXPERIMENT 4

Determination of strength of iron in a given solution by potentiometric method.

4 Hours

EXPERIMENT 5

Determination of amount of hydrochloric acid present in the given sample using pH meter.

4 Hours

EXPERIMENT 6
Conductometric titration of mixture of acids.

4 Hours

EXPERIMENT 7
Determination of corrosion inhibition on mild steel using natural inhibitors.

4 Hours

EXPERIMENT 8
Estimation of barium by precipitation titration.

Total: 75 Hours

Reference(s)

1. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010.
2. B. S. Chauhan, Engineering Chemistry, 3rd Edition, Laxmi Publication Ltd, New Delhi, 2010.
3. B. R. Puri, L. R. Sharma and Madan S Pathania, Principles of physical chemistry, 46th Edition, Vishal publishing Ltd, New Delhi, 2013.
4. B. S. Bahl, G. D. Tuli and Arun Bahl, Essentials of Physical Chemistry, 5th Edition, S. Chand & Company, New Delhi, 2012.
5. S. Vairam, Engineering Chemistry, 1st Edition, John -Willy, India private limited, New Delhi, 2014.
6. Sashi Chawla, Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	1	1			2	1		1	1	2			2	1			1	1		20
2	1	4			2	4	1			2			1	2				1	2						20
3		1	1		4	5			2	4			2	1			1	2							23
4	2	1			2	5	1			3				2			2	2				2			22
5	2	2			1	4			2	1			1	1				1							15
																								Total	100

Assessment Questions

Remember

1. List any two advantages of hydrogen oxygen fuel cells.
2. Name any two secondary batteries used in electronic appliances.
3. State pilling bedworth rule.
4. List any two applications of lithium battery.
5. Define overvoltage.
6. Recall the two limitations of quinhydrone electrode.
7. List the three major applications of galvanic series.
8. Recall the term redox reaction.
9. Define standard electrode potential.

Understand

1. Identify any two factors affecting the rate of corrosion based on the nature of metal.
2. Compare solar battery with lead acid-battery with respect to cell reactions, advantages and limitations.
3. Explain the working of hydrogen-oxygen fuel cell with necessary diagram and cell reactions. Mention its two advantages and limitations.
4. Identify the four advantages of electroless plating over electroplating.
5. Explain the difference between galvanic and differential aeration corrosion with an example each.
6. Summarize any five factors that affect overvoltage value of a cell.
7. Differentiate cell from battery.
8. Sketch and explain the construction and working of saturated calomel electrode with necessary cell reactions.
9. With a neat sketch explain the working of a silver – silver chloride electrode.
10. Elucidate the working principle of Weston cadmium cell with suitable cell reactions.
11. Distinguish galvanic and electrolytic cells based on cell reactions.

Apply

1. Assess the six advantages of solid polymer electrolyte fuel cell.
2. Many metals form oxide layer when exposed to atmospheric conditions due to corrosion. Predict the four types of metal oxide layers formed with two examples each.
3. An iron pipe line buried under soil is used to carry natural gas, suggest any two corrosion control techniques that can be employed to minimize/control corrosion.
4. Predict the type of corrosion taking place when a piece of iron rod is exposed to moisture and explain the mechanism of rust formation.
5. Illustrate the construction of 6V lead-acid battery and explain its functioning during discharging and charging process.
6. Select a suitable secondary storage battery used in mobile phones. Explain its reactions during charging and discharging process.
7. Find the electrode potential of zinc rod using saturated calomel electrode as reference electrode (E cell value is 1.10 V).
8. Apply the principle of ion selective electrode to find the pH of HCl solution using glass electrode with necessary equations.
9. Can we use KCl salt bridge to construct a cell using Ag and Pb half-cell. Give reason.
10. Identify a suitable technique to achieve copper coating on stainless steel object with a neat diagram.

Analyse

1. Can you store zinc sulphate solution in a copper container? Give reason if your answer is yes/no.
2. Predict why copper cannot displace hydrogen from mineral acid solution.
3. Compare a deep cycle battery and a starting battery based on its application.
4. Zinc corrodes at a faster rate when coupled with copper than lead. Give reason.
5. Does the water exhaust from hydrogen - oxygen fuel cell is drinkable? Give reasons if Yes/No.

Evaluate

1. Electrode potentials of A and B are E0A/A+ = +0.76 V and E0B/B+ = -0.34 V respectively. Choose the appropriate anode half-cell and cathode half-cell by giving the cell representation.
2. Glass electrode cannot be used in solutions having pH greater than 9.0. Give reason.
3. Represent diagrammatically an electrochemical cell that produces 1.1 volt as an output. Write the half-cell reactions responsible for that.

4. The standard reduction potentials of metals Ag, Fe, Cu and Zn are +0.80v,-0.44v, +0.34v and -0.76v respectively. Arrange the metals in the increasing order of their ability to undergo corrosion.
5. Identify any two advantages of microbial fuel cell over lead acid battery.

Create

1. Derive the probable reason and possible solution for the following:
   i) Stainless steel should not be used to build ship hull.
   ii) Small anodic area results in intense corrosion.
   iii) Metal under water drop undergoes accelerated corrosion.
2. As an engineer, which type of metal oxide forming metal you will choose for your design? Reason out.

15CH204 INDUSTRIAL CHEMISTRY 3 0 2 4

Course Objectives

- Impart knowledge on the principles of water characterization, treatment methods and industrial applications
- Understand the principles and applications of electrochemistry, fuels and combustion
- Recognize the fundamentals of polymers, nano chemistry and analytical techniques

Course Outcomes (COs)

1. Identify the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Utilize the concepts of electrochemistry in real time applications.
3. Realize the importance of fuel chemistry in day to day life.
4. Differentiate the polymers used in day to day life based on its source, properties and applications
5. Familiarize with the synthesis and characterization techniques of nanomaterials.

UNIT I **10 Hours**

WATER PURIFICATION TECHNOLOGY: SOFTENING AND DESALINATION

Hardness of water: Equivalents of calcium carbonate - Units of hardness - Degree of hardness and estimation (EDTA method). Use of water for industrial purposes: Boiler feed water-scale-sludge -priming and foaming -caustic embrittlement. Softening of hard water: External conditioning - ion exchange methods - Internal conditioning - trisodium, dihydrogen, trihydrogen phosphate and sodium hexameta phosphate- carbonate- colloidal methods. Desalination: Reverse osmosis - electrodialysis. Domestic water treatment - Disinfection of water - break point chlorination

UNIT II **10 Hours**

ELECTROCHEMISTRY

Introduction - EMF - Single electrode potential -Calomel electrode - Glass electrode -pH measurement using glass electrode - Electrochemical series. Cells: Electrochemical cells - Cell reactions- Reversible cells and irreversible cells. Batteries - characteristics of battery - types of batteries, construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Fuel cell: Hydrogen - Oxygen fuel cell.Electroplating of copper and electroless plating of nickel

UNIT III **8 Hours**

FUELS AND COMBUSTION

Fuel: Introduction - classification of fuels - calorific value - higher and lower calorific values - analysis of coal (proximate and ultimate) - carbonization - manufacture of synthetic petrol (Bergius process) - knocking - octane number - cetane number - natural gas - Compressed Natural Gas (CNG)- Liquefied Petroleum Gases (LPG) - producer gas - water gas. Combustion of fuels: introduction- theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - ignition temperature

UNIT IV **9 Hours**

POLYMER AND COMPOSITES

Monomers - functionality - degree of polymerizations - classification of polymers based on source and applications; porosity - tortuosity - molecular weight determination by Ostwald method - polymerization methods: addition, condensation and copolymerization - mechanism of free radical polymerization - thermosetting and thermoplastics. Polymer blends - composites, significance, blending-miscible and immiscible blends, phase morphology, fibre reinforced plastics, long and short fibre reinforced composites

UNIT V **8 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire -nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production - properties - applications. Working principle and applications - Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV-Visible spectrophotometer

FOR FURTHER READING

Application of nanomaterials in medicine, environment, energy, information and communication sectors

2 Hours

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

4 Hours

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH

4 Hours

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 Hours

EXPERIMENT 4

Determination of strength of a commercial mineral acid by conductometric titration

4 Hours

EXPERIMENT 5

Conductometric titration of mixture of acids

4 Hours

EXPERIMENT 6

Determination of the strength of iron in the given sample by potentiometric method

4 Hours

EXPERIMENT 7
Determination of molecular weight of polyvinyl alcohol by Ostwald viscometry method

4 Hours

EXPERIMENT 8
Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008
5. G. Cao, Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific, New Jersey, 2011
6. S. Sarkar, Fuels and combustion, 3rd edition, Orient Longman Ltd. New Delhi, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		2	4	3			1	3		1		3				1						21
2	2	1	2		2	5	2		1	1	3				1				1						21
3	1	2	2		1	3	3			2	2			1	1				1						19
4	1	1	1		3	4	1		1	1	3			1	2				1						20
5	1	1	1		1	2	2			2	3			2	2				2						19
																								Total	100

Assessment Questions

Remember
1. Define the term break point chlorination.
2. Name a method to prevent the scale formation in the industrial boilers.
3. Define single electrode potential of an electrode.
4. List any two advantages of H_2-O_2 fuel cell.
5. Define functionality of a monomer.
6. Name any two thermoplastic and thermosetting polymers.
7. List any two applications of SEM.
8. Recall any two application of X-Ray diffractometer.
9. List three factors which affects the standard electrode potential of cell.

Understand

1. Illustrate any three applications of electrochemical series.
2. Summarize the four applications of calorimeter.
3. Explain the components of TEM with a neat sketch.
4. Compare bottom up approach with top down approach of nanoparticle synthesis.
5. Distinguish between alkaline and non alkaline hardness.
6. Differentiate between thermoplastic and thermosetting plastics
7. Why copper cannot displace hydrogen from mineral acid solution?
8. Identify two significances of RO method in water treatment.
9. Indicate any two advantages of water gas over producer gas.
10. Compare nanocluster with nanocrystal.
11. Identify the reasons for change of properties of materials at nanoscale.

Apply

1. A water sample contains 204 mgs of CaSO4 and 73 mgs of Mg(HCO3)2 per litre. Calculate the total hardness in terms of CaCO3 equivalence.
2. 100 ml of sample water has hardness equivalent to 12.5ml of 0.08N MgSO4. Calculate hardness in ppm.
3. Find out the single electrode potential of a half cell of zinc electrode dipped in a 0.01M ZnSO4 solution at 25°C? E° Zn/Zn 2+ = 0.763 V, R=8.314 JK-1Mol-1, F= 96500 Coulombs.
4. Calculate the reduction potential of Cu2+/Cu=0.5M at 25°C. E° Cu 2+/ Cu= +0.337V.
5. Find out the weight and volume of air required for the complete combustion of 1 kg of coke.
6. A sample of coal containing 60% C, 6% H, 33% O, 0.5 % S, 0.2% N and 0.3% of ash. Find the gross and net calorific value of coal.
7. Calculate the degree of polymerization of polypropylene having molecular weight of 25200.
8. Apply the principle of ion selective electrode to determine the pH of HCl solution using glass electrode with equations.

Analyse

1. Calgon conditioning is advantageous over phosphate conditioning- reason out.
2. Soft water is not demineralized water whereas demineralized water is a soft water- Jusify.
3. Hydrogen electrode is not generally used for pH measurements – Why?
4. Zinc reacts with dil.H2SO4 to give hydrogen but silver doesn’t liberate hydrogen. Give reasons.
5. Good fuel should have low ash content- Give reasons.
6. Sugar is an example of non-electrolyte - Reason out.

Evaluate

1. Hydrogen fuel is an ideal fuel for the future among all other fuels- Justify.
2. Choose a best method for water purification and explain their components.

15CH205 WATER TECHNOLOGY AND GREEN CHEMISTRY

3 0 2 4

Course Objectives

- Imparting the knowledge on the principles of water technology and green chemistry
- Understanding the principles and applications of green technology in water treatments
- Infer the engineering applications of green chemistry in dyes, corrosion engineering and nanotechnology

Course Outcomes (COs)

1. Understand the importance of green chemistry with its emergence and development.
2. Realize the designing of safer methodologies for green technology to meet the objectives of green engineering.
3. Identify the type of corrosion and its mechanism which will help to develop the corrosion control methods.
4. Apply suitable technique to extract natural dye from its source.
5. Familiarize with the synthesis and characterization techniques of nanomaterials.

UNIT I **9 Hours**

WATER TREATMENT

Water quality parameters - Hardness of water - Disadvantages of hard water - Degree of hardness and its estimation (EDTA method) - Boiler feed water - Boiler troubles: Priming, foaming and caustic embrittlement - Softening of hard water: Internal conditioning: Sodium hexameta phosphate - Phosphate methods; External conditioning: Ion exchange method - Desalination: Reverse osmosis - Electrodialysis. Domestic water treatment - Disinfection of water - Break point chlorination.

UNIT II **8 Hours**

WASTE WATER ANALYSIS

Basic principles and concept of green chemistry - Need of green chemistry in day-to-day life - Scientific areas for practical applications of green chemistry - Industrial effluents - Waste water analysis: Concept of chemical oxygen demand (COD) and biological oxygen demand (BOD) - Removal of trace pollutants in waste water: Membrane Bioreactor (MBR) technology - Wet oxidation method.

UNIT III **10 Hours**

CHEMISTRY OF CORROSION

Corrosion: Mechanism of corrosion - chemical and electrochemical - Pilling-Bedworth rule - oxygen absorption - hydrogen evolution - galvanic series. Types of corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline, water line and wire fence corrosion) - factors influencing corrosion. Methods of corrosion control: choice of metals and alloys - proper designing - cathodic protection (Sacrificial anode method, impressed current method)-modifying the environment. Protective coatings: Concept of electroplating: electroplating (gold and copper) - electroless plating (nickel and copper).

UNIT IV **9 Hours**

NATURAL DYES

Introduction - definition - classification of natural dyes - concept of chromophores and auxochromes - Extraction process of colour component from natural dyes: Aqueous extraction, non-aqueous extraction - Purification of natural dyes: Chromatography techniques - Types - Column chromatography - thin layer chromatography - Qualitative analysis: UV-Visible spectroscopic study - Mordant: Metallic and non-metallic mordant - advantages and disadvantages of natural dyes.

UNIT V **9 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire - nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production - properties - applications. Working principle and applications: Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV- Visible spectrophotometer. Synthesis of Au and Ag nanoparticles using plant extract - Advantages.

FOR FURTHER READING

Protection of metals in concrete against corrosion, Microwave technology on green chemistry

2 Hours

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

4 Hours

EXPERIMENT 2

Water quality- river/bore well water with respect to hardness and TDS

4 Hours

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 Hours

EXPERIMENT 4

Estimation of strength of iron by potentiometric method using calomel electrode

4 Hours

EXPERIMENT 5

Extraction of a natural dye by aqueous extraction method

4 Hours

EXPERIMENT 6

Measurement of rate of corrosion of mild steel in aerated neutral/acidic/alkaline solution by weight loss measurements/Tafel polarization method

4 Hours

EXPERIMENT 7

Determination of dye concentration in a given sample by using UV-Visible spectroscopic method

4 Hours

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. V K Ahluwalia, Green Chemistry - Environmentally Benign Reactions, Ane Books Pvt. Ltd., New Delhi, 2nd Edition, 2012
3. Giusy Lofrano, Green Technologies for Wastewater Treatment - Energy Recovery and Emerging Compounds Removal, Springer Dordrecht Heidelberg, New York, London, 2012
4. Ashis Kumar Samanta and Adwaita Konar, Natural Dyes - Dyeing of Textiles with Natural Dyes, Dr.Emriye Akcakoca Kumbasar (Ed.), InTech Publisher, New Delhi, 2011
5. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010
6. David Pozo perez, Nanotechnology and Nanomaterials, InTech Publishers, NewDelhi, 2010

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2			3	3				3	3			2	1							1			20
2	2				3	4				2	2			2	1			1							17
3	1	2	1		4	3	3			1	3			1	2			2							23
4	1	2			6	6				3												2			20
5	3	2	2		3	6	2		2																20
																								Total	100

Assessment Questions

Remember

1. List out any four water quality parameters.
2. Name the salts responsible for temporary hardness of water.
3. Recall any two practical applications of green chemistry.
4. Define wet oxidation in waste water treatment.
5. State Pilling Bed-worth′s rule.
6. Recall any two examples for differential aeration corrosion.
7. Name any two natural dyes.
8. Recall the role of auxochromes in dyes.
9. Name the four methods of nanomaterial synthesis.
10. Name any two plant extracts used in silver nanoparticles synthesis.

Understand

1. Hardness of water is always expressed in terms of CaCO3 equivalent. Reason out.
2. Soft water is not demineralized water whereas demineralized water is soft water - Justify.
3. Represent the need of green chemistry in waste water treatment.
4. Indicate the importance of MBR technology in waste water treatment.
5. Express the mechanism of wet corrosion.
6. Bolt and nut made from same metal is preferred in practice. Reason out.
7. Classify the types of natural dyes based on their chemical structure.
8. Compare the properties of metallic and non-metallic mordents.
9. Infer any two important needs of green chemistry in nanotechnology sector.
10. Identify the physicochemical and engineering properties of nanomaterials.

Apply

1. A sample of water contains 180 mgs of $MgSO_4$ per litre. Calculate the hardness in terms of $CaCO_3$ equivalents. (Molecular weight of $MgSO_4$ is 120).
2. Calculate the non-carbonate hardness of a sample of water containing the dissolved salts as given below in mg/l $Mg(HCO_3)_2$ = 7.3; $Ca(HCO_3)_2$ = 40.5 and NaCl =50.
3. Select the scientific areas for the practical applications of green chemistry.
4. Predict the significance of sacrificial anode in the prevention of corrosion.
5. Outline the principle of electro-deposition to achieve copper coating on stainless steel object with a neat diagram.
6. Select a suitable technique used for the purification of natural dye.
7. Assess the role of Scanning Electron Microscope (SEM) in nano-materials characterization..

Analyse

1. Distinguish between scale and sludge.
2. Identify the four reasons for boiler troubles.
3. Differentiate between BOD and COD.
4. The rate of corrosion increases with increase in temperature. Give reason.
5. Outline the effect of pH of the conducting medium on corrosion.
6. Differentiate chromophores & auxochromes in dyes.

Evaluate

1. Substantiate the statement that nature of the environment affects corrosion..
2. Choose and explain any two best methods to synthesis nanoparticles.

Create

1. Plan and execute a method to get pure water from waste water using available low coast material in your area.
2. Relate the characteristic properties of natural with synthetic dyes.

15BT001 FOOD BIOTECHNOLOGY 3 0 0 3

Course Objectives

- To learn the constituents of foods and their functional roles
- To educate students on causes of food spoilage and to develop new processing techniques to avoid food borne infections
- To study and follow the quality safety and standards of foods

Course Outcomes (COs)

1. Describe the extensive history of food biotechnology and how it effects modern food production.
2. Describe the beneficial effects of microorganisms on foods with regards to nutritional and functional properties.
3. Compare and contrast the fermentation processes utilized in producing different products.
4. Appraise the applications and implications of genomics and genetic modification on foods.
5. Critique the ethical concerns associated with modern biotechnology processes.

UNIT I **9 Hours**

INTRODUCTION

Food Science- Definition Major Food groups and their characterization.Food as a source of energy Energy value of foods, energy requirements of the body. Functional properties of dietary carbohydrates - Plasticizing properties of fats Enrobing fats Emulsifying properties of fats Rancidity and reversion of fats - Milk, meat and egg proteins - Endogenous enzymes in foods. Malnutrition, Advanced development in food technology- Neutraceuticals, Prebiotics and Probiotics, Artificial meat, Ethics in accepting genetically modified foods. Functions and deficiency symptoms of vitamins A, D, E, K, C and B complex groups

UNIT II **9 Hours**

FOOD MICROBIOLOGY

Microbes in food - bacteria, yeasts and molds sources, factors influencing microbial activity in foods; Fermented foods- soyasauce, sauerkraut, bread, Fish sauce, Food chemicals Vinegar, Aminoacids, Lactic acid, Beta carotene; single cell protein; Food borne diseases food infections salmonellosis, Clostridium Perfringens Gastroenteritis, shigellosis, Food intoxications Botulism, Mycotoxins; Food spoilage causes and types (Vegetables, Dairy products , Alcoholic beverages).,Biological toxins

UNIT III **9 Hours**

FOOD COLOURS, FLAVOURS AND ADDITIVES

Food colours - natural and artificial; food flavours - synthetic and natural. Classification, Chemistry of Spices and Condiments and functional characteristics.Tea, coffee, cocoa, aroma compounds, essential oils, oleoresin, alkaloids, tannins. Flavanoids

UNIT IV **9 Hours**

FOOD PRESERVATION AND PACKAGING

Principles involved in the use of sterilization, pasteurization and blanching; canning, drying, ozonation, freezing, bacteriocin; Functions and types of food packaging. Osmotic inhibition

UNIT V **9 Hours**

QUALITY CONTROL METHODS AND SYSTEMS

Good Manufacturing Principles (GMP's), Sanitary Standard Operating Principles (SSOP’s), Codex Alimentarius Commission (CAC), Right to food act, Food security act. HACCP Program

FOR FURTHER READING

Separation of food colorants from microbes by TLC; Isolation and identification of storage mycoflora from food stuffs/vegetables/fruits; Extraction and characterization of gluten and dough rising capacity; Preparation of cheese; Extraction and estimation of antioxidant in vegetables/fruits/food; Extraction and detection of aflatoxins from mycoflora; Extraction and estimation of alpha amylase from vegetables/fruits; Determination of quality parameters in milk; Study the drying characteristics of food sample

Total: 45 Hours

Reference(s)

1. V. A. Vaclavik and E. W. Christian, Essentials of Food Science, Springer, 2007
2. B. Sivasankar, Food Processing and Preservation, Prentice-Hall of India Pvt. Ltd, 2004.
3. T. J. Montville and K. R. Matthews, Food Microbiology - An Introduction, ASM press, 2008.
4. 2. G. Campbell-platt, Food Science and Technology, Wiley-Blackwell, 2009. T. P. Coultate, Food - The Chemistry of Its Components, Royal Society, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2					2				2				2					1			1	1		11
2	2					2				2				1				1	1						9
3	2					2				2								2							8
4	2					2				2				1											7
5	2					2				2				1											7
																								Total	42

Assessment Questions

Remember

1. Define energy.
2. List the five enrobing fats
3. List three microorganism responsible for spoilage of vegetables
4. State the importance of carbohydrates in food.
5. Recall the three types of spoilage of food materials
6. Define antioxidant
7. Label five artificial food colours with examples.
8. Define mycoflora.
9. State the principle involved in the use of sterilization
10. Define Pasteurization
11. Expand CAC
12. Expand SSOP
13. List out any five biological toxins
14. Classify foods based on their ease of spoilage
15. Define Perigo effect
16. Expand SCP and why it is required in food
17. Draw a flow chart for the different stages of beer production

Understand

1. Classify nutrients based on their biological functions
2. Classify the sources of fat soluble vitamins
3. Indicate the flavor and color are produced by carbohydrates
4. Interpret HACCP
5. Interpret the role of fiber in our diet?
6. Explain five food flavours with examples
7. Indicate the method by which rancidity occurs in fat
8. Interpret the carbohydrates interms of retain water and inhibit crystallization
9. Interpret the characters of fats which are useful in food.
10. Indicate the role of soya flour in bread

11. Explain the three methods to preserve food
12. Explain the function and deficiency symptoms of vitamins A,D and E
13. Explain the structure and biological role of any three water soluble vitamins
14. Explain how rigor mortis is relevant in cooking meat
15. Explain the role of different enzymes in bread making
16. Explain how salmonellosis can be prevented
17. Explain how the native enzymes cause spoilage of food

Analyse

1. Compare the factors influencing microbial activity of food
2. Analyse the proteins responsible for flavor of milk.
3. Justify standard sanitary operating principle.
4. Analyse the compounds responsible for roasted aroma of coffee
5. Justify the sweet taste of sugar
6. Differentiate between synthetic and Natural food flavours
7. Differentiate between bacteria and Yeast

Evaluate

1. Explain how will you determine the concentration of cyanocobalamin?
2. Explain how will you evaluate the quality of milk?

Create

1. Differentiate the composition of cheese and butter with their calorific values
2. Generate the protocol to identify food pathogens

3 0 0 3

15BT002 VACCINE TECHNOLOGY

Course Objectives

- To study the various forms of vaccines
- To learn the techniques of vaccine production and their delivery methods
- To give an exposure on the regulatory and biosafety measures of vaccine.

Course Outcomes (COs)

1. Acquire in-depth knowledge on various forms of vaccines
2. Learn the techniques required for vaccine commercialization
3. Criticize the need for quality assurance in vaccine production.

UNIT I **9 Hours**

INTRODUCTION

Vaccines - definition, History of vaccine development, Conventional and Modern vaccines, passive and active immunization, immunization programs and role of WHO in immunization programs

UNIT II **9 Hours**

TYPES AND METHODS OF APPLICATION

Subunit, synthetic, DNA, recombinant and edible vaccines. Uses of nanoparticles in vaccine application. Reverse Vaccinology.

UNIT III **9 Hours**

TECHNIQUES IN VACCINE PRODUCTION

Purification, preservation and formulation techniques. Commercial production of DPT, TT, polio, rabies and hepatitis vaccines.

UNIT IV **9 Hours**

DELIVERY METHODS

Needle free Vaccine delivery, ISCOMS, Adjuvant delivery systems, Intranasal and inhaled vaccine delivery, liquid jet and solid dose injectors, development of gene-based vectors.

UNIT V **9 Hours**

REGULATORY AND BIOSAFETY MEASURES

Quality assurance in vaccine production. Regulatory issues - Environmental concerns with the use of recombinant vaccines - Disease security and biosecurity principles and OIE guidelines.

FOR FURTHER READING

Principles of vaccination, Peptide vaccines, Commercial production of malarial vaccine, Delivery of immunogens through microsperes, Biosafety aspects of vaccine production.

Total: 45 Hours

Reference(s)

1. P. Ramadass, Animal Biotechnology - Recent concepts and Developments, MJP Publications, 2008.
2. T. J. Kindt, R. A. Goldsby, B. A. Osborne and J. Kuby, Kuby Immunology, W.H. Freeman & company, 2007.
3. S. A. Plotkin, W. A. Orenstein and P. A. Offit, Vaccines, W B Saunders Company, 2012.
4. Cheryl Barton, Advances in Vaccine Technology and Delivery, Espicom Business Intelligence, 2009.
5. Ronald W. Ellis, New Vaccine Technologies, Landes Bioscience, 2001.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. List four types of vaccines
2. Relate the use of ISCOMS as the vehicle for delivery of immunogens.
3. Recall the stabilizers used in vaccine formulation.
4. Define immunomodulators.

5. Define vaccine boosters.
6. Define herd immunity.
7. Recal whether vaccines have aborted fetal tissue?
8. Define immunization.
9. List two risks of not vaccinating.
10. State two vaccines that preteens/teens need.

Understand

1. Explain the determinants of primary vaccine antibody response
2. Classify adjuvants
3. Illustrate the production of polio and hepatitis vaccine.
4. Mention four significance of subunit vaccines.
5. Identify the role of WHO in immunization programs.
6. Demonstrate the use of liposomes in the delivery of immunogens.
7. Explain the history of vaccine development.
8. Paraphrase the mechanism how DNA vaccines raises both humoral and cellular immunity.
9. Identify whether vaccines cause autism.
10. Explain what would happen if we stop immunizations.

Apply

1. Compute the effectiveness of modern and traditional vaccines.
2. Outline the steps involved in the formulation of DPT vaccine.
3. Categorize the synthetic vaccines based on the immunogenic receptors
4. Compute the strategies in designing vaccines for active immunization
5. Sketch the methodology for production of malarial vaccines.
6. Demonstrate how vaccines work against viruses and bacteria.
7. Demonstrate the relationship between natural immunity and vaccine acquired immunity.
8. I was invited to a chicken pox party. Interpret whether it be better for my child to get the chicken pox this way and examine why we vaccinate against a mild disease like chicken pox.
9. Interpret whether we can we get a disease from the vaccine that’s supposed to prevent it? And why do some vaccines have live pathogens but others have killed pathogens?
10. Interpret why there is a new flu vaccine every year.

Analyse

1. Distinguish between passive and active immunization.
2. Organize the adverse reactions associated with toxoid vaccines.
3. Relate the use of ISCOMS as the vehicle for delivery of immunogens.
4. Hypothesize the purification and preservation methods of DPT vaccine
5. Examine why all vaccines 100% aren’t effective.
6. Compare polio vaccine with cancer.

Evaluate

1. Judge the effectiveness ofSabin polio vaccines.
2. Critique the OIE guidelines for vaccine production
3. Judge whether babies’ immune systems can handle so many vaccines?
4. Allergy to eggs is a contraindication to getting some vaccines.Judge this statement.

Create

1. Propose the appropriate formulation method for polio, rabies and hepatitis vaccines.
2. Produce the processes for the purification of bacterial vaccines.

15BT003 AGRO INDUSTRIAL BIOTECHNOLOGY 3 0 0 3

Course Objectives

- To develop the skills of the students in the area of industry based Agricultural Biotechnology
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development.
- To give way to the bolster green technology and incline towards more ecofriendly options.

Course Outcomes (COs)

1. Produce plant using micropropogation techniques
2. Achieve Sustainable agriculture
3. Produce hybrid variety of plant using transgenic technologies.

UNIT I **9 Hours**

BASICS OF PLANT TISSUE CULTURE

Totipotency; Tissue culture media; Plant hormones and morphogenesis; Direct and indirect organogenesis; Direct and indirect embryogenesis; Cell suspension culture; Micropropagation shoot tip culture, somatic embryos, artificial seeds

UNIT II **9 Hours**

SCALE UP PROCESS IN PLANT BIOTECHNOLOGY

Large-scale cell suspension culture; Production of secondary metabolites; Protoplast culture, Plant cell wall structure and cell wall hydrolyzing enzymes; Protoplast isolation and purification; Protoplast viability test

UNIT III **9 Hours**

GENE TRANSFORMATION TECHNIQUES

Direct transformation of protoplasts using PEG; electroporation; Transformation by particle bombardment;Assembly of particle gun; Microprojectile preparation and bombardment

UNIT IV **9 Hours**

TRANSGENIC TECHNOLOGIES

Agrobacterium biology; monocot transformation, binary vector; Floral dip transformation; Promoters and polyA signals; Protein targeting signals; Plant selectable markers; Reporter genes; Positive selection

UNIT V **9 Hours**

COMMERCIAL CROPS

Genetic engineering of crops; Commercial status of transgenic plants; Herbicide resistance, Pest resistance, Bt toxin, synthetic Bt toxin; Genetic engineering for male sterility- Barnase-Barstar; Delay of fruit ripening; polygalacturanase, ACC synthase, ACC oxidase

FOR FURTHER READING

Embryogenesis, Principles of Gene transformation, Vectors for Gene Transfer, Biotechnology in Commercial Food products, Industrial Enzyme production

Total: 45 Hours

Reference(s)

1. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.2008.
2. B.B. Buchanan, W. Gruissen and R.L. Jones (eds), Biochemistry and Molecular Biology of Plants, AmericanSociety of Plant Biology, Rockville, USA. 2000
3. M. J. Chrispeels and D.F. Sadava (eds), Plants, Genes and Crop Biotechnology, 2nd Edition, Jones and BarlettPress, 2003
4. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds), Plant Biotechnology, Springer Verlag, Heidelberg. 20005. H.K. Das (ed)., Text Book of Biotechnology, Wiley India Pvt Ltd. New Delhi, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					6				4									5			2			20
3	3					2				6				5				5					4		25
4	3										6			4					6						19
5	3						4			4													5		16
																								Total	100

Assessment Questions

Remember

1. What is T – DNA? Mention its significance in gene transfer?
2. Compare the crown gall disease with hairy root disease.
3. How the natural plasmid of Agrobacterium is modified to suit a plant vector
4. Explain the different methods of gene transfer techniques
5. Explain particle bombardment gene tranfer method
6. Explain the PEG mediated gene transformation method.
7. Explain the electroporation method of gene transformation
8. Explain the silicon carbide method of gene transfer.
9. What are the basic features of vectors for plant transformation?
10. What are promoters?
11. What are terminators?
12. Define selectable markers
13. What is the use of reporter gene?
14. What do you meant by biotic stress?
15. What do you meant by abiotic stress?
16. Define transgenic
17. Define herbicide
18. What do you understand the nature and scale of insect pest to crops
19. Explain the importance of agricultural science
20. What do you mean by floriculture and viticulture?
21. Differentiate crop rotation and multiple cropping.
22. Name any two diseases that are caused by virus in cattle’s
23. Which of the following is the proper sequence of agricultural practice?
24. Define petro crops. Give two examples
25. What are polyploidy?

26. What are molecular markers?
27. Explain the role of molecular markers in crop and farm animal improvement
28. What is sustainable agriculture?
29. Name any plant growth regulators
30. Name three kinds of organisms which cause diseases in plants
31. Define management of livestock
32. Name any two diseases that are caused by virus in cattle?
33. Why is advisable to cultivate pulse crops in between two successive cereal crops?
34. What are the regulation should follow for the GM crops and products?

Understand

1. Elaborate on the process of T – DNA transfer and integration with suitable diagram and table with virulent genes and functions
2. How the vectors are useful in the plant transformation technique?
3. Explain the role of Co – integrative and Binary Vectors in plant transformations
4. How to produce viral resistance plants?
5. How to produce bacterial resistance plants?
6. How do you produce herbicide resistance plants?
7. How the transgenic used as bioreactors?
8. Elaborate the Strategies for engineering herbicide resistance
9. Explain the uses of biopesticides
10. Ellucidate the role of biofertilizers and biopesticides in sustainable agriculture
11. What do you mean by molecular breeding?
12. Distinguish between agriculture and horticulture.
13. To meet increased demand of food, what steps would you suggest?
14. Explain the basic features of Vectors for plant transformation
15. Explain the uses of herbicides in Modern Agriculture.

Apply

1. How to produce viral resistance plants?
2. How to produce bacterial resistance plants?
3. Discuss and differentiate traditional and modern agricultural practices.
4. Explain the different types of silk worms and the post cocoon technology
5. Given an account on aquaculture
6. How do you produce hybrid plants?
7. What are the techniques will you follow for the production of hybrids?
8. Greener Genetic Engineering - justify

Analyse

1. Compare the crown gall disese with that of hairy root disease
2. What are the modification will you do for the natural plasmid of *Agrobacterium* is modified to suit a plant vector?
3. Distinguish the biotic and abiotic stress
4. Illustrate the mechanism of T- DNA transfer and integration with suitable diagram
5. Explicate the environmental impact of herbicide resistance crops
6. What are the BT approaches for the production of insect resistant crops?
7. Elaborate on the strategies of water and soil management in agriculture practices
8. Enumerate the major aspects of animal husbandry
9. How the molecular mapping has been created?
10. Express the biotechnological implications of complete genome sequencing Projects
11. Discuss the current status of transgenic crops.

15BT004 STEM CELL TECHNOLOGY 3 0 0 3

Course Objectives

- To gain knowledge on the basics of stem cells and their origin
- To learn the methods of stem cell identification and various sources
- To give way to the therapeutic treatment using stem cells

Course Outcomes (COs)

1. Gain knowledge on the basics of stem cells and their origin
2. Learn the methods of stem cell identification and various sources
3. Give way to the therapeutic treatment using stem cells

UNIT I **9 Hours**

INTRODUCTION TO STEM CELL

Introduction to stem cells; Stem cell niche - embroyonic stem cells, hematepoitic stem cells, bone marrow stem cells, germline stem cells, cancer stem cells, neural stem cells, adult stem cells, muscle and cardiac stem cell; Properties potency and self renewal-Epigenetics

UNIT II **9 Hours**

DIFFERENTIATION OF STEM CELLS

Differentiation status of cells - Primordial germ cell, Skin cell, Gastrointestinal cells; Embryonic stem cell differentiation as a model to study haematopoetic cell development. Endothelial cell development

UNIT III **9 Hours**

GENERATION OF STEM CELLS

Testing and generation of embryonic stem cells; testing for adult stem cells and differentiation. Animal models of regeneration

UNIT IV **9 Hours**

MANIPULATION OF EMBRYONIC STEM CELLS

Integration of transgenes into a defined locus in human embryonic stem cells; Genetic manipulation of embryonic stem cells; Genetic manipulation through DNA delivery by electroporation, chemical-based reagents and viruses-Nucleofection

UNIT V **9 Hours**

APPLICATIONS OF STEM CELLS

Uses of Stem cells; Human stem cells; Renewal of stem cells; Stem cells and Tissue engineering; Embryonic stem cells and Gene therapy; Therapeutic Cloning

FOR FURTHER READING

Stemcell concepts and Types, Differentiation mechanism, Animal models in stemcell research, Genetic alterratio of embryonic stecells, Tissue engineering applications

Total: 45 Hours

Reference(s)

1. MD. Steward Sell, Stem cells, Human Press Inc., 2004
2. Ariff Bongso and Eng Hin Lee, Stem cells, World Scientific Publication Co. Pvt. Ltd., 2005.
3. Robert Paul Lanza, Essentials of stem cell biology, Academic Press, 2006.
4. Harvey F. Lodish, Arnold Berk and Chris A. Kaiser, Molecular cell Biology, W. H. Freeman and Co., 2008.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					4					6			4				3							20
2	3					5									8				4						20
3	3					3				4				7				3							20
4		4				5								8				3							20
5		4					4			6				3				3							20
																								Total	100

Assessment Questions

Remember

1. Stem cells are unspecialized cells that give rise to specialized cells
2. Human iPSCs express stem cell markers and are capable of generating cells characteristic of all three germ layers
3. The differentiation of iPSCs to form differentiated body cells involves various steps
4. Programmed cell death is ‘apoptosis’
5. Weiser’s chelating method and enzyme digestion method is used for IEC isolation
6. Embryonic stem cell are pluripotent in nature while adult stem cell are not
7. Myoblasts in general do not express skeletal muscle myosin
8. Focal adhesion are signalling complexes
9. ‘Satellite cells’ are found in skeletal muscle
10. PEG based hydrogels are typical examples of polymeric scaffolds

Understand

1. Induced pluripotent cells are made with forced expression of specific genes from non pluripotent cells
2. Explain the properties of NSCs
3. Explain the purification of MSCs is done by clonal isolation
4. Genetic manipulation through DNA delivery by electroporation
5. Secondary cells are normally derived from cell banks
6. Bone morphologic proteins are specific growth and differentiation factors for osteoblasts
7. Therapeutic cloning techniques in nuclear transplantation used in tissue regeneration therapy
8. Blastocyst contain inner mass which lead to the production of embryonic stem cells
9. Gene therapy for therapeutic applications of stem cell
10. Explain the techniques for production methodology of iPSCs.

Apply

1. Illustrate the need, properties, possibilities and applications of human stem cells
2. Specific applications of animal models in development of tissue engineered devices
3. Apply the use of polymeric scaffolds in NSC transplantation
4. Application of stem cell in tissue engineering

5. Reprogramming of adult cell leads to induced pluripotent cells
6. Interpret from where embryos come from to make new ESC lines.
7. Interpret the uses if induced pluripotent stem cells.
8. Demonstate two potential benefits of stem cell research.
9. Demonstrate the classification stem cells.
10. Interpret which of the types of stem cells are medically most successful.

Analyse

1. Differentiate between totipotent, pluripotent, and multipotent.
2. Examine how embryonic stem cells, somatic stem cells, and cord blood stem cells differ.
3. Compare and contrat between the merits and demerits of stem cell therapy.
4. Differentiate reproductive and therapeutic cloning.
5. Examine why the extraction of embryonic stem cells immoral.
6. Examine whether adult stem cells can be instead of using human embryonic stem cells in research.
7. Analyze the difference between embryonic stem cells and stem cell lines.
8. Compare and contrast between cell and stem cell.

Evaluate

1. Some somatic stem cells in our bodies can be the source of common cancers. Justify the statement.
2. Judge whether human embryonic stem cells can be used successfully to treat any human diseases.

Create

1. Develop the procedure for preparation of embryonic stem cell lines.
2. Design a methodology to show how stem cells are currently used to treat disease.

15BT005 ENVIRONMENTAL BIOTECHNOLOGY

3 0 0 3

Course Objectives

- To know the effects of industrial activities on global issues
- To understand the principles involved in the various analytical process
- To get exposed to the ideas of Bioremediation techniques

Course Outcomes (COs)

1. Isolate and Identify the microorganisms from contaminated sites
2. Apply Biological treatment methods in of different wastes
3. Produce of biogas from multiple wastes

UNIT I **9 Hours**

GLOBAL ISSUES

Climate system, Greenhouse gases and their sources, ozone. Effects of industrial activity- acid rain, smog, global warming and eutrophication, Radiation hazards.

UNIT II **9 Hours**

AEROBIC TREATMENT OF WATER

Nature of water pollutants, BOD, COD, TOC, ThOD, Preliminary and primary treatments. Secondary treatment Aerobic lagoons or ponds, trickling filters, activated sludge process, fluidized bed

UNIT III **9 Hours**

ANAEROBIC TREATMENT OF WATER

Anaerobic treatment- Anaerobic ponds, anaerobic reactors, UASB, Tertiary treatment suspended solids removal, oil and grease, biological nitrogen removal nitrification and denitrification, biological phosphorus removal.

UNIT IV **9 Hours**

BIODEGRADATION

Biodegradation of macromolecules; genobiotics; Bioremediation of metal contaminated soils, spilled oil and grease deposits, synthetic pesticides. Phytotechnology-terrestrial phytosystems, metal phytoremediation, Phytotechnology-aquatic photosystems, algal treatment system

UNIT V **9 Hours**

SOLID WASTE MANAGEMENT

Sources, generation, classification and composition of solid wastes. Solid waste management methods - Sanitary land filling, Recycling, composting, Incineration, energy recovery from organic waste. Waste minimization technologies, Hazardous Waste Management, Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment. Hospital Waste Management, Disaster Management.

FOR FURTHER READING

Climate change, Neuclear waste disposal issues, Pollutants of water and their effects, Heavy metal Pollution, Plants for bioremediation, orgaic fertilizers, vermicompos

Total: 45 Hours

Reference(s)

1. Alan Scragg, Environmental Biotechnology, Oxford University Press Inc., 2007.
2. Bimal C. Bhattacharyya and B. Rintu, Environmental Biotechnology, Oxford University Press Inc., 2007.
3. P. R. Yadav, and Rajiv Tyagi, (2006). .Environmental Biotechnology, Discovery Publishing house
4. Indu Shekhar Thakur, (2006) Environmental Biotechnology- Basic concepts and application, I.K International, Pvt. Ltd., 2006

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	6					4					6			4											20
2	5					5									8				2						20
3	6					3				4				5											18
4	5					5									4			2				2			18
5	3						4			6					6				3			2			24
																								Total	100

Assessment Questions

Remember

1. Explain what are all green house gases
2. Mention the ways by which smog is formed.
3. Name the methods employed for bioremediation of metals and salts.
4. Define anaerobic composting with suitable examples
5. Explain the test methods available to find water quality

6. Mention the secondary methods available to treat waste water.
7. List out the importance of activation sludge process.
8. List causes for eutrophication.
9. What is nitrification and denitrification and mention the organism used?
10. What is thermal conversion process and mention the method employeed?

Understand

1. Explain how greenhouses gases are produced.
2. Is it possible to convert nascent oxygen in to a stable molecule? If so, how?
3. Distinguish the properties of oxygen and ozone.
4. Differentiate BOD and COD.
5. When will you employ phtoremediation for waste treatment?
6. Distinguish bioremediation and phytoremediation.
7. What is the mechanism behind nitrification and denitrification?
8. Explain the principel behind activated sludge process?
9. What is aerobic and anaerobic condition? In what condition we adopt anaerobic condition for the waste water tretment?
10. Mention the advantages of UASB. How it differ from anaerobic ponds?

Apply

1. State the hazards of radioactive materials
2. Draw the diagram of an activated sludge process and highlight its structure and applications
3. Write the chemical process involved in removal of nitrogen and phosphorus
4. Give any two thermal combustion process and its uses and advantages
5. Mention the application of membrane bioreactor in industries.
6. Sketch the plan to treat waste water from food industry.
7. Explain which type of pollution we go for phytoremediation. Analyse the condition and parameter to be maintain.
8. Define biodegradation. What is the application?
9. What is the use of solid removal? How it helps to carry out the process?
10. Application of anaerobic reactor in wast water treatment.
11. Discuss the thermal conversion processn and its application in industries.

Analyse

1. What are the Methods for bioremediation of metals?
2. Explain how you find out degradation effeciency of a microorganisms?
3. Identify the microbes present multiple contaminated sites.
4. Elucidate a protocol to minimize the global warming.
5. Evaluvate in what way biological nutrient removal linked with EUTROPHICATION.
6. Analyse various techniques used for biodegradation.
7. Evaluvate insitu and exsitu bioremediation process.
8. Analyse different type of secondary treatment and its advantage.
9. Analyse thermal conversion process and its uses in various industries.

Create

1. Construct the reactors in which both nitrification and denitrification process to take place simultaneously.
2. What are the major criteria should be checked before going for bioremediation process?

15BT006 BIOMASS AND BIOENERGY 3 0 0 3

Course Objectives

- To introduce the basic concepts, principles, potentials and limitations of various energy sources
- To know and understand contemporary issues pertaining to the energy and environment

Course Outcomes (COs)

1. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment
2. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation
3. Implement the environmental aspects of bioenergy and techno-economic analysis of bioenergy systems
4. Understand the concepts of second and third generation of bioenergy and the conversion processes of biomass feedstock to bioenergy
5. Analysis of various bioenergy systems and their performance in improving energy supply

UNIT I **9 Hours**

OVERVIEW OF ENERGY USE

Fossil fuels - past, present & future, Remedies & alternatives for fossil fuels, Today's energy use, Fossil fuels and environmental impact, Renewable energy source and devices.

UNIT II **9 Hours**

BIOMASS AND BIO-ENERGY

Biomass potential - terrestial, aquatic and marine - collection - storage and utilization, Dedicated bioenergy crops, Woody biomass, Liquid biofuels, Synthetic fuels from the biomass, biomass to biofuel conversion.

UNIT III **9 Hours**

PROPERTIES OF FUELS

Fuel properties - alcohol, biogas, producer gas, vegetable oil. Combustion - air requirement - Octane and Cetane numbers. Analysis of products of combustion. Fuel blending - fuel efficiency in dual fuel operation

UNIT IV **9 Hours**

AGRICULTURE AS BIOMASS:

Bioenergy from wastes, agricultural wastes and byproducts - sources and availability, utilisation pattern - as uel, Biochemical conversion of organic wastes, anaerobic digesters, methane production - sludge treatment - suitability of wastes as fuel.

UNIT V **9 Hours**

DOWNSTREAM PROCESSING

Introduction to downstream processing principles, characteristics of biomolecules and bioprocesses. Cell disruption for product release mechanical, enzymatic and chemical methods, fileration, centrifugation, chromatography, esterification, pyrolysis

FOR FURTHER READING

Solar Energy, wind energy and hydro energy; Alcohol production - cellulose degradation; Biogas and producer gas engines

Total: 45 Hours

Reference(s)

1. Stout. B.A. Biomass energy - A monograph, TEES mono- fraph series - Texas University Press, College Station, 1985
2. Chahal.D.S. Food, Feed and Fuel from Biomass. Oxford & IBH Publishing Co. Pvt LTD. NewDelhi, 1991

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					2				4				3											12
2	2					4				4									5			4			19
3	4					2				5				4											15
4	2						3				6			5				5					5		26
5	4					4				8									6				6		28
																								Total	100

Assessment Questions

Remember

1. Recognize renewable energy and nonrenewable energy.
2. List four alternatives for fossil fuel.
3. Define bioenergy.
4. List four liquid biofuels.
5. Define flash point for a fuel.
6. State about producer gas.
7. State partition coefficient in chromatography.
8. Define retention time in a chromatography.
9. Recognise the purpose of cell disruption.
10. State the significance of centrifugation.

Understand

1. Summarize the need for alternative to fossil fuel.
2. Classify the different types of biomass used for energy production.
3. Compare the properties of a conventional and synthetic fuel.
4. Indicate the steps involved in biofuel production from lignocellulosic biomass.
5. Interpret the properties of a good fuel.
6. Compare octane and cetane number.
7. Classify chromatography technique based on nature of mobile phase.
8. Identify how resolution helps in understanding the efficiency of a chromatography system.
9. Contrast chemical and enzymatic method of cell disruption.
10. Formulate the various stages of downstream processing steps involved in biofuel production.

Apply

1. Implement the use of gyrotester in selection of centrifuge for separation of a bioproduct.
2. Demonstrate the variation in cell wall structure of a gram positive and gram negative bacteria.
3. Find the ways to disrupt a cell wall of a microalga.

4. Construct the expression for the determination of yield using stoichiometric calculations for production of biofuel using a biomass.
5. Assess the unit operations involved for separation of glycerol from biodiesel produced during transesterification process.
6. Implement a suitable method for determination of fuel efficiency of a biofuel.
7. Execute for determination of expression for the filter medium resistance in filtration.
8. Assess the various properties that a good fuel should possess.
9. Demonstrate the application of chromatography involved during downstream processing of biofuel.

Analyse

1. Differentiate first and second generation biomass used for bioenergy production.
2. Organize the environmental impact of using fossil fuel.
3. Differentiate with pros and cons of woody and bacterial biomass for production of biofuel.
4. Compare biogas and biomethane.
5. Differentiate producer gas and synthesis gas.
6. Attribute on the products of combustion of a biofuel.
7. Differentiate between frontal and displacement mode of operating chromatography system.
8. Check suitable methods of cell disruption to isolate intracellular enzyme.
9. Criticize on the resolution of two chromatographic peaks.

Evaluate

1. Criticize how the chromatogram is used to determine the resolution of chromatographic separation?

Create

1. Generate the steps involved sequentially to produce biofuel from a lignocellulosic biomass.
2. Plan downstream processing steps involved for a biofuel production from microalgae.

15BT007 BIOPOLYMERS 3 0 0 3

Course Objectives

- To know what are biopolymers, their classification and potential applications
- To expose how biopolymers help in the development of the next generation of materials, products, and processes
- To facilitate the students to undertake research work both for improving /modifying their functional properties and to develop new products and processes

Course Outcomes (COs)

1. Can classify biopolymers based on the properties and structure and characterize them
2. Know about nucleic acid, proteins and polysaccharides and their synthesis and use
3. Learn the synthesis and uses of polyesters and polyisoprenoids
4. Acquire knowledge to prepare synthetic biodegradable polymers for various uses
5. Know about different animal and plant fibers for textile and composite applications

UNIT I **9 Hours**

CLASSIFICATION AND STRUCTURE

Biopolymer/bio-macromolecule-definition and history, different methods of classification , structure, formation, modification-blending, grafting -properties, characterization- molecular weight, glass transition , amorphous and crystalline behavior, mechanical properties, thermal, bio and photodegradation and applications.

UNIT II **9 Hours**

POLYNUCLEOTIDES, POLYAMIDES AND POLYSACCHARIDES

Polynucleotides- DNA, RNA, protein- chemical synthesis-Collagen, casein, pectin, albumin and polysaccharides-synthesis/biosynthesis, structure and applications of important members under each class

UNIT III **9 Hours**

POLYESTER, POLYISOPRENOIDS AND POLYPHOSPHATES

Poly(hydroxyalkanoates) cutan, cutin, poly(hydroxyl butyrate-co-hydroxy valerate) , polyisoprenoids and polyphosphate-Structure, synthesis and specific uses with example

UNIT IV **9 Hours**

SYNTHETIC BIOPOLYMERS AND POLYMER HYDROGELS

Synthetic biodegradable polymers-Introduction, applications, and chemical synthesis of important members, polymers and copolymers of lactic, glycolic acid etc, poly (alpha amino acids), polyethylene glycol, polycaprolactone, gypsum and polymer hydrogels

UNIT V **9 Hours**

NATURAL FIBERS AND THEIR COMPOSITES

Silk, wool, flax, jute, linen, cotton,sisal, bamboo, pineapple leaf and oil palm fibers, kneaf, and industrial hemp, properties, applications , property improvement by biochemical treatment . Wood a composite material, Biocomposites- formation, properties and applications

FOR FURTHER READING

Polymerization methods, molecular weight by GPC, Lignin, gums , resins, environmental effects of biopolymers, sugar based biopolymers

Total: 45 Hours

Reference(s)

1. R.M. Johnson, R. M. Mwaikambo, L. Y., Tucker, N. Biopolymers, Rapra Technology 2003
2. Richard Wool., and Susan Sun, X (Eds)., Biobased polymers and composites, Academic Press 2005
3. Alexander Steinbucghel (Ed.)Encyclopedia of Biopolymers, Vols.1-10, Wiley-VCH 2004
4. Platt K., Biodegradable polymers, Rapra Technology 2006
5. Biopolymers(New Materials for Sustainable Films and Coatings), Wiley, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	5					4					5			3				3							20
2	5					4				3				3				5							20
3	3					4				5				5				3							20
4	3										6			4				5							18
5	3						3			5					3				4				4		22
																								Total	100

Assessment Questions
Remember

1. Define biopolymers.
2. State how biopolymers are classified?
3. Define glass transition temperature.
4. State two examples each for natural polysaccharide and polyamide
5. Define natural fibers. How natural fibers are classfied?
6. Define gums and resins.
7. Define wool, silk and sisal fibers
8. List two biochemical methods used to improve the property of biocomposites?
9. State industrial hemp properties and uses.
10. Define natural polymer and list two uses.

Understand

1. Identify how the biodegradability of a polymer is ascertained?
2. Describe polynucleotide, polysaccharide and polyamides
3. Describe synthetic biopolymers? Give examples
4. The segment -CH2CH2CH2CH2CH2CH2- represents the polymer named ________ .
   A) POLYSTYRENE B) POLYETHYLENE C) POLYBUTYLENE D) POLYPROPYLENE
5. Describe how long will it take for the biopolymer to decompose.
6. Explain green composites.
7. Identify how silk biodegrades.
8. Explain cotton and linen fiber properties.
9. Describe chemical synthesis of bionelle.
10. Explain polyisoprenoids and polyphosphate

Apply

1. Name a biopolymer produced by microorganism. Sketch its structure and applications
2. Interpret how a microorganism produce polyhydroxybutyrate?
3. Name four fiber forming biopolymers and demonstrate their, properties and uses
4. List two natural polyamides and interpret their structure, properties and applications
5. Discuss briefly on fiber forming natural biopolymers and their uses
6. Demonstrate the importance of polymer hydrogels.
7. Interpret natural fiber composites and their uses
8. State any two biological polymers and demonstrate their structures and function
9. Demonstrate synthesis and structure analysis of polyisoprenoids.
10. Demonstate two methods to produce biopol and their application.

Analyse

1. Silk and nylon-6 are polyamides. Silk is biodegradable. Nylon-6 is not biodegrable.Examine why.
2. Analyse the importance of membranes in industry.
3. Differentiate between natural and synthetic biodegradable polymer.
4. Compare and contrast between the structural properties of polyisoprenoids and polyphosphate.
5. Examine the mechanism behind protein, lipid and nuclic acid synthesis.
6. Relate the plastic degrading bacteria found recently and the mechanism of action on degradation?
7. Analyze the enzyme responcible for biodegration of sythetic polymer.
8. Examine the classification of biopolymers and its modification.
9. Examine two possible modification should be done to create biopolymers.

Evaluate

1. Judge whether polyphosphates play an important role in polymer technology.

Create

1. Develop a procedure to creat a synthetic membrane.
2. Develop a chemical synthetic pathway of biodegardable synthetic polymer.

15BT008 TISSUE ENGINEERING AND BIOMATERIALS 3 0 0 3

Course Objectives

- To expose the students on the growth of tissues and various growth factors for tissue engineering
- To understand the various scaffolds and cell delivery vehicles used for tissue engineering
- To learn about various biomaterials based body implants and their biocompatibility

Course Outcomes (COs)

1. Understand the concept of tissue engineering
2. Aware of the recent developments in the field of tissue engineering
3. Design a scaffold using biomaterials for tissue engineering applications

UNIT I **9 Hours**

INTRODUCTION AND CELL CULTURE TECHNIQUES

Regulatory issues concerning tissue engineering, Cell culture; primary cultures &cell lines; cell quantification; bioreactors for cell cultures; Growth factors and signals for tissue engineering; extra cellular matrix (ECM) (structure, function and applications); typical tissue engineered device. Epithelial cell culture (cornea);

UNIT II **9 Hours**

STEM CELL CULTURE

Importance and unique properties of stem cells; Similarities and differences between embryonic and adult stem cells; Pluripotent stem cells; Hematopoietic stem cells & lymphoid stems cells; Potential uses of human stem cells and the strategies to overcome

UNIT III **9 Hours**

CELL DELIVERY VEHICLES

Definition & purpose of delivery vehicles; Types of vehicles and comparative performance; Natural polymers: Collagen; Synthetic polymers: alginate hydrogels; Micro encapsulation: agarose microbeads. Polymeric scaffolds for tissue engineering applications; Drug delivery in Tissue engineering; Animal models for the evaluation of orthopedic implants

UNIT IV **9 Hours**

BIOMATERIALS CLASSIFICATION AND PROPERTIES

Biomaterials: Definition, Classification: Polymers, ceramics (biosorbable and bio active) and composites. Surface, physical and chemical properties of materials - mechanical properties of implants.Bulk analysis-FTIR, SEM; Surface analysis - AES. Sterilization techniques: ETO, gamma radiation, autoclaving. Effects of sterilization on material properties.

UNIT V **9 Hours**

BODY IMPLANTS FROM BIOMATERIAL

Hard tissue replacement implant; Orthopedic implants, (Hip, Knee, etc.), Soft tissue replacement implant; skin implants, Burn (wound) dressings Synthetic Skin, Heart valve implants. Blood and tissue compatibility of biomaterials, biomimetics, inflammation and Wound healing process- Tissue response to biomaterials, toxicity of biomaterials. Enhancement of biocompatibility

FOR FURTHER READING

Mesenchymal cell culture (cardiac cells, bone), Induced pluripotent stem cell, Biomimetic materials, Standards in biomaterials - Product development and regulations, Degradation of biomaterial in biological environments.

Total: 45 Hours

Reference(s)

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall of India, 2007
2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations in Chemical Engineering, Tata McGraw-Hill Professional, 2005.
3. M. Coulson and J. F. Richardson, Coulson and Richardson, Chemical Engineering, Vol. 2, Butterworth Heineman, 2004.
4. G. K. Roy, Fundamentals of Heat and Mass Transfer, KannaPublications, 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3						3				6			4				5							21
5	3									4									6				6		19
6																									0
																								Total	100

Assessment Questions

Remember

1. Differentiate between implant and transplant.
2. Explain constitute of skin substitutes in tissue engineering.

3. Explain the conditions for cryopreservation of cells.
4. Give examples on synthetic polymers
5. List two unique properties of stem cells.
6. List two potential human stem cells.
7. Define delivery vehicles
8. List two ceramic materials used as implants.
9. State two commercially available orthopedic implant materials.
10. List two product development regulations related to biomaterials.

Understand
1. Discuss the design properties considered while fabricating scaffolds for tissue applications
2. Interpret the mechanisms involved in cell delivery through vehicles
3. Discuss the risks and complications of knee implants
4. Discuss on skin implants with examples
5. Explain the structur and function of extra cellular matrix.
6. Classify the types of vehicles used in cell delivery.
7. Discuss two uses of agarose microbeads.
8. Explain the importance of drug delivery in tissue engineering.
9. Describe two sterilization techniques.
10. Discuss the four important properties of a biomaterial.

Apply
1. What are 2 important animal models in the development of tissue engineered devices?
2. Explain its applications in biomedical instrumentatiom
3. Illustrate the vascular graft preparation using shell-tube bioreactor
4. Sketch the process of micro encapsulation.
5. Sketch the principle of FTIR.
6. Interpret two applications of SEM in tissue engineering.
7. Sketch the parts of SEM.
8. Sketch the entire process of tissue response to biomaterials.
9. Demonstrate two methods to enhance the biocompatibility of biomaterials.
10. Interpret two applications of AES in surface analysis.

Analyse
1. Interpret the approaches used for creation of tissue engineered heart valve
2. Analyze the basic graft preparation concepts in tissue engineering
3. Examine how epithelial cell culture is used for corneal transplant.
4. Compare and contrast between embryonic and adult stem cells.
5. Diferentiate hematopoietic stem cells & lymphoid stems cells.
6. Examine how polymeric scaffolds can be used in tissue engineering.
7. Compare and contrast between biodegradable and non biodegradable materials.

Evaluate
1. Heart valve implants should be ductile.Justify the statement.
2. Defend the statemen,'Biodegradable materials are more useful than non biodegradable materials in orthopedic implants'.
3. Justify the statement 'Mechanical properties required for an orthopedic implants'.

Create
1. Design a bioreactor for cell cultures.
2. Develop a process for using mesenchymal stem cells in bone implants.

15BT009 BIOSENSORS 3 0 0 3

Course Objectives

- To understand the principle, operations and classification of biosensors
- To introduce transducers and physiological property measurement using biosensor
- To espouse the science and engineering by application of biosensors in various fields

Course Outcomes (COs)

1. Understand Electrode and its basics of construction
2. Emphasis the significance of biosensors in bioprocess industries
3. Understand the basic design of transducers
4. Acquire knowledge on the mass transfer limitations associated with biosensor fabrications
5. Learn the application of biosensor in healthcare sector and agriculture

UNIT I **9 Hours**

ELECTROCHEMISTRY, CLASSIFICATION AND OPERATION

Electrochemistry single electrode potential- Nernst equation Tafel plot Electrical components DC and AC Circuits Operational amplifiers and functions, desired characteristics of biosensors: reliability, simplicity, cost, and related parameters. Classification and components of Biosensor - Advantages and limitations, biocatalysis based biosensors, Types of enzyme electrodes

UNIT II **9 Hours**

TRANSDUCERS IN BIOSENSORS

Types of transducers, principles and applications - Calorimetric, acoustic, optical (absorption, fluorescence, bio/chemiluminescence, surface Plasmon resonance (SPR)), potentiometric / amperometric, conductrometric resistor metric, piezoelectric, semiconductor (ion sensitive field effect transistor (ISFET), enzyme field effect transistor (ENFET), impedimetric, mechanical and molecular electronics based transducers. Chemiluminiscence based biosensors.

UNIT III **9 Hours**

BIOSELECTIVE LAYERS

Bioselective layers: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Microbial metabolism; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Methods for application of bio selective layers in desired patterns- pin-based spotting,

UNIT IV **9 Hours**

BIO MEMBRANES: MASS TRANSPORT AND FABRICATION

Mass transport: Mass transport effect of analytes to the surface of the biosensor transducer on the detected signal and associated kinetics. The design of micro fluid flow systems that interface with biosensors. Different assay types (Displacement, competitive, sandwich, and direct). Biosensor fabrication methods: self-assembled monolayers,Screen printing, photolithography, micro contact printing, micro-electromechanical system (MEMS).

UNIT V **9 Hours**

BIOSENSOR ENGINEERING AND APPLICATIONS

Applications- Case studies: Glucose, urea and cholesterol biosensors; Clark electrode, Implantable sensors for long-term monitoring; Drug development and detection; Industrial on-line monitoring, Environmental monitoring; Technological process control; veterinary, agriculture, Food quality control;

FOR FURTHER READING

Biochips and biosensor arrays; Problems and limitations. Ink-jet dispensing and micro stamp printing, engineering concepts for mass production.

Total: 45 Hours

Reference(s)

1. Ursula Spichiger-Keller, Chemical Sensors and Biosensors for Medical and Biological Applications, Wiley-VCH, 1998
2. D. A. Skoog, F. J. Holler and Nieman A. Timorthy, Principles of Instrumental analysis, 6th edition, 2006.
3. D. G. Buerk, Biosensors: Theory and Applications, Technomic, Lancaster, 1993.
4. Jon Cooper and Tony cass, Biosensors, Oxford University Press, 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					4				6				8											20
2		2				5				5					8										20
3		3			4						5			8											20
4		2					5			5				8											20
5		2				4					5				5			4							20
																								Total	100

Assessment Questions

Remember

1. List the four components of biosensor.
2. State the seven different types of bioreceptors
3. Recall the five different classifications of transducer.
4. State the first law of thermodynamics.
5. Recall the five main classes of enzymes.
6. Define line edge roughness.
7. List 2 commercially available biosensors.
8. Remember 2 limitations of an implantable biosensor.
9. State the principle of pin based spotting.
10. State the principle of pin based spotting.

Understand

1. Indicate two methods used to amplify the signal produced in a biosensor.
2. Illustrate the method by which self assembled monolayers are used in biosensor fabrication
3. Explain the principle of Surface Plasmon Resonance based biosensor.
4. Indicate the mechanism of enzyme catalyzed biosensors.
5. Represent the diagramatic procedure of a antibody based biosensor

6. Indicate the type of assay is used in Urease sensors
7. Interpret the working of a DNA based biosensor.
8. Explain any two transduction principles used in biosensors.
9. Discuss any 2 DNA based biosensors.
10. Explain the kinetics associated with the mass transport of analytes.
11. Recognize the importance of biosensors in environmental monitoring.Recognize the importance of biosensors in environmental monitoring.

Apply

1. Construct a sensor to find the quality of soil for rice cultivation.
2. Design a implantable sensor for monitoring and delivering drug for diabetes.
3. Show the construction of a glucose biosensor.
4. Interpret the difference between MEMS and NEMS.
5. Sketch the operation of a Molecular Beacons based DNA biosensor.
6. Interpret the first main limitation of a biosensor and describe how it can be overcome.
7. Sketch a FET and a ISFET.
8. Interpret the relationship between screen printing and micro contact printing.
9. Interpret the relation between screen printing and micro contact printing.
10. Interpret the differences between biochips and biosensor arrays.

Analyse

1. Outline the four important characteristics of a biosensor.
2. Compare and contrast anodic and cathodic polarization using the Tafel plot extrapolation.
3. Compare the effect of pH on the cathode potential for oxygen reduction to water or to hydrogen peroxide (5mM) over a pH range of 4 to 11.
4. Differentiate between bio, chemical and physical sensors.
5. Outline the characteristics needed for reference electrode.
6. Compare the two different types of photomasks used in photolithography.

Evaluate

1. Defend the statement ‘two half cells needed in order to be able to measure a cell emf’.
2. A fluoride ion electrode is used to measure the fluoride concentration in a cup of tea. When immersed in a mixture of 35 cm3 of tea and 15 cm3 of an ionic-strength adjustment buffer, the electrode gave a reading of 90 mV. When 2 cm3 of a 0.005 M fluoride solution was added to this mixture, the reading became 166.7 mV. Check the concentration (C) of fluoride ions in the initial cup of tea.
3. Determine the similarities between SAM and Langmuir-blodgett lipid bilayer.
4. Justify the statement 'Biosensors are importantÂ in environmental monitoring'.

Create

1. Design a biosensor which uses immune receptors.
2. Construct micro stamp printing for use in biosensors.

15BT010 CANCER BIOLOGY 3 0 0 3

Course Objectives

- To understand the basics of cancer and its development
- To learn about the detailed concepts and methods involved in studying cancer
- To learn the application of biotechnology in eliminating cancer

Course Outcomes (COs)

1. Acquire in depth knowledge in molecular biology of cancer.
2. Learn about the diagnosis and prevention of cancer
3. Have the basic knowledge about the cancer treatment

UNIT I **9 Hours**

FUNDAMENTALS OF CELL CYCLE AND CANCER

Mitosis, Regulation of cell cycle, check points, cell proliferation, apoptosis; Signal transduction pathways, receptor tyrosine kinases (RTKs), RAS signalling. Causes of cancer - Infection, Radiation, Ionising radiation, Ultraviolet radiation, magnetic fields, Tobacco, Alcohol, Tea and coffee, Stress; defective apoptotic pathways leading to cancer.

UNIT II **9 Hours**

INTRODUCTION TO CANCER

Mutations that cause changes in signal molecules, effects on receptor, signal switches, modulation of cell cycle in cancer; Mechanism of spread. Different forms of cancers, Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, mechanism of oncogene activation, retroviruses and oncogenes, detection of oncogenes.

UNIT III **9 Hours**

CELLULAR OVERVIEW OF CANCER

Oncogenes/proto oncogene activity; tumor suppressor genes - pRb, p53, APC, BRCA paradigms; Telomerases, Principles of Cancer Metastasis: three step theory of invasion, proteinases and tumour cell invasion; Angiogenesis.

UNIT IV **9 Hours**

CANCER PREVENTION AND DIAGNOSIS

Chemotherapy, radiation therapy; Cancer detection: tumour imaging and molecular imaging, Proteomics, Metabolomics, Gene expression profiling, Protein imaging, Nanotubes, graphene and nanocells, advances in cancer detection.

UNIT V **9 Hours**

CANCER TREATMENT

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation, mechanisms of radiation carcinogenesis, Life style and its consequences for cancer.

FOR FURTHER READING

Different types of tumour markers; New approaches of cancer therapy mAbs, vaccines, gene therapy, Stem cell therapy to treat cancer.

Total: 45 Hours

Reference(s)

1. Pelengaris S and Khan M., The Molecular Biology of cancer , Blackwell Scientific Publications, Oxford, 2006.
2. Robin Hesketh, Introduction to Cancer Biology, Cambridge University Press, 2013.
3. Kufe, DW, Pollock, RE, Weichselbaum, RR, Bast R.C., Gansler TS., Holland JF Frei, E, Cancer medicine, 6th Edn, BC Deckker Inc., Toranto, Canada, 2003.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					6			4											19
2	3					4				4							2		5			4			22
3	3					2				5				5									5		20
4	3										6			5				5							19
5		2					2			4									6				6		20
																								Total	100

Assessment Questions

Remember

1. Define clonal nature of cancer growth.
2. Differentiate tissue involution from tissue expansion.
3. What are the phases present in cell cycle regulation?
4. Does CDk's upregulate the cell cycle process? In which phase DNA synthesis is carried out?
5. Expalin what is spindle check point.
6. State what is meant by replicative senescence.
7. Define ubiquitination.
8. Write the significances of HDAC in cell growth.
9. What is the role 14 - 3 – 3 gene in nuclear export?

Understand

1. Recall the function of RB protein in cell cycle regulation.
2. Explain CDK4 instigate the elongation process in cell cycle.
3. Explain how does Cyclin E inter connected with transcription process.
4. What is meant by replicative senescence?
5. Expalin the genes responsible for oncogenic stress.
6. List the role of ubiquitin ligase in cell cycle process.
7. List out the role of HDAC in cell cycle process.
8. What will happen if CDC 25 is not expressed properly during cell cycle?
9. Does BRCA gene used in DNA damage repairing process?
10. Illustrate the function APC/C gene in spindle check point.

Apply

1. Does growth factor initiate and progress the cell growth?
2. Does BID regulate the programmed cell death? Justify it.
3. Expalin various chemical compounds fascinate carcinogenesis.
4. Evaluvate how Kundson theory matched in cancer formation.
5. Explain how is p53 performed as negative feedback regulator in cancer progression.
6. Expalin how is mitochondrial outer membrane permiabilization process regulated with respect to BCl2 family gene.
7. Apply the importance of VEGF factor in angiogenesis mechanism.
8. Analyse the radiation techniques used in cancer treatment.
9. Give the significances of retinoblastoma protein in transcription process
10. Does NOXA gene act as negative regulator to apoptosis?

Analyse

1. Analyse how cell cyclins are termed as drive engines of cell cycle progression.
2. Expalin how does radiation act as carcinogenic agent to promote cancer.
3. Analyse cell cycle progression regulated by coordinated action of various signalling molecules.
4. Bestow the sequence of events occur after a cell receive a death signal.
5. Explain how beta catenin act as oncogene and instigate the wint signalling process.
6. Illustrate how does cell suicide executionated once a cell received death signal.
7. In what way the cell to extracellular membrane interaction will be disturbed by various proteinases enzymes?
8. Expalin how is computerized tomography used to detect the malignancy of a patient
9. Explain how Cadherin is activated by tyrosine kinase.
10. Analyse will happen if CDC 25 is not expressed properly during cell cycle.

Create

1. Develop an innovative method to identify what type of cancer in a patient
2. Design one recombinant vaccine to destruct the cancer cell without any side effects.

3 0 0 3

15BT011 MOLECULAR MODELING

Course Objectives

- To providethefundamental knowledge and mathematical skills to model biomolecules
- To learn the different force field methods for energy minimization and analysing the dynamics and stable conformation of molecules
- To apply the modelling skills to understand the analog and structure based drug design concepts for synthesizing new potent drugs

Course Outcomes (COs)

1. Mathematical and software skills to model biomolecules
2. Design new molecules such as therapeutic drugs
3. Engineer proteins by modification

UNIT I **8 Hours**

INTRODUCTION

Definition, concepts in molecular modellingand models used. Areas of application Single molecule calculation, assemblies of molecules and reaction of the molecules.Drawbacks of mechanical models as compared to graphical models Co-ordinate systems, Z- matrix, potential energy surface.

UNIT II **10 Hours**

CLASSICAL AND QUANTUM MECHANICS

Introduction to classical mechanics. Wave function, Eigen value and Eigen function, operators, Schrodinger equation, one electron atom, many electron atom and molecules. Energy of a polyelectronic system, Born oppenheimer approximation, Postulates of quantum mechanics, electronic structure calculations, ab initio, semi-empirical and density functional theory calculations, molecular size versus accuracy. Approximate molecular orbital theories

UNIT III **9 Hours**

EMPIRICAL FORCE FIELD MODELS

Molecular Mechanics, energy calculations and energy minimization, bond stretch, angle bending, torsional term.Electrostaticinteraction,Van der waals interactions. Miscellaneous interaction

UNIT IV **9 Hours**

MOLECULAR DYNAMICS

Introduction, Molecular dynamics using simple models.Dynamics with continuous potentials.Constant temperature and constant dynamics.Conformation searching, systematic search. Applicationsof conformation and systematic search to protein molecules and enzyme modification

UNIT V **9 Hours**

APPLICATIONS IN DESIGN OF NEW MOLECULES

Introduction to QSAR. Lead module, linear and nonlinear modeled equations,biological activities, physicochemical parameter and molecular descriptors, modelling in drug/new molecule discovery. 3D pharmacophores,molecular docking. De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies

FOR FURTHER READING

Graphical models, olecular theories, Atomic structures ad confirmation, Tertiary confirmations of proteins, Modelling tools, Molecular docking

Total: 45 Hours

Reference(s)

1. Andrew R. Leach, Principles and Applications of Modeling, Pearson Education Ltd., 2001
2. Hans Pieter Heltje and Gerd Folkens, Molecular Modelling, VCH, 2001.
3. Jonathan Goodman, Chemical Applications of Molecular Modeling, Royal Society of Chemistry, Cambridge, 1998.
4. Guy H. Grant and W. Graham Richards, Computational Chemistry, OxfordUniversity Press, 1985.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	3					4				5				2				7							21
2	3					6				4				6											19
3		3					5				3							8							19
4		3								6					3				8						20
5		3				6				3					5			4							21
																								Total	100

Assessment Questions

Remember

1. Explain what is molecular modelling.
2. Define molecular dynamics.
3. Define a potential energy surface.
4. Analyse Z-matrix.
5. Analyse energy minimization.
6. Define local energy and global energy minima.
7. Define transition state.
8. Differentiate quntum mechanics and molecular mechanics
9. Explain what is an operator and its significance.
10. Define force fields.

Understand

1. Define eingen function and eigen value
2. Explain Born-oppemheimer approximation
3. What are the postulates of quantum mechanics?
4. Explain density functional theory.
5. Define force field? Name some important force fields.
6. Explain Poisson-Boltzmann surface area and generalized born surface area
7. Explain how ab initio differs from semi empirical methods.
8. Explain Monte Carlo simulations
9. Define molecular docking. Mention the types of searching methods under docking.
10. Define pharmacophore. List out its features.

Apply

1. Interpret the AMBER force field in modelling of proteins
2. Explain conformational analysis. List out the different conformational search methods and elaborate any one method
3. Explain how ab initio quantum mechanics is useful in calculation of molecular properties taking a typical property of molecule.
4. Define graphical models? How it differs from mechanical model.Discuss briefly on graphical models and potential energy surfaces.
5. Explain any two force field models for simulation liquid water
6. Expalin what is conformational analysis of molecules? Discuss any two systematic methodsfor exploring the conformations
7. Recall Schrodinger equation. Give the full time dependent form and time independent forms of this equation.

8. Give the expressions for total energy, linear momentum and potential energy operators. Explain what is Newton-Raphson energy minimization
9. Discuss the applications of Monte Carlo simulation in modelling the energy function of molecules
10. Describe the constrained systematic search in finding 3D pharmacophores

Analyse

1. Explain the QSAR method in drug design.
2. Evaluvate ab initio method.
3. Explain how density function is useful to investigate the ground state electronic structure of many electron atom or molecules.
4. Explain any two semi empirical methods for performing calculations on ground state organic molecules.
5. Discuss the postulates of quantum mechanics.
6. Define pharmacophore. Analyse its features
7. Explain Monte Carlo simulations
8. Discuss Morse and Linnard Jones potentials.

Evaluate

1. Evaluvate ab initio differs from semi empirical methods.

Create

1. Write the Schrodinger equation for hydrogen molecule ion
2. Explain how the free energy change in flexible molecules is modeled.
3. Explain how density function is useful to investigate the ground state electronic structure of many electron atom or molecules.

3 0 0 3

15BT012 BIOPHYSICS

Course Objectives

- To analyze the various forces responsible for biological molecular structure.
- To be familiar with different levels of conformation in biomolecules.
- To gain the knowledge of cellular permeability and ion transport.
- To understand the dynamics of biological systems.

Course Outcomes (COs)

1. Gain structural knowledge of biological systems.
2. Understand transport and dynamic properties of biological systems.

UNIT I **9 Hours**

MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS

Intramolecular bonds covalent ionic and hydrogen bonds biological structures - general features water structure hydration interfacial phenomena and membranes self assembly and molecular structure of membranes.

UNIT II **9 Hours**

CONFORMATION OF NUCLEIC ACID

Primary structure the bases sugars and the phosphodiester bonds- double helical structure the a b and z forms properties of circular DNA topology polymorphism and flexibility of DNA structure of ribonucleic acids hydration of nucleic acids.

UNIT III **9 Hours**

CONFORMATION OF PROTEINS

Conformation of the peptide bond secondary structures Ramachandran plots use of potential functions tertiary structure folding hydration of proteins hydropathy index.

UNIT IV **9 Hours**

CELLULAR PERMEABILITY AND ION TRANSPORT

Ionic conductivity transport across ion channels mechanism - ion pumps-proton transfer nerve conduction techniques of studying ion transport and models.

UNIT V **9 Hours**

ENERGETICS

Concepts in thermodynamics force and motion entropy and stability analyses of fluxes diffusion potential basic properties of fluids and biomaterials laminar and turbulent flows.

FOR FURTHER READING

Molecular structure predictions, Intramolecular forces, Protein Structure, DNA Tpology, Transport Process in biological systems, Bioenergetics

Total: 45 Hours

Reference(s)

1. Glaser R., "Biophysics" Springer Verlag , 2000.
2. Duane R., Biophysics: Molecules In Motion" Academic Press, 1999.
3. Charles C.R., and Schimmel P.R., â??Biophysical Chemistryâ?? 1-3 Vols, W.H. Freeman & Co., 1980.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		6				4					6			4											20
2		5				5									8				2						20
3		6				3				4				5								2			20
4		5				5									4			2				2			18
5		3					4			6					6				3						22
																								Total	100

Assessment Questions

Remember

1. Discuss the bonds in biological structure
2. Detail notes on self assembly
3. Define DNA polymorphism.

4. Describe primary structure.
5. Define hydropathy index.
6. Classification of nucleic acid structure.
7. List out ion transport models.
8. Discuss ionic conductivity.
9. State thermodynamic law.
10. Discuss stability analysis

Understand

1. Differentiate ionic and covalent bond and which one is strong.
2. Discuss the molecular structure of a membrane.
3. Explain which helical structure of DNA is stronger. Why?
4. What is ribonucleic acid hydration?
5. Explain the importance of ramachandran plot.
6. Recall the potencial function of tertiary structure.
7. List out ion channel mechanisms.
8. Explain the need of studying ion transport and models.
9. Explain the connection between motion entropy and thermodynamic force.
10. Differentiate the properties of fluids and biomaterial.

Apply

1. Explain how the super helical structure of DNA gives stability to DNA.
2. What is the mechanism of protein folding? Give its applications.
3. Illustrate the structure of a protein present as a solution is determined.
4. Demonstrate calcium ion flux and cell signalling
5. Explain how do you quantify and characterize the receptors
6. Application of various devices for measuring flow rates of different fluids.
7. Analyse the mechanism of action of Neurotransmitters
8. Distinguish Ligand-gated and Voltage-gated ion channels.
9. Analyse nerve conduction technique and its uses.
10. Evaluate the role of Cyclic GMP and G protein in cell signalling

Analyse

1. Analyse the features of the DNA double helix facilitate its replication. What features might make its replication complicated?
2. Explain how different types of organisms-for example, bacteria, fruit flies, frogs and humans-be expected to sustain different types of DNA damage.
3. Analyse how the disulfide bonds increase in the stability of the protein.
4. Analyse the factors that will affect the peptide synthesis.
5. Analyze the allosteric changes in the globin structure.
6. Explain ion channel defects and analyse the factors involved.
7. Anayse the different methods of signal amplification
8. Analyse the peptide bond secondary structure conformation by ramachandran plot.

Evaluate

1. Expalin how to get the absorption spectra of Nucleic acid in the Ultra-Violet range.
2. Evaluvate biomaterial laminar and turbulent flow. How it distinguish from fluids?

Create

1. How will you engineer a protein with high thermal stability protein?
2. Illustarte the motion entropy that affect the flux diffusion potential.

15BT013 MOLECULAR PATHOGENESIS AND DISEASE DIAGNOSIS

3 0 0 3

Course Objectives

- To familiarize students about pathogen and zoonotic diseases
- To attain fundamental knowledge on host defense mechanism and host pathogen interaction
- To explain the methods involved in diagnosis of diseases

Course Outcomes (COs)

1. Infer pathogen and zoonotic diseases
2. Understand the host defense mechanisms against pathogens
3. Differentiate between virulence factors and toxins
4. Learn host pathogen interaction
5. Demonstrate modern approaches of disease diagnosis

UNIT I **9 Hours**

PATHOGEN AND ZOONOTIC DISEASES

Pathogens; Attributes and component of microbial pathogenicity; Pathogen types and mode of entry; Robert Koch's postulates; General disease symptoms; Microbial Zoonosis and diseases- HUS, MRSA, Leptospirosis, Salmonellosis; Swine flu (H_1N_1), Avian flu (H_5N_1).

UNIT II **9 Hours**

HOST DEFENSE MECHANISM AGAINST PATHOGENS

Host natural defense mechanism; humoral and cellular defense mechanisms; Components of host surface defense systems- skin, mucosa, eye, mouth, respiratory tract; Components of systemic defense- tissues and blood; Complements and inflammation process.

UNIT III **9 Hours**

VIRULENCE FACTOR AND TOXIN

Virulence factors; Endo and exo toxins; Colonizing and invasion virulence factors; E. coli pathogens ETEC, EPEC, EIEC, EHEC, EAEC; Salmonella enterica toxin; Shigella toxin; Vibrio cholerae toxin; Clostridial toxins- C. perfringens, C. botulinum

UNIT IV **9 Hours**

HOST-PATHOGEN INTERACTION

Virulence gene and their regulation; Virulence assays; Cytopathic vs cytotoxic effects; Criteria and tests in identifying virulence factors; Serotyping

UNIT V **9 Hours**

DISEASE DIAGNOSIS

Influenza virus; Diagnosis of disease using immunological methods-EIA, ELISA, Ouchterlony double diffusion, Immunobloting; Diagnosis of disease using molecular methods- PCR, Hybridization, DNA sequencing

FOR FURTHER READING

Methods to detect genetic diversity and structure in nature population; Emerging microbial diseases; Fungal toxins; Real time PCR, DNA microarray; Recent trends in disease diagnosis, Vaccines

Total: 45 Hours

Reference(s)

1. K. Talaro and A. Talaro, Foundations in Microbiology, W.C. Brown Publishers, 2006
2. C.A. Janeway and P. T. Travers, Immunobiology, Blackwell J Scientific Publishers, 2004
3. C.L. Gyles, F.P. John, G. Songer and C. O. Theon, Pathogenesis of Bacterial Infections in Animals, Blackwell Publishers, 2010
4. Paul Digard, Anthony Nash and R. E. Randall, Molecular Pathogenesis of Virus Infections, Cambridge University Press, 2005
5. Nester, Anderson, Roberts, Pearsall, Nester, Microbiology: A Human Perspective, Mc Graw Hill, 3rd Edition, 2001
6. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					6				4				4											18
2	4					4				4	2			4				4							22
3	2					4				4				4				4				2			20
4	2					4				4	2			4				4							20
5	2					3				4	2			4				3				2			20
																								Total	100

Assessment Questions

Remember

1. Define pathogenicity.
2. Recognize HUS
3. Recall humoral defense mechanisms
4. List out the types of toxin
5. State the roles of skin and mucosa with relation to surface defense
6. Define virulence
7. List out the types of hybridization
8. Write down the principle of ELISA
9. Recognize Taq DNA polymerase
10. Define serotyping

Understand

1. Interpret ETEC
2. Classify virulence factors
3. Identify the causative agent of Botilinum
4. Summarize the general disease symptoms of MRSA and Leptospirosis
5. Illustrate Robert Koch’s postulates
6. Infer EPEC
7. Identify the causative agent of gas gangrene
8. Compare between Southern and Northern blotting
9. Illustrate components of systemic defense systems
10. Summarize the role of host surface defense systems

Apply

1. Predict the avian flu infection within body with illustration
2. Demonstrate the Ouchterlony double diffusion assay
3. Choose the robust molecular method of identification of viral infection with justification
4. Find out the method of calculation of Tm of oligoes.
5. Access the role of nitrocellulose membrane in blotting
6. Find the annealing temperature of primer
7. Demonstrate the steps of ELISA
8. Demonstrate immunoblotting
9. Choose suitable technique to demonstrate virulence assay
10. Access the role of eye in surface defense

Analyse

1. Differentiate between cytopathic and cytotoxic effect.
2. Compare ELISA and EIA
3. Analyze the DNA hybridization method for disease diagnosis
4. Compare humoral and cellular defense mechanisms
5. Differentiate between maxam – gilbert and Sanger's methods of DNA sequencing
6. Justify the significance of DNTPs and MgCl2 in PCR

Evaluate

1. Critique the criterion and tests in identifying virulence factor
2. Judge the roles of components of host surface defense systems
3. Evaluate the roles of components of systemic defense
4. Critique the significance of colonizing and invasion virulence factors in progression of disease

Create

1. Generalize the specific diagnostic tests for *E. coli* and *Salmonella* infections
2. Relate immunobloting in disease diagnosis

15BT014 BIOETHICS,BIOSAFETY AND IPR 3 0 0 3

Course Objectives

- To learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products
- To understand and follow the regulatory framework important for the product safety and benefit for the society

Course Outcomes (COs)

1. Gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas
2. Devise business strategies by taking account of IPRs
3. Assist in technology upgradation and enhancing competitiveness
4. Acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
5. Gain more insights into the regulatory affairs.

UNIT I **9 Hours**

ETHICAL AND MORAL ISSUES IN BIOTECHNOLOGICAL RESEARCH

Relevance of regulation and control of research in biotechnology / Societal obligations of a biotechnologist / Ethical concerns relating to experimentation on animals / Genetic engineering of plants and animals for food (GM foods) / bio weapons and bioterrorism /Plagiarism

UNIT II **9 Hours**

ETHICAL, LEGAL AND SOCIAL IMPLICATIONS IN BIOMEDICAL/ BIOTECHNOLOGICAL PRACTICE

Cloning / Genetic testing and screening / Human gene therapy and genetic modification / Stem cell research / Human clinical trials and drug testing.

UNIT III **9 Hours**

BIOSAFETY

General guidelines for recombinant DNA (rDNA) research, NIH Guidelines / Classification of microorganisms according to pathogenicity / Containment facilities and biosafety practices / Cartagena Protocol on Biosafety / Guidelines for recombinant DNA research in India.

UNIT IV **9 Hours**

RELEASE OF GM ORGANISMS TO THE ENVIRONMENT

Environmental Impact Assessment and Risk Analysis / Protection of biodiversity, Convention on Biodiversity and the Indian Biodiversity Act

UNIT V **9 Hours**

INTELLECTUAL PROPERTY RIGHTS

Different types of intellectual property rights / Patents, International patents / Patenting procedures-Patent applications-Rules governing patenting.

FOR FURTHER READING

Impact on the pharma sector / Patenting of life forms / Plant variety protection-registration of newer varieties, rights and obligations, Farmers rights / Protection of Traditional Knowledge

Total: 45 Hours

Reference(s)

1. Intellectual property rights in agricultural Biotechnology-F. H. Erbisch and K. M. Maredia, 1998, University Press
2. Biotechnology, Biosafety and Biodiverstiy- Sivamiah Shantharam, Jane F. Montegomery,1999, Oxford & IBH Publ. New Delhi,
3. Genetically modified Food Sources, Safety Assessment and Control- Tutelyal, VA, 2013, Academic Press an Imprint of Elsevier, New Delhi.
4. Bioethics: An Introduction to the History Methods and Practice- Jec ker Nany S, JohsenAlbert, Perlman, Robert A, 2nd ed., 2010, John & Bartlett, New Delhi
5. Environmental Safety of Biotech and Conventional IPM Technology, Sharma, HC Dhillon, MK, Sahrawat, KN- 2012 ed. Stadium Press LLC. USA
6. Bioethics: An Introduction to the History Methods and Practice, 2nd ed. 2010 Jecker Nany S, Jones & Barlet ,New Delhi

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3				6						8			3											20
2	3					4				4									5			4			20
3	3				2					5					5								5		20
4	3										6				4			5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. Give the legal impacts of biotechnology
2. List the socioeconomic impacts.
3. Give the classification of entrepreneurs.
4. Give the classification of entrepreneurs.
5. Define Value Chain.
6. Define IPR.
7. Mention the steps involved in business.
8. Mention the steps involved in business.
9. What are the basic keys necessary for success?
10. What are the international conventions of IPR?

Understand

1. Explain intellectual property rights.
2. Explain intellectual property protection
3. List the dos and donts in IPR
4. What is WTO guidelines?
5. Which are the barriers for the growth according to the biotech companies?
6. Explain the concept of technological transfer
7. Explainthe diffusion of technology in technology innovation
8. What are the stratergies to facilitate technology transfer?
9. Explain the plant breeders right.
10. Explain how to handle biological waste disposal.

Apply

1. Describe the stratergies for facilitating transfer.
2. Explain on variuos trade marks
3. Public perceptions in product development patent laws
4. Technology transfer methods in India
5. Copyrights , TRIPS & IPR protection
6. Elaborate the importance of checklist in writing business proposals
7. Discuss in detail about the various funding agencies in India
8. Interpret on licensing of biotechnological invention
9. Interpret on licensing of biotechnological invention

Analyse

1. Explain what the patent application procedure in India is. Who can apply for a patent? Elaborate on the documentation required for filing a patent application
2. Discuss in detail about the various funding agencies in India
3. Elaborate the importance of checklist in writing business proposals
4. Explain how PBRs will help to protect crop varieties.
5. Explain different types of licensing agreements.
6. Interpret on outward and inward licensing.

Evaluate

1. Bioethics and current legal issues in marketing
2. Which are the barriers for the growth according to the biotech companies?
3. Distinguish business plan from business models.
4. Explain the role of higher authority in case of Managerial responsibilities & skills.
5. Explain life sciences industry cycle
6. Interpret on licensing of biotechnological invention

Create

1. Develop the business plan for starting Bio ventures in a very competitive market.
2. Create a business proposals based on the opportunity available around you.

15BT015 SYSTEMS AND SYNTHETIC BIOLOGY 3 0 0 3

Course Objectives

- To expose the students to bottom-up and top-down design and analysis strategies for systems and synthetic biology
- To render knowledge of how to perform research in interdisciplinary fields like systems biology and synthetic biology.
- To work in multi-disciplinary teams for both computational and wet-lab projects

Course Outcomes (COs)

1. Acquire in depth knowledge in fermentation, product recovery and its instrumentation.
2. Learn about the production of primary and secondary metabolites
3. Have the basic knowledge about the production of enzymes, vaccines and other recombinant products in biotechnology

UNIT I **8 Hours**

INTRODUCTION TO BASIC CELLULAR AND MOLECULAR BIOLOGY

Central dogma of biology, mechanisms of gene expression, Kinetics of Enzyme Action, Rate Processes, Raw laws, Stoichiometric, Introduction to cell metabolism, Metabolic pathways, Protein signalling, Enzymatic reaction kinetics.

UNIT II **10 Hours**

BIOLOGICAL NETWORKS

Introduction to systems and synthetic biology, Biological networks: metabolic, signaling, regulatory, Network alignment and comparisons, network organization, Designing, simulating and building gene circuits, Genome design and synthesis.

UNIT III **9 Hours**

SYNTHETIC NETWORKS

Simple synthetic networks, Noise in gene expression, Structure of biological networks, Synthetic Networks, Design of promoters, Design of RNAs, Design of circuits, Characterization and optimization of devices, Examples and Applications of Synthetic Networks, Building synthetic networks, Monitoring outputs.

UNIT IV **10 Hours**

TOOLS IN SYSTEMS AND SYNTHETIC BIOLOGY

Flux analysis FBA, Computer aided design tools for metabolic engineering (lenera programs, retrosynthesis), Development of a flux theoretical model, correlation of the model with experimental data, Simulating synthetic networks, Manipulating DNA and measuring network responses.

UNIT V **8 Hours**

ETHICS IN SYSTEMS AND SYNTHETIC BIOLOGY

Biosafety introduction, Reengineering living organisms, ethical questions of synthetic biology, Current science-society situation and the place of synthetic biology, Controversies around key concepts: novelty, perfection, intentionality, complexity, life, Scientist's responsibility - Dual-use research and its implications from ethics to biosecurity.

FOR FURTHER READING

Biological sequence analysis, metabolic engineering, strain design optimisation, Genetic models, bottom-up approach to gene regulation, Business and Synthetic Biology.

Total: 45 Hours

Reference(s)

1. Pengcheng Fu, Sven Panke, "Systems Biology and Synthetic Biology", Wiley-Blackwell Publisher, 2009.
2. Uri Alon, an Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall, 2006.
3. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill, 1986.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					6			3											18
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						5			4									6				6		24
																								Total	100

Assessment Questions

Remember

1. Define translation.
2. State the rate law.
3. Give the definition for stoichiometry.
4. Recall the enzyme kinetic models are used.

5. Discuss cell metabolism.
6. Explain the network organization and its importance in biological network.
7. Importance of design of promoters
8. Give some examples for synthetic network.
9. Explain the ethical question of synthetic biology
10. Discuss novalty and perfection, intentionality.

Understand

1. What is replication and transcription?
2. Give an example of metabolism.
3. What do you know about yield coefficients?
4. What do you understand by the central dogma of life?
5. How will you prepare gene circuits?
6. Develop a methodology for arriving at protein network.
7. Distingush primary and secondary metabolism.
8. Define rate of reaction and rate limiting step.
9. Discuss genome synthesis.
10. Describe the noise in gene expression

Apply

1. Interpret how you will manipulate DNA.
2. Give you understanding on mathematical modeling being an important tool for both systems as well as synthetic biology.
3. Identify the potential biotechnological impact of gene design to mankind.
4. Examine the role of modeling in metobolic engineering.
5. Discuss the application of synthetic biology.
6. List out the tools used in synthetic biology and mention it application.
7. Discuss the protein the metabolic pathway and its signalling
8. What are primary metabolites and its function?

Analyse

1. Compare systems and synthetic biology.
2. How FBA is used as a tool in systems biology?
3. How would you use mathematical models for analysing metabolic network?
4. Apply your ideas and differentiate metabolic network from protein signalling.
5. Analyze the stability of genetically modified DNA.
6. Interpret the steps in deducing biological networks.
7. Analyse the bottom up approch to gene regulations.
8. Evaluvate the monitoring outputs in synthetic network.

Evaluate

1. Appraise the salient features of synthetic biology.
2. Interpret the applications of synthetic biology in biotechnology.
3. Explain the importance of metabolic engineering in synthetic biology.

Create

1. Scheme the central dogma of life.
2. Propose a methodology for designing new gene circuit.
3. Design a metabolic pathway so that a metabolite is produced double its usual amount.

15BT016 METABOLIC ENGINEERING 3 0 0 3

Course Objectives

- To study in detail about cellular metabolism
- To understand the key principles in metabolic engineering
- To learn the tools of metabolic engineering and its application

Course Outcomes (COs)

1. Understand the metabolic pathways of biomolecules.
2. Integrate the techniques of molecular biology with the tools of mathematical analysis.
3. Assess the significance of metabolic engineering in pharmaceutical companies.

UNIT I **9 Hours**

OVERVIEW OF CELLULAR METABOLISM

Transport mechanisms and their models, Enzyme kinetics, Mechanisms and their dynamic representation, Regulation of enzyme activity versus regulation of enzyme concentration, Regulation of metabolic networks, Regulation of at the whole cell level, Example of important pathways.

UNIT II **9 Hours**

INTRODUCTION TO METABOLIC ENGINEERING

Importance of metabolic engineering; Concept of metabolic pathway synthesis; Central Metabolism: Fueling metabolism, Supply of biomass precursors, Anabolism, Anaplerosis. Need for pathway synthesis, Paradigm shift; Information resources; Scope and future of metabolic engineering; Methods for metabolic characterization.

UNIT III **9 Hours**

REGULATION OF METABOLIC PATHWAY

Regulation of Enzymatic Activity, Regulation of Enzyme concentration, Regulation at whole cell level, Regulation of Metabolic networks, Transport mechanisms and their models, Mechanisms and their dynamic representation

UNIT IV **9 Hours**

TOOLS IN METABOLIC ENGINEERING

Metabolic flux analysis (MFA), Methods for MFA - Metabolite Balancing, Tracer Experiments, MS and NMR in labelling measurement,

UNIT V **9 Hours**

CONTROL ANALYSIS IN METABOLIC ENGINEERING

Metabolic control analysis (MCA), Determination of Flux control coefficients, MCA of Linear and Branched pathways.

FOR FURTHER READING

Thermodynamic principles, Productivity, Enzyme kinetics, Applications of MFA and MCA, Xenobiotics degradation.

Total: 45 Hours

Reference(s)

1. G.N. Stephanopoulos, A.A. Aristidou, J. Nielsen: Metabolic Engineering. Principles and Methodologies. Academic Press, 1998.
2. S. Y. Lee & E.T. Papoutsakis, Metabolic Engineering, Marcel Dekker, New York, 1999.
3. R.Heinrich and S. Schuster, The Regulation of Cellular Systems, Chapman & Hall, 1996.
4. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill, 1986.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					8					6			3											20
2	3					4				4									6			3			20
3	3					3					4			5									5		20
4	3										6			5					6						20
6	3						3			4					5				5						20
																								Total	100

Assessment Questions

Remember

1. Define a black box model.
2. Define turn-over number.
3. Outline your views on Metabolic engineeering
4. State the importance of Metabolic engineeering
5. Name few metabolic pathways for fueling reactions.
6. Define elemental balances.
7. Give a case study for metabolic engineering
8. Explain paradiagram shift.
9. Explain metabolite balancing
10. Define thermodynamic principels
11. Define xenobitic.

Understand

1. Indicate the importance of black box model.
2. Explain the TCA cycle in detail
3. Express your understanding on the application of MFA.
4. Describe two metabolic pathways for transporation processes
5. Discuss the principle and working of MS
6. Indicate how one will use NMR in labelling measurement.
7. Describe control analysis.
8. Methods for metabolic characterization
9. Explain the need for new pathway synthesis.

Apply

1. Demonstrate how fueling reactions are inter-connected.
2. Sketch oxidative phosphorylation and elctron transport chain.
3. Interpret the equations and plots for the different types of enzyme inhibitions.

4. Show with an example, the process of signal transduction by phosphorylation.
5. Employ your understanding to determine the fliuxes in a metabolic pathway.
6. Illustrate an example for biosynthetic pathway.
7. Review on Xenobiotics degradation.
8. Demonstrate how fueling reactions are inter-connected
9. Explain how the cellular property was improved.
10. Discuss MFA and its applications.

Analyse
1. Differentiate between active and passive transportation.
2. Criticize on fermentative pathways of yeast.
3. Point out the regulation at whole cell level.
4. Compare the different possibilities for metabolic pathway manipulation
5. Illustrate mathematically the yield coefficient.
6. Outline how one can exploit synthetic biology in metabolic engineering

Evaluate
1. Predict the model for mixed-acid fermentation
2. Compare the different types of enzyme inhibitions
3. Justify the metabolic pathway regulation.
4. Estimate how you will do a heterologous pathway mofication in yeast.

Create
1. Generate a Michales Menten model for enzyme catalysed reaction.
2. Devise a metabolic pathway with different fluxes.

15BT017 NANOBIOTECHNOLOGY 3 0 0 3

Course Objectives
- To develop the skills of the student in the area of Nano biotechnology and its application.
- To familiarize student with different techniques for synthesizing and characterizing of various nanoparticles.
- To motivate and facilitate student to undertake the project and research work in Nano biotechnology.

Course Outcomes (COs)
1. Make the students understand the components of Nano biotechnology
2. Have knowledge about the instruments used in Nano biotechnology.
3. Make them know the applications of Nano biotechnology in various fields.
4. Exhibit the basic knowledge in the interface of Biotechnology and nanotechnology to solve biotechnological problems
5. Implicate the potential of nanomaterials and nanostructures in various real-world applications

UNIT I **9 Hours**

INTRODUCTION TO NANOBIOTECHNOLOGY

Synthesis and Characteristics of nanoparticles; Characterization of Nanoscale materials, Strategies for Nano architecture- bottom up, top down and functional approaches; Carbon nanotubes- properties, synthesis and application.

UNIT II **9 Hours**

DNA AND PROTEIN BASED NANOSTRUCTURES

DNA-gold particle conjugates; DNA nanostructrures for mechanics and computing; Polymer nanocontainers; Peptide nanotubes and their applications electronics, antibacterial agents

UNIT III **9 Hours**

NANOANALYTICS AND NANO-STRUCTURED MATERIALS

Scanning electron microscopy; Atomic force microscopy; Scanning probe microscopy; Mass spectroscopy; Fourier transform infrared spectroscopy; Quantum dots, DNA microarrays; Nano biosensors. Transmission electron microscope-STEM.

UNIT IV **9 Hours**

NANOPARTICLES IN DRUG DELIVERY

Applications of Nano-biotechnology in drug delivery; Polymeric nanoparticles for drug and gene delivery; Protein targeting- targeting signals, translocation and sorting; Micelles for drug delivery

UNIT V **9 Hours**

NANOMATERIALS AND NANOMEDICINE

Cardiavascular implants, Biomaterials for optamology, Structure, property of Biological Materials: tissues, bones and teeth, collagen rich, tissues, elastic tissues, nanostructured collagen mimics in tissue Engineering. Biopolymers: Preparation of nanobiomaterials Polymeric scaffolds collagen, Elastins: Mucopolysaccharides, proteoglycans, cellulose and derivates; Dextrans; Alginates; Pectins; Chitin, nanosurgery.

FOR FURTHER READING

Synthesis of nanoparticles bacteria, fungi, yeast and plants, chemical Transformation of Biomaterials. Protein self-assembly, nanochips, nanopolymers.instruments for thermal characterization of nanomaterials. Synthesis of nanodrugs, nanocomposites. Nanotechnology in cancer research.

Total: 45 Hours

Reference(s)

1. C. M. Niemeyer and C. A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspectives, Weiheim: Wiley-VCH Verlag GmbH and Co. KGaA, 2004
2. T. Pradeep, Nano: The Essentials Understanding Nanoscience and Nanotechnology, New Delhi: Tata McGraw- Hill, 2008.
3. H. S. Nalwa, Encyclopedia of Nanoscience & Nanotechnology, California: American Scientific Publishers, 2004
4. Bhusan, Handbook of Nanotechnology,Berlin, Heidelberg, Germany: Springer-Verlag, 2004
5. P. M. Ajayan, L. S. Schadler, and P. V. Braun, Nanocomposite Science and Technology, Weiheim: Wiley-VCH Verlag, GmbH & Co. KGaA, 2003
6. M. Kohler and W. Fritzsche, Nanotechnology: An Introduction to Nanostructuring Techniques. Weiheim: Wiley-VCH Verlag GmbH & Co. KgaA, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions
Remember

1. Define Nanobiotechnology
2. Define interferometer
3. List the different characterization methods of nanoparticles
4. Define scaffold.
5. Expand MNT
6. Remember who used the word nanotechnology first and when?
7. List the biomaterials used for orthopedic applications
8. Recall the resolution limit of AFM, STM, SEM and TEM.
9. State the principle of Nanotechnology.
10. List out the four ares of nanoscience.
11. State two metals used as orthopedic implants.

Understand

1. Classify scanning probe microscopy
2. Interpret the role of nanotechnology in cancer research?
3. Indicate the role of biodegradable polymers in human welfare
4. Explain the role of QD in FACS
5. Indicate the role of photodynamic therapy in Nanotechnology
6. Explain the use of Transmission Electron Microscope (TEM)
7. Interpret the role of controlled drug delivery for prolonged circulation
8. Explain the fate of nanoparticles afetr drug delivery
9. Explain the carbon nanotube application in tissue engineering.
10. Discover why nanotechnology plays by different rules.
11. Identify four uses of nano crystals.

Apply

1. Construct a nanobiosensor for neurodegenerative disease.
2. Demonstrate the steps involved in the synthesis of gold nanoparticles and in identifying molecular disease.
3. Interpret how micelles are used in drug delivery.
4. Interpret why carbon nanotubes have very high tensile strength.
5. Demonstrate how carbon nanotubes conduct heat.
6. Demonstrate how nanotechnology is useful in destroying tumours of cancer.
7. Sketch the parts of an Atomic Force Microscopy.
8. Demonstrate how polymers are used for the synthesis of scaffold.
9. Interpret how the melting point of materials can be tuned using nanotechnology.
10. Demonstrate two phenomena which are dominant and important at nanoscales.

Analyse

1. Differentiate between nanoparticles and dendrimers
2. Justify the micro fabricated sensors used as central tools in the development of many types of sensors
3. Justify ,nano-sized delivery vehicle suitable for targeted drug delivery
4. Differentiate SWNT and MWNT.
5. Compare and contrast between a biodegradable and non biodegradable implant.
6. Differentiate between TEM and SEM.
7. Examine how the mapping of DNA of a newly born baby be useful.
8. Relate MEMS with NEMS.

Evaluate

1. Justify the importance of controlled drug delivery in the field of medicine.
2. Justify the statement 'Carbonnanutubes find wide applications in nanotechnology'.

Create

1. Investigate how DNA can be conjucated with nanoparticles.
2. Design the method for using commercially available nano drug for Hepatitis C

15BT018 PROTEOMICS AND GENOMICS 3 0 0 3

Course Objectives

- To learn how genomes and proeteoms are being used to provide new insights in biotechnology.
- To understand how a genome and protein sequence is determined and analyzed.
- To formulate genome-related hypothesis and design an experimental plan for testing and analysis.

Course Outcomes (COs)

1. Develop knowledge in genomics and proteomics approaches involved in Biotechnology.
2. Grasp the advanced genome-based concepts
3. Advanced knowledge about the proteomic analysis

UNIT I **8 Hours**

INTRODUCTION

Introduction to genomes, transcriptomes and proteomes; Organisation and structure of genomes; DNA sequencing methods; Recombinant DNA technology; Human genome project; Overview of Protein structure; Introduction to omics: Genomics, Proteomics, Transcriptomics, Metabolomics, Fluxomics.

UNIT II **10 Hours**

GENOMICS

Introduction and scope of genomics, Next generation sequencing methods, Genetic Mapping, Physical Mapping, Integration of mapping methods, Gene variation and Single Nucleotide Polymorphisms (SNPs), Expressed sequenced tags (ESTs), Gene-disease association, Polymorphism, Social, Legal and Ethical Implications of Human Genome Research.

UNIT III **9 Hours**

PROTEOMICS

Introduction and scope of proteomics, Protein separation techniques: ion-exchange, size-exclusion and affinity chromatography techniques, Polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Two dimensional PAGE for proteome analysis, Introduction to mass spectrometry, Protein sequencing, Protein modifications and proteomics.

UNIT IV **9 Hours**

ADVANCED PROTEOMICS AND GEMOMICS

Comparative genomics, Functional genomics, Structural genomics, Personal Genomics, Protein engineering, DNA and Protein chips, Functional proteomics, Quantitative proteomics, Structural proteomics, DNA Protein interactions, Protein Protein interactions, HTP Analysis.

UNIT V **9 Hours**

APPLICATIONS OF GENOMICS AND PROTEOMICS

Systems and Synthetic biology, Genomics based drug design, Predictive Medicine, Cytogenomics, Clinical and biomedical application of proteomics, Applications of proteome analysis to drug.

FOR FURTHER READING

Challenges and future prospects of genomics and proteomic research, Next generation sequencing, NGS Data analysis, Genomics and systems biology, Proteomics and systems biology.

Total: 45 Hours

Reference(s)

1. T.A. Brown, Genomes 3, Garland Science, 2007.
2. D.C. Libeler, Introduction to Proteomics: Tools for the New Biology, Humana Press, 2006.
3. Arthur M. Lesk, Introduction to Protein Science- Architecture, Function and Genomics, Oxford University Press, 2004.
4. Peter Sudbery, Human Molecular genetics, Benjamin-Cummings Publishing Company, 2010.
5. S. R Pennington, and M.J. Dunn, Proteomics: from Protein Sequence to Function First, Viva Books Private Limited, 2002.
6. S.B Primrose and R.M Twyman, Principles of Genome Analysis and Genomics, Blackwell Publishing Co., 2005.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			3			19
3	3					2				5				5									5		20
4	3						2				6			4				6							21
5	3						3			4								4					6		20
																								Total	100

Assessment Questions

Remember

1. Define genome
2. Define proteomics
3. List the base calling programs used in the Human genome projects
4. Give the principle of MS
5. List out the demerits of 2D SDS-PAGE.
6. Write the pros and cons of MALDI
7. Give the importance of electrosprayÂ in colloid thruster?
8. Give the need for genomic studyÂ for the drug development
9. Define peptide mass fingerprinting?
10. Define micro satellites?

Understand

1. The drug efficacy varies depending on their genetic variations – Validate
2. Illustrate the steps involved in the massive parallel signature sequencing
3. Explain about protein designing in detail
4. Explain why protein exists as Protein-protein partner.
5. Explain the advantages and disadvantages of using PCR for sequencing
6. Illustrate the steps involved in the massive parallel signature sequencing
7. Discuss on Genome Annotation
8. Differentiate homology modeling and Threading
9. Describe about protein designing
10. Discuss about the prediction of protein structure.

Apply

1. Illustrate the steps involved in the HTPs methods.
2. Explain the advantages and disadvantages of using PCR for sequencing
3. Explain how SAGE is different from DNA microarrays?
4. Illustrate the steps involved in the massive parallel signature sequencing
5. Give the significance of SDS PAGE?
6. Determine the sequence of protein via the indirect sequencing of the gene encoding the protein
7. Describe the mass spectrometers employed for the protein identification?
8. Explain how will you determine the mass of a protein?
9. Explain how electrospray is used in colloid thruster
10. Give the reason for PCR significanceÂ in high throughput sequencing?

Analyse

1. Justify the significance of PCR in HTP.
2. “Proteome changes over the time” – Justify the statement
3. Justify how HTP sequencing of genome data is carried out.
4. Proteome changes over the time – Justify the statement
5. High throughput sequencing is necessary for the sequencing of the vast amount of genome data in the organisms - Justify.
6. Distinguish between functional genomics and comparative genomics
7. Explain how can you ionize sample in MS?

Evaluate

1. Depict the steps in comparative genomics in drug design.
2. Design a possible purification procedure for a GST tagged, 20 kDa protein over expressed in E. coli
3. The Assembler programs are not useful in Human genome project – validate

Create

1. Design a possible purification procedure for a GST tagged, 20 kDa protein over expressed in E. coli
2. Determine the sequence of protein via the indirect sequencing of the gene encoding the protein

15BT019 ENZYME AND PROTEIN ENGINEERING 3 0 0 3

Course Objectives

- To study the structural, physical and chemical characterization of proteins
- To learn the stability, dynamics, structure/function relationships and folding of proteins
- To understand enzyme engineering, their industrial, analytical, medical and environmental applications and design, fabrication and function of enzyme biosensors

Course Outcomes (COs)

1. Gain knowledge on structure of protein and action of enzymes as catalyst
2. Analyze the working of various enzymes and their conformational changes
3. Understand the methods of engineering enzymes
4. Study the technique of protein sequencing and synthesis of peptides
5. Design and fabricate enzyme biosensors for environmental applications

UNIT I **9 Hours**

BASIC STRUCTURAL PRINCIPLES OF PROTEIN AND INTRODUCTION TO ENZYMES

Amino Acids properties (size, solubility, charge, pKa), Kyle-Doolittle (Hydropathy) Index; Peptides as building blocks of proteins; Torsional (dihedral) angles, Ramachandran Plot; Secondary Structures of proteins; Loops ? Types and Functions;Principle of catalysis,collision theory, transition state theory; role of entropy in catalysis. Enzymes as catalysts, Classification of enzymes.Mechanisms of enzyme-action

UNIT II **9 Hours**

TECHNIQUES OF MUTAGENESIS

Rational Design, Non rational design, Mutagenesis library construction- Chemical, Staggered Extension, Random Elongation, Random priming, Error prone PCR , Impact of structure analysis and prediction-structure and modeling, role of biocomputing, denova design.

UNIT III **9 Hours**

ENGINEERING ENZYMES

Engineering stability (Bacillus subtilisnetural protease, Pseudomonas isoamylase, carbamylase from Agrobacterium radiobacter), specificity and features to ease protein purification, Engineering antibodies-Engineering signal molecules (hormones/ receptors), Engineering protein to facilitate recovery.

UNIT IV **9 Hours**

METAGENOMICS

Metegenomics and ecosystems Biology- conceptual framework, tools and methods- Analyses of metagenomics, Single gene approach, Targeted partial metagenome sequencing, Analyses of metatranscriptome- Limitation in anlaysing the metatranscriptome- 16s rRNa sequencing and metatranscriptomepyrosequencing, metaproteome-molecular methods to study complex microbial communities, metabolomics- metabolome of an ecosystem and metagenomics.

UNIT V **9 Hours**

ENZYME ENGINEERING AND BIOSENSORS

Chemical and genetic methods, Property alteration, Prediction of enzyme structure, design and construction of novel enzymes; Applications; Extreme conditions; reactions in organic solvents; antibodies as enzymes; Application of enzymes in analysis; design of enzyme electrodes, Classification and Design of enzyme biosensors.

FOR FURTHER READINGS

Ramachandran plot, mechanisms of enzyme action, Site directed mutagenesis, RNA techniques, Enzyme immobilization and kinetics, Sensors

Total: 45 Hours

Reference(s)

1. Lilia Alberghina, Protien Engineering in Industrial Biotechnology, Harwood Academic publications, 2005.
2. P. C. E. Moody and A. J. Wilkinson, Protein Engineering,IRL Press, Oxford, 1990.
3. Wiseman, Enzyme Biotechnology, Ellis Horwood Publishers, 1995.
4. Chaplin and Bucke, Enzyme Technology, Cambridge University Press, 1990
5. Price and Stevens, Fundamentals of Enzymology, Oxford University Press, 2002
6. E. K. Pye and L. B. Wingard, Enzyme Engineering II, Plenum Press, 1974

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2				2				2				2							10
2	2					2				2				2				2							10
3	2					2				1								1							6
4	2					2				3								1				2			10
5	2					2				2															6
																								Total	42

Assessment Questions

Remember

1. Define Amino Acids
2. Define Metegenomics and ecosystems Biology
3. Define Single gene approach
4. Define BIOSENSORS
5. Define Kyle-Doolittle (Hydropathy) Index
6. Enlist the Aromatic and Imino amino acids
7. Define Staggered Extension
8. Define Catalytic antibodies
9. Define Mutagenesis
10. Define Pyrosequencing

Understand

1. Classify Amino Acids based on their charge and functional groups present in them
2. Discuss properties such as size, solubility, charge and pKa of amino acids
3. Describe the Secondary structure of Proteins

4. Define Loops, Domains and Motifs in Protein structures
5. Classify enzymes based on their functional roles.
6. Briefly explain theÂ Mechanisms of enzyme-action
7. Explain Rational Design andÂ Non rational design of Mutagenesis
8. Explain the process of Mutagenesis library construction
9. Give the Limitations in anlaysing the metatranscriptome
10. Differentiate Metaproteome and Metatranscriptome

Apply

1. Define ramachandran plot and explain its application in determining conformations of proteins.
2. Differentiate collision theory and transition state theory
3. Discuss onÂ Random Elongation and Random Priming
4. Briefly explain the role of Biocomputing
5. Explain the specificity and features to ease protein purification
6. Explain the process of Engineering Antibodies and Signal molecules
7. Explain 16s rRNa sequencing and metatranscriptome pyrosequencing
8. Explain the techniques involved in Prediction of enzyme structure
9. Explain the concept of Enzyme engineering and its applications
10. Explain the Classification of enzyme biosensors.

Analyse

1. Analyse the Types and Functions of Loops in Proteins
2. Explain how Enzymes act as catalysts
3. All Enzymes are Proteins but not all proteins are Enzymes -Justify
4. Anayse Error prone PCR
5. Analyse Metabolomics and explain metabolome of an ecosystem
6. Analyse the design andÂ construction of novel enzymes
7. Explain how antibodies act as enzymes

Evaluate

1. Explain the role of entropy in catalysis.
2. Critically evaluate the Design of enzyme biosensors.
3. Evaluate Engineering stability in Bacillus subtilisnetural protease,Pseudomonas isoamylase and Carbamylase from Agrobacterium radiobacter

Create

1. Design an enzyme biosensors for detection of any infectious disease.
2. Create a model design of enzyme electrode to use in Enzyme Biosensors

15BT020 BIOENTREPRENEURSHIP 3 0 0 3

Course Objectives

- To develop the Creativity, responsibility, freedom to be able to decide what work one wants to do and how, dedication, diversity and last but not the least having fun and enjoying what one does.
- To develop the entrepreneurial skill in the field of biotechnology
- To learn the Business strategy and Technology Transfer

Course Outcomes

1. Project management, communication, finance, marketing and networking

UNIT I **9 Hours**

INTRODUCTION

Entrepreneurship, Definition; Factors necessary for Entrepreneurship, Attributes in an Entrepreneur, Bioentrepreneurship; Indicators of Bio entrepreneurship

UNIT II **9 Hours**

COMPONENTS OF A BIOTECH COMPANY

Paths for starting new Biotech ventures, History of establishment of pioneer biotechnology companies, Key for success, Mission and Strategy, product selection for new Biotech venture

UNIT III **9 Hours**

BIOTECH BUSINESS MODELS

Vertical model, Platform Business Model, Hybrid Model, Service Business Model from Genomics based companies

UNIT IV **9 Hours**

BUSINESS PLAN

General considerations, Business plan – Do's and dont's, How to write Business proposal, Checklist for Business proposal writing,

UNIT V **9 Hours**

BUSINESS STRATEGIES AND TECHNOLOGY TRANSFER

Intellectual property in biotech - Licensing, Accessing University technology, Licensing of Biotechnological invention

FOR FURTHER READING

Building of a Bioentrepreneur, Successful Bioentrepreneur in India.,Product Model,Deficiencies in start up Business Plan, Funding agencies in India

Total: 45 Hours

Reference(s)

1. Rajeev roy ,Entrepreneurship, oxford publications 2nd edition, 2011
2. S. N. Jogdand, Entrepreneurship and Business of Biotechnology, Himalaya Publishing Home, 2007.
3. R Oliver, The coming biotech age: The business of biomaterials. New York: McGraw Hill, 2000
4. S. Shaleesha. Bioethics, Wisdom educational service, Chennai, 2008.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		4				4	2				2			4				2				2			20
2		5				5									8				2						20
3		6				3				4				7											20
4		5				5									6			2				2			20
5		3					4			6					4				3						20
																								Total	100

Assessment Questions

Remember

1. Give the classification of entrepreneurs.
2. List the Indicators of Bio entrepreneurship.
3. Define IPR.
4. Define Value Chain.
5. Define Bioentrepreneurship.
6. List the Do’s and don’ts in business planning
7. Give the basic keys necessary for success
8. State Bankruptcy law.
9. Name the major 5 P`s in marketing mix
10. Define Break-even analysis.

Understand

1. Explain how to turn a scientist into an entrepreneur
2. Enlist the three types of capital needed for a startup company
3. Describe the barriers for the growth according to the biotech companies
4. Distinguish business plan from business models.
5. Comment on “win - win” business models.
6. List out the different types of licensing agreements
7. Distinguish opportunity Vs necessity based entrepreneurship
8. Describe the essential paths for starting new biotech ventures
9. Explain life sciences industry cycle
10. Brief out the Technology transfer methods in India

Apply

1. Explain the various paths and legal issues associated with starting new biotech ventures
2. Describe the role of Public perceptions in product development patent laws
3. Elaborate the importance of checklist in writing business proposals
4. Explain the various types of intellectual property rights (IPR) and its protection
5. Discuss in detail about the various funding agencies in India
6. Interpret on licensing of biotechnological invention
7. Explain the service business model from genomics based companies
8. Explain Bioethics and current legal issues in marketing
9. Explain Vertical model and Platform Business Model
10. Give the Checklist for Business proposal writing,

Analyse

1. Figure out the Deficiencies in startup Business Plan.
2. Give the role of higher authority in case of Managerial responsibilities & skills
3. Differentiate Spin- offs versus start-ups.
4. How PBRs will help to protect crop varieties?
5. Give a note on Copyrights, TRIPS & IPR protection
6. Describe the patent application procedure in India? Who can apply for a patent? Elaborate on the documentation required for filing a patent application.
7. Enlist the Indicators of Bio entrepreneurship
8. Explain Hybrid Model and Service Business Model

Evaluate

1. Comment on "Innovation is the hall mark of the entrepreneurship
2. Discriminate capital, debt and equity.
3. Explain the General considerations in Business plan
4. Evaluate Intellectual property licensing in biotechnology

Create

1. Develop the business plan for starting Bio ventures in a very competitive market.
2. Create a business proposals based on the opportunity available around you.

15BT021 MARINE BIOTECHNOLOGY

3 0 0 3

Course Objectives

- To give an overview of marine environment and its living and nonliving resources in support of marine biotechnology
- To impart a comprehensive understanding on marine microbiology from basics to advances in the field.

Course Outcomes (COs)

1. To learn the advanced techniques and tools used in recombinant DNA technology, genomics and proteomics and their applications in marine genomics and proteomics.
2. To train the students in various theoretical and practical aspects of screening, isolation, characterization and production of bioactive compounds from marine environment, and their clinical application.
3. To give an overview on bioinformatics and its application in marine biotechnology

UNIT I **9 Hours**

ISOLATION OF MARINE NATURAL PRODUCTS

Marine chemical ecology; Collection of marine Organisms; Isolation and separation of marine natural products from marine flora and fauna; Common extraction methods; solvents used; partitioning; bioassay guided fractionation; chromatographic systems used for separation.

UNIT II **9 Hours**

BIOACTIVE COMPOUNDS AND BIOMATERIALS FROM MARINE ENVIRONMENT

Diversity of marine derived compounds - Alkaloid, Terpenoids and steroides, nucleoside, aminoacids, peptides, depsipeptide, Marine Toxins - Paralytic shellfish poisoning (PSP), Neurotoxic shellfish poisoning (NSP), Diarrhetic shellfish poisoning (DSP), Ciguatera poisoning, Amnesic shellfish poisoning

(ASP), azaspiracid shellfish poisoning, tetradotoxin, other miscellaneous toxins; Marine Enzymes-protease, lipase, chitinase, glucanase; Marine biominerals; Biominerelized structures; Biocomposites; Biopolymers - polysaccharides, chitin, marine collagens.

UNIT III **9 Hours**

SCREENING PLATFORMS AND INSTRUMENTATION

Assay plates; Spectrophotometers; Micro-plate readers; Fluorescence assisted cell sorting (FACS); Fluorescence Microscopy; Atomic Force Microscopy (AFM); Chromatography – basic considerations, FPLC, HPLC, HPTLC; Mass spectrometry; Microarrays; Gene chips; Protein arrays; Protein chips; Automated and robotic Systems.

UNIT IV **9 Hours**

HIGH-THROUGHPUT SCREENING ASSAYS

Types of HTS assays: *In vitro* biochemical and cell based assays; Isotopic detection techniques; Non-isotopic detection techniques; Enzyme linked immunosorbent assay; Radio immunoassay; Scintillation proximity assays; Chromogenic assays; Fluorescence assays; Fluorescence correlation spectroscopy; Fluorescence life time assays; Fluorescence resonance energy transfer (FRET), Electrochemiluminescence.

UNIT V **9 Hours**

BIOASSAYS FOR SCREENING ENZYMES AND BIOACTIVE MOLECULES

Enzyme assays- protease, lipase, amylase, cellulase; Bench top and primary bioassay screens -; micro well cytotoxicity assay; antibacterial assay; antifungal; antiviral and anticancer assay; MTT assay; LDH assay; Caspase assay;Assays for tropical diseases - antimalarial assay, Larvicidal assay, Molluscicidal assay, Amoebicidal assay, antidiabetic activity assay; Diuretic activity assay; Antifouling assay.

FOR FURTHER READING

Discovery and development cycle of drugs - toxicity evaluation, animal experiments, clinical trails protocols, ethical considerations; Marine derived drugs in preclinical and clinical trail- their source, nature, mode of action and targeted diseases; FDA approved and EMEA approved marine derived drugs and their use and mode of action.

Total: 45 Hours

Reference(s)

1. Atta-ur-Rahman, Iqbal Choudhary, M., and Thomsen, W.J. eds. 2005. Bioassay Techniques for Drug Development (Taylor and Francis).
2. Seethala, R., and Fernandes, P.B. eds. 2001. Handbook of Drug Screening (Marcel Dekker Inc).
3. Zhang, L., and Demain, A.L. eds. 2005. Natural Products Drug Discovery and Therapeutic Medicine. Humana Press.
4. Lansing Taylor, D., Harkins, J.R., and Giuliano, K.A. eds. 2007. Methods in Molecular Biology, Volume 356. Humana Press.
5. Braga, P.C., and Ricci, D. eds. (2005). Methods in Molecular Biology, Volume 242.
6. Hammes, G.G. ed. 2005. Spectroscopy for the biological sciences. Wiley Interscience.
7. Kastin, A.J. ed. 2006. Handbook of biologically active peptides. Elsevier.
8. D.S. Bhakuni and D.S. Rawat 2005 Bioactive Marine Natural Products (Springer and Anamaya Publishers, New Delhi, India.
9. Ehrlich**,** Hermann ed 2010. Biological Materials of Marine Origin. Invertebrates (Springer)
10. http://www.mdpi.com/journal/marinedrugs

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		6				4					6			4											20
2		5				5									8				2						20
3		6				3				4				5								2			20
4		5				5									4			2				2			18
5		3					4			6					6				3						22
																								Total	100

Assesment Questions

Remember

1. Define Marine chemical ecology
2. Indicate the role of marine enzyme in Biotech industry
3. List five biominerals from marine organisms
4. Recall the solvents used to extract marine bioactive compounds
5. Illustrate five types of shell fish toxin with examples.
6. Explain diversity of marine derived compounds-Alkaloids,Terpenoids,Peptides,Steroids
7. Explain five types of marine enzymes with examples
8. Recall Biopolymer
9. List the various cytotoxicity assays
10. Describe the role of FRET

Understand

1. Explain the current research on Marine chemical ecology
2. Describe the techniques available to Collect marine Organisms
3. Expand NSP
4. Expand Caspases and mention its role
5. List the side effects of NSP
6. Expand FACS
7. Define: Electrochemiluminescence
8. Examine the protocol to identify the Terpenoids from Marine Algae
9. Describe the concept of radio Immunoassay
10. Enlist the isotopic detection methods

Analyze

1. Differentiate between chitin and chitosan based on solubility
2. Indicate the role of tetradoxin in human metabolism
3. Differentiate between FPLC and HPLC
4. Classify the Biominerals in detail
5. Diffrentiate between Radio immunoassay and Scintillation proximity assays

Evaluate

1. Interpret the principle behind AFM
2. Support the characteristics of gene chips and protein chips
3. Justify the principle of assay plate reader available in laboratory
4. List the six Types of HTS assays: In vitro biochemical and cell based assays

Create

1. Construct the procedure to find the valuable compounds from marine sponge as a source and identify the methods to check anti microbial activity and anti cancer activity

ENTREPRENEURSHIP ELECTIVES

15GE001 ENTREPRENEURSHIP DEVELOPMENT I

3 0 0 3

Course Objectives

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc

Course Outcomes (COs)

1. Able to gain Knowledge about entrepreneurship, motivation and business.
2. Able to develop small scale industries in different field.

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractionation, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

FOR FURTHER READING

Role of social networking sites in business

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3							2	2			1		2			2		2		2		4		20
2		3					2			2		2		2		2			3			4			20
3			3			2					2				2			4		3			4		20
4				3			2			2			2			3		4						4	20
5		1		2				2		2		2			2				5			4			20
																								Total	100

Assessment Questions

Remember

1. What is entrepreneurship?
2. What are the factors that motivate people to go into business?
3. Define a small-scale industry
4. Who is an intrapreneur?
5. State functions of SISI
6. What is serial entrepreneur?
7. What is Technopreneurship?
8. What is reversal method?
9. What is brainstorming?
10. What do you mean by term business idea?
11. Mention any two schemes Indian government provides to the development of entrepreneurship
12. What is a project report?
13. What is project scheduling?
14. Mention any four techniques available for project scheduling.
15. Define MOU.
16. Mention any five external sources of finance to an entrepreneur.
17. Classify the financial needs of an organization
18. Why is motivational theories important for an entrepreneur?

Understand

1. Why is entrepreneurship important of growth of a nation?
2. Mention the essential quality required for someone to be an entrepreneur.
3. How is network analysis helpful to the development of an entrepreneur?
4. Mention the essential requirements for a virtual capital.
5. How under-capitalization affects an entrepreneur
6. Mention the causes of dissolution of a firm.
7. How important is the support of IDBI to an entrepreneur?
8. What are the salient features of New Small Enterprise Policy, 1991?
9. Why scheduling is very important for a production design?

Apply

1. If you want to become as an entrepreneur, what will be your idea?
2. Select any one of the creative idea generation method and suggest an innovation that you can implement in your business.
3. Write a short notes on various legal aspects that you have to consider to run you business.
4. How will you generate your capital and other financial supports?
5. In case of getting enough financial support, plan your business and plot the various stages using any of the tools or techniques

Create

1. Draft a sample project report for your business
2. Do a network analysis using PERT and CPM for your business plan.
3. Write a brief report to apply to a financial organization for seeking financial support to your business

15GE002 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promoting the product / services
- Handle the human resources and taxation
- Understand Government industrial policies / support provided and prepare a business plan

Course Outcomes (COs)

1. Increase in awareness of the entrepreneurship Development for engineering decisions.

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment,Segmentation, Targeting and positioning, Formulating marketing strategies,Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

FOR FURTHER READING

Ethics in Entrepreneurship

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.htm

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	2			2	2					2	2				2				2	20
2	2									6					6							6			20
3		3				2					3			3					3		3			3	20
4			3				3			3					3		3		3				2		20
5			3				3					3			3						3	2		3	20
																								Total	100

Assessment Questions

Remember

1. Who are Fabian Entrepreneur?
2. Mention the three functions of NSIC?
3. Narrate the role of IDBI in the development of Entrepreneurship?
4. What are the stages in a Project Lifecycle?
5. Give the meaning of Feasibility Report
6. What is Motivating Training?
7. Who is a Small Scale Entrepreneur?
8. How to develop Rural Entrepreneur?
9. What are the Social Problems of Women Entrepreneur?
10. What are the types of entrepreneurs?
11. List the various qualities of entrepreneur.
12. What is entrepreneurship training?
13. State the role of NISIET.
14. List the challenges and opportunities available in SSI's?

Understand

1. What are the elements of EDP?
2. How would you Classify Projects?
3. What is the role played by commercial banks in the development of entrepreneur?
4. What are the target groups of EDP?
5. What are the major problems faced by Small Entrepreneur?
6. What are the problems & prospects for women entrepreneur in India?

Apply

1. Describe the various functions performed by Entrepreneurs?
2. Explain the role of different agencies in the development of Entrepreneur?
3. Discuss the criteria for selecting a particular project?
4. Describe the role of Entrepreneur in the Development of Country?
5. Define business idea. Elaborate the problems and opportunities for an entrepreneur.
6. Elaborate the schemes offered by commercial banks for development of entrepreneurship.
7. Explain the significant role played by DIC & SISI for the development of entrepreneurship.

Analyse

1. Differentiate between entrepreneur and entrepreneurship
2. What are the problems of Women entrepreneurs and discuss the ways to overcome these barriers?
3. Discuss the importance of small scale industries in India

Evaluate

1. Review the entrepreneurial growth by the communities of south India.
2. Critically examine the growth and development of ancillarisation in India.

Create

1. Design a short entrepreneurship development programme for farmer.
2. "All economy is the effect for which entrepreneurship is the cause"-Discuss.
3. Discuss the various sources and collection of credit information of entrepreneurs
4. Discuss the role of the government both at the Central and State level in motivating and developing entrepreneurship in India.
5. Briefly explain the recommendation and policy implication for survival of SME's.
6. Developing countries like India need imitative entrepreneurs rather than innovative entrepreneurs”. Do you agree? Justify your answer with examples.
7. Discuss the “Culture of Entrepreneurship” and its role in economic development of a nation. What factors contribute to nurturing such a culture?

PHYSICAL SCIENCE ELECTIVES

15GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Understand the fundamentals of physics of nanomaterials.
- Correlate on multidisciplinary branch.
- Acquire the knowledge in nanomaterials synthesis, compile and analyze data and draw conclusions at nano level.

Course Outcomes (COs)

1. Categorize nanomaterials based on their properties.
2. Design different experimental methods for preparation of nanomaterials.
3. Infer the working mechanism of different characterization instruments as well as analyses and interpret data.
4. Know the different techniques for making nano semiconducting materials and utilize them for applications.
5. Understand the impact of nanomaterials and their applications in nanodevices.

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures,nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - magnetic properties of nanoscale materials -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - chemical vapour deposition, plasma enhanced CVD, colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization - DC sputtering and RF sputtering process.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials.

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LEDâ??s - basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- nano motors -bio nano particles-nano - objects - applications of nano materials in biological field.

FOR FURTHER READING

Application of graphene in various field - supercapacitors - third generation solar cell-dye sensitized solar cell (DSSC) -fuel cells.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007.
3. Guozhong Cao, Y. Wang, Nanostructures and Nanomaterials-Synthesis, Properties & Applications, Imperials College Press, 2011.
4. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw - Hill Education (India) Ltd, 2012.
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, Fuel cells: Principles and Applications, University Press, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	4	4		2					4				3					4						24
2	2	3	4		4	4				3				4											24
3	2	4	2			2	2				2			2											16
4		2			2	4				2				4					3						17
5	2	4				3	2				4				4										19
																								Total	100

Assessment Questions

Remember

1. Explain the term nano
2. List three types of classifications of nanomaterials.
3. Recall the principle behind lithography.
4. Define top-down and bottom-up approach.
5. Name two types of nanoarchitecture
6. Define nanocomposites.
7. Recall the principle of electron microscopy.
8. List 5 characterization techniques in nanotechnology.
9. Define quantum well and quantum wire**.**
10. Write the allotropy of carbon.

Understand

1. Explain the effect of nanometer length scale.
2. Can affect the system total energy when particle size reduced? Justify.
3. Explain plasma enhanced CVD.
4. Identify the difference between self-assembly and self-organization.
5. Name 3 synthesis process under bottom-up approach.
6. Explain contact mode in AFM.
7. Is it possible to explain the entire details of the sample by taking one characterization technique? if no, justify.

Apply

1. Find three day to day live commercial application of nanotechnology
2. Choose two template methods used to obtain nanowire or nanorods.
3. Construct the experimental setup for organic LED.
4. Find 4 industrial applications of CNT.

Analyse

1. Differentiate between bulk and nanomaterials.
2. Identify the roll of nanoparticles in biological field.
3. Distinguish between glow discharge and RF sputtering.
4. Criticize the future challenges for nanotechnology

Evaluate

1. Nanomaterials, do they exist in nature? If yes, identify the nanomaterials and recognize.

15GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials.
- Analyze the factors affecting the operation of semiconductor devices.
- Apply the physics of semiconductors to develop semiconductor devices.

Course Outcomes (COs)

1. Exemplify the transport properties of semiconductors.
2. Understand the physics of PN junction.
3. Analyze the factors affecting the properties of PN junction diode.
4. Demonstrate the geometry and operation of bipolar junction Transistors.
5. Summarize the optical properties and design of optoelectronic devices.

UNIT I **9 Hours**

CARRIER TRANSPORT IN SEMICONDUCTORS

Carrier drift - drift current density - mobility effects on carrier density - conductivity in semiconductor - carrier transport by diffusion - diffusion current density - total current density - breakdown phenomena - avalanche breakdown.

UNIT II **9 Hours**

PHYSICS OF P-N JUNCTION

Basic structure-Built in potential barrier, Electric field and space charge width of P-N junction under zero, forward and reverse bias- Diffusion capacitance - one sided and linearly graded junctions.

UNIT III **9 Hours**

P-N JUNCTION DIODE

Qualitative description of charge flow in p-n junction - boundary condition - minority carrier distribution - ideal p-n junction current - temperature effects - applications - the turn on transient and turn off transient.

UNIT IV **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

Introduction to basic principle of operation - the modes of operation - amplification - minority carrier distribution in forward active mode - non-ideal effects - base with modulation - high injection emitter band gap narrowing - current clouding - breakdown voltage - voltage in open emitter configuration and open base configuration.

UNIT V **9 Hours**

OPTO ELECTRONIC DEVICES

Optical absorption in a semiconductor, photon absorption coefficient - electron hole pair generation - solar cell - homo junction and hetero junction - Photo transistor - laser diode, the optical cavity, optical absorption, loss and gain - threshold current.

FOR FURTHER READING

Organic semiconductors- diodes - transistors-working and applications

Total: 45 Hours

Reference(s)

1. Donald A Neamen, Semiconductor Physics and Devices, Tata McGraw Hill, 2012.
2. S. M. Sze and M. K. Lee, Semiconductor Devices, Physics and Technology, John-Wiley & Sons, 2015.
3. Ben. G. Streetman and S. K. Banerjee , Solid State Electronic Devices, Pearson Education Ltd, 2015.
4. C. Kittel, Introduction to Solid State Physics, John-Wiley & Sons, 2012.
5. J. Millman and C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill, 2010.
6. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley-VCH, 2006.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	4	4		2					2				3					2						20
2	2	3	4		4	4				3				4											24
3	2	4	2		2	2					4			4											20
4		2			2	4				2				4					4						18
5	2	4				2	2				4				4										18
																								Total	100

Assessment Questions

Remember

1. Define drift current density
2. Recall diffusion capacitance
3. Write the ideal diode equation
4. List the three modes of transistor operation
5. State the principle of solar cell

Understand

1. Identify the two scattering mechanisms that affect mobility of charge carriers in semiconductors
2. Sketch the energy band diagram of a P-N junction under thermal equilibrium
3. Exemplify the boundary conditions used to calculate minority carrier distribution in a junction diode
4. Explain the base width modulation occur in transistors
5. Illustrate the working mechanism of a phototransistor

Apply

1. By applying the concept of scattering, explain the mobility of holes in a semiconductor.
2. Apply Poission equation to space charge region and hence derive the electric field under zero bias
3. Show that the minority carrier concentrations in a diode decay exponentially with distance away from the junction to their thermal-equilibrium values.

4. Derive an expression for excess minority current in the emitter region under forward action mode by applying the ambipolar transport equation.
5. Show that the minority carrier concentrations in a diode decay exponentially with distance away from the junction to their thermal-equilibrium values.

Analyse

1. Differentiate drift current and diffusion current
2. Space charge width increases upon reverse bias. Justify
3. Silicon is preferred over germanium for the manufacture of semiconductor devices. Justify
4. Compare emitter bandgap narrowing and current crowding.
5. Differentiate homojunction and heterojunction laser

15GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science.
- Explore different strategies for producing lasers.
- Create expertise on the applications of lasers in various fields.

Course Outcomes (COs)

1. Realize the concept of stimulated emission and apply the same for laser oscillation.
2. Understand the properties laser and working of different laser systems.
3. Determine the rotation of earth, velocity and distance using lasers and apply the same for day today applications.
4. Design the different laser based instrumentation for medical field.
5. Summarize the applications of lasers in industry.

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - Einstein's prediction - spontaneous emission - stimulated emission - Einstein's relations - A and B coefficients - population inversion - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification. Components of lasers: active medium - pumping - pumping mechanisms - resonant cavity.

UNIT II **9 Hours**

CHARACTERISTICS AND TYPES OF LASERS

Introduction - directionality - intensity - coherence - monochromaticity. Classification of lasers - principle, construction, working, energy level diagram and applications of CO2 laser - dye laser - excimer laser - Nd:YAG laser - semiconductor laser.

UNIT III **9 Hours**

LASERS IN SCIENCE

Harmonic generation - stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - LIGO - rotation of the earth - measurement of distance - velocity measurement - holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Eye laser surgery - LASIK - photocoagulations - light induced biological hazards: Eye and skin - homeostasis - dentistry - laser angioplasty - laser endoscopy - different laser therapies.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting. Laser tracking: LIDAR. Lasers in electronics industry: ranging - information storage - bar code scanner. Lasers in defence: laser based military weapons - laser walls.

FOR FURTHER READING

Q-switching - mode locking - thermo-optic effects - astronomy lasers - fighting crime with lasers - laser engraving.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015.
2. M. N. Avadhanulu, An Introduction to Lasers Theory and Applications, S. Chand Publisher, 2013.
3. W. Koechner, M. Bass, Solid State Lasers: a graduate text, Springer Verlag, New York, 2006.
4. K. P. R. Nair, Atoms, Molecules and Lasers, Narosa Publishing House, 2009.
5. K. R. Nambiar, Lasers: Principles Types and Applications, New Age International Publications, 2006.
6. A. Sennaroglu, Solid-State Lasers and Applications, CRC Press, 2006.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	2	1		2	3	1			2			1	2							20
2	2	2			3	2	2		2	2			1	1			1		2						20
3	3				2	2	1		2		3		2	1	1			1	2						20
4	2	2			2	1	1		2	2	1		2	2	1			1	1						20
5	2	1			1		3		2		2		2	1			1	2	3						20
																								Total	100

Assessment Questions

Remember

1. Recognise the term LASER
2. Define stimulated absorption
3. Define spontaneous emission
4. Define stimulated emission
5. Distinguish between spontaneous and stimulated emission
6. State population inversion
7. List the four characteristics of lasers
8. Mention the five medical applications of lasers
9. State the principle behind the holography
10. Recall the term resonant cavity

Understand

1. Identify the condition needed for laser action
2. Interpret the pumping of atoms
3. Exemplify the optical excitation occurs in three level laser systems
4. Explain the determination of rotation of earth using laser
5. Summarize the application of lasers in welding and cutting
6. Explain the term LASIK
7. Classify the different types of lasers based on materials
8. Illustrate the working of laser in material processing

Apply

1. Predict the condition for laser action
2. Derive the Einstein's A and B coefficients
3. Deduce the expression for large stimulated emission
4. Construct the experimental setup for distance measurement
5. Find the applications of lasers in stimulated Raman
6. Assess the wavelength of emission of GaAs semiconductor laser whose bandgap energy is 1.44 eV.

Analyse

1. Laser beam should be monochromatic, Justify?
2. Differentiate ordinary light source from laser source
3. Compare the working of gas lasers with excimer laser
4. Four level laser systems are more efficient than three level laser systems. Justiify**?**

Evaluate

1. Determine the intensity of laser beam be focused on an area equal to the square of its wavelength. For He-Ne laser wavelength is 6328 A^0 and radiates energy at the rate of 1mW.
2. Choose the appropriate lasers for the materials processing in industry

15GE0C1 CORROSION SCIENCE 3 0 0 3

Course Objectives

- Recognize the terminologies used in corrosion science.
- Impart knowledge about the various types of corrosion and its mechanism.
- Understand the various methods of corrosion control, corrosion testing and monitoring.

Course Outcomes (COs)

1. Familiarize with the fundamentals of corrosion science.
2. Understand the types of corrosion and role of chemistry behind corrosion of metals.
3. Develop their ability to identify, formulate and solve corrosion based problems.
4. Calculate the corrosion rate using different methods.
5. Analyze the analytical part of corrosion science which gives contextual knowledge to their higher research programmes.

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - passivation - direct and indirect damage by corrosion - importance of corrosion prevention in industries - area relationship in both active and passive states of metals - Pilling Bedworth ratio and its significance - units of corrosion rate (mdd and mpy) - importance of pitting factor - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages.

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion. High temperature oxidation, kinetics of protective film formation and catastrophic oxidation corrosion.

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - cracking - corrosion fatigue - filliform corrosion - fretting damage and microbes induced corrosion - corrosion mechanism on steel, iron, zinc and copper metal surfaces - thick layer and thin layer scale formation - in situ corrosion scale analysis.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: factors affecting corrosion - electrochemical methods of polarization - Tafel extrapolation polarization, linear polarization, impedance techniques - weight loss method - susceptibility test - testing for intergranular susceptibility and stress corrosion. Visual testing - liquid penetrant testing - magnetic particle testing - eddy current testing.

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection. Stray current corrosion problems and its prevention. Protective coatings: anodic and cathodic coatings - metal coatings: hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of sacrificial anode for corrosion control.

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems.

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, Introduction to Corrosion Engineering, CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, Singapore, 2008.
5. David E.J. Talbot (Author), James D.R. Talbot, Corrosion Science and Technology, Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	2	2		1	2	1		1	1	1		1	1	2		2	1			1				20
2	1	3			2	1	1			2			1	2			1	1					1		16
3	2	1			1	4	1			3				2			2	2				2			20
4	1	1	1		2	3	1		2	2	1		2	1	1		1	2					1		22
5	1	2			1	2			2	3			2	3			1	2			1	2			22
																								Total	100

Assessment Questions

Remember

1. Define Corrosion
2. Mention the five types of corrosion
3. Define dry corrosion. Explain the mechanism.
4. What are corrosion inhibitors? Give two examples.
5. What are corrosion inhibitors? Give two examples.
6. Write the working principle of Tafel polarization techniques.
7. How polarization and impedance techniques are used to measure the corrosion products?
8. Define cathodic protection.
9. Elaborate non-electrochemical and electrochemical methods of corrosion testing and monitoring.
10. What is Tafel linear polarization?
11. What is Tafel linear polarization?

Understand

1. Explain the mechanism of electrochemical corrosion.
2. Identify the relation between the two units used to measure corrosion rate.
3. Illustrate the Pourbaix digrams of Mg/Al/Fe and their limitations.
4. List the eight forms of corrosion. Explain each type with an example.
5. What are the factors influencing the corrosion rate? Explain.
6. Discuss the Pilling-Bedworth rule.
7. Differentiate between electrochemical and dry corrosion.
8. How inhibitors are used to protect the corrosion rate of the metal? Explain.
9. What are consequences of Pilling-Bedworth ratio?
10. List the difference between filliform corrosion and pitting corrosion.

Apply

1. Area relationship between the anodic and cathodic part in galvanic corrosion. Discuss.
2. Describe alternatives to protective coatings.
3. How Tafel polarization and impedance techniques used to measure the corrosion products?

Analyse

1. Explain why corrosion rate of metal is faster in aqueous solution than atmosphere air?
2. Why pitting corrosion is localized corrosion? Explain.
3. Compare the effects of corrosion products.
4. Identify different forms of corrosion in the metal surface.
5. What are the major implications of enhanced techniques of corrosion product analysis?

15GE0C2 ENERGY STORING DEVICES AND FUEL CELLS 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles.
- Identify the types of fuel cells and to relate the factors of energy and environment.
- Analyze various energy storage devices and fuel cells.

Course Outcomes (COs)

1. Understand the knowledge of various energy storing devices.
2. Acquire the knowledge to analyze the working of different types of primary and secondary batteries.
3. Differentiate the types of fuel cells and recognize the utility of hydrogen as a fuel.
4. Realize the importance of using green fuel for sustainable development.

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of practical batteries - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries- zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells.

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - biomass pyrolysis -gas clean up - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy - life cycle assessment of fuel cell systems. Solar Cells: energy conversion devices, photovoltaic and photoelectrochemical cells - photobiochemical conversion cell.

FOR FURTHER READING

Energy conservation, Over utilization, Energy demanding activities.

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009.
2. F. Barbir,PEM fuel cells: Theory and practice,Elsevier, Burlington, MA, Academic Press, 2013.
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001.
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012.
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016.
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2			1	2	2			1			1	3				1							15
2	4	1			4	5	2			2			1	2				1							22
3	3				4	6	2		1	3			1	1				1							22
4	1	2			4	4	1			4			2	4											22
5	2	2			2	5				3			2	3											19
																								Total	100

Assessment Questions

Remember

1. How galvanic cell is differing from electrolytic cell?
2. How is the potential of an electrochemical cell calculated?
3. List any four characteristics of primary batteries.
4. Mention any two characteristics and applications of zinc-carbon battery.
5. Recognize any two applications and characteristics of primary magnesium batteries.
6. Identify the applications and characteristics of Zn/HgO primary batteries.
7. Indicate any two applications of Zn/alkaline/MnO_2 battery.
8. Mentioned any two applications of Zn/Ag_2O primary battery.
9. Define capacity of a cell
10. Define discharge rate of a battery.
11. Describe the construction, cell reaction and applications of zinc-carbon battery.
12. Explain the construction, chemistry, advantages and uses of mercuric oxide battery.
13. Explain the major components and reaction of direct methanol fuel cell. List two applications.
14. Explain the working principle, components and applications of alkaline fuel cells
15. Discus the conversion of sunlight into electrical power in photoelectrochemical cells.

Understand

1. Mention the five different types of energy storage devices
2. Define the term battery
3. List any two differences between battery and cell.
4. Mention the three major components of cell.
5. Classify the batteries based on their cell reversibility.
6. Define cycle Life of a cell.
7. Explain the construction, cell reaction and applications of silver oxide batteries.
8. With a neat sketch explain the construction and working of phosphoric acid fuel cell.
9. Explain the major components and reactions of direct methanol fuel cell
10. Explain the production of hydrogen photobiochemical conversion cell.

Apply

1. Specific gravity is an indicator of charge in lead acid battery – Justify.
2. Illustrate the process of water electrolysis for the production of hydrogen.
3. How is the potential of an electrochemical cell calculated?
4. How is the potential of an electrochemical cell calculated?

Analyse

1. In the mid-winter car battery is not working –reason out.
2. Discuss the hydrogen energy strategies for sustainable development.
3. How galvanic cell is differing from electrolytic cell?
4. How batteries are rated?
5. Differentiate between primary and secondary batteries.

15GE0C3 POLYMER CHEMISTRY AND PROCESSING 3 0 0 3

Course Objectives

- Impart knowledge on the basic concepts of polymers and its mechanism.
- Use the appropriate polymerization techniques to synthesize the polymers and its processing.
- Select the suitable polymers for various applications.

Course Outcomes (COs)

1. Understand the basic concepts of polymer chemistry and mechanism of polymerization reactions.
2. Acquire knowledge of polymerization techniques.
3. Identify the structural, mechanical and electrical features of polymers.
4. Apply the polymer processing techniques to design polymer products.
5. Realize the applications of specialty polymers.

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical polymerization - cationic, anionic and co-ordination (Ziegler-Natta) polymerization, copolymerization, condensation polymerization (nylon-6,6) ring opening polymerization (nylon-6). Elastomers: Natural rubber - vulcanization - synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone(PEEK), polysulphones, polyimides.

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation.

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties by TGA and DSC, Testing tensile strength, Izod impact, Compressive strength, Rockwell hardness, Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption.

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plactics fabrication: hand-layup - filament winding and pultrusion.

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration.

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International (P) Ltd., New Delhi, 2015.
2. Joel R. Fried, Polymer Science and Technology, Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, Polymer Analysis, John Wiley & Sons, New York, 2008
5. George Odian , Principles of Polymerization, John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, Introduction to Polymers, CRC Press, New York, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	3		2	2	3		2	2	3		1	1	1										22
2	1	1	4		1	1	3		1	1	3		1	1											18
3	1	1	1		1	1			1	2	2			2			1	1	4						18
4	1				1	2	2		3	2	2		2	2	1								2		20
5	1	1	1		2	2	1		2	2	3		2	2	3										22
																								Total	100

Assessment Questions

Remember

1. Recall two factors that govern termination of cationic polymerization.
2. Identify the monomers used in styrene -butadiene rubber.
3. Give an examples for the thermosetting and thermoplastic polymers.
4. What is copolymerization? Give an example
5. Name two synthetic polymers which are used for making textile fibres.
6. Define the role of Ziegler – Natta catalysts
7. List the examples of Ziegler – Natta catalysts.
8. Identify the four types of polymerization technique.
9. List any two disadvantages of suspension polymerization.

10. Point out the advantages of bulk polymerization technique.
11. Why does natural rubber need compounding?
12. List any four applications of injection moulding process.
13. List the various additives in processing of plastics.
14. List the two properties of heat resistant polymers.
15. Mention the application of flame retardant polymers.

Understand

1. Classify the polymers based on source
2. Discuss the addition and chain growth polymerization with example
3. Compare addition and condensation polymerization reaction with example for each type.
4. Explain homogeneous and heterogeneous polymerization.
5. Explain the mechanism involved in addition polymerization of vinylChloride
6. Explain the condensation polymerization method taking nylon 6, 6, nylon synthesis as a representative example.
7. Discuss the preparation method and any three properties of Polysulphone.
8. Summaries the salient features, advantages and disadvantages of bulk and emulsion polymerization techniques.
9. Compare the homogeneous and heterogeneous polymerization method.
10. With a neat sketch, discuss the functioning of melt, dry and wet spinning process.
11. Illustrate the compression and extrusion moulding of plastics with diagram neat diagram.
12. Explain the coordination polymerization mechanism using a sutable example.

Apply

1. Relate the various steps involved in anionic and cationic polymerisation using suitable examples.
2. Select the suitable polymerization techniques for synthesis of PMMA and SBR
3. Assess the characterisation techniques used to find the structure of polymer.
4. Find the method to process the composite materials with example.
5. Execute the filament – winding Technique for manufacturing of rocket motor bodies.

Analyse

1. Distinguish between addition and condensation polymerisation.
2. Natural rubber need vulcanization –Justify.
3. Compare the salient features, advantages and disadvantages of solution and suspension polymerization techniques.
4. Bring out the differences between thermoforming and vacuum-forming process.
5. Outline the applications of polymer in controlled drug delivery and artificial organs.

Evaluate

1. Judge the biomedical applications of polymers in Hemo dialysis and hemo filtration.
2. Choose the suitable moulding Technique for polyvinyl chloride.

15BT0YA WASTE MANAGEMENT AND UTILIZATION

3 0 0 3

Course Objectives

- To study the properties an characteristics of wastes
- Solid waste characteristics and treatment methods
- To learn the various power generation systems

Course Outcomes (COs)

1. Isolate and Identify the microorganisms from contaminated sites
2. Biologically treat different types of wastes
3. Produce biogas from multifarious wastes

UNIT I **9 Hours**

SOLID WASTE - CHARACTERISTICS AND PERSPECTIVES

Definition - types - sources - generation and estimation. Properties: physical, chemical and biological regulation

UNIT II **9 Hours**

COLLECTION AND PROCESSING TECHNIQUES

Onsite handling, Types of waste collection mechanism, volume reduction : mechanical and thermal methods, mechanical and magnetic electro mechanical separation, Land Fill Method of Disposal - classification, types, method;

UNIT III **9 Hours**

HAZARDOUS WASTE

The Hazard; EPAHazardous waste designation system; RCRA and HSWA; CERCLA and SARA; waste management techniques; disposal of radioactive elements; treatment technologies; land disposal techniques

UNIT IV **9 Hours**

POWER GENERATION FROM WASTE I

Basics, types, working and typical conversion efficiencies of composting anaerobic digestion, factors affecting bio-digestion, RDF, incineration, gasification, pyrolysis

UNIT V **9 Hours**

POWER GENERATION FROM WASTE II

Biomass introduction, bio-mass conversion technologies (wet and dry process), photosynthesis, agricultural waste derived energy, urban waste derived energy.

FOR FURTHER READING

Waste generation, Environmental quality monitoring at Landfills, Ground water contamination and remediation, classification of bio-gas plants, Energy plantation.

Total: 45 Hours

Reference(s)

1. L.D. Mackenzie and J.M. Susan, Principles of Environmental Engineering and Science, Mc Graw Hill, 2004.
2. R.M. Forbes, R.W. Peter, F. Marina and H. Peter, Integrated Solid Waste Management: A Life Cycle Inventory, Mc Graw Hill, 2009.
3. Wilber, L.C., (1989), Handbook of Energy Systems Engineering, Wiley and Sons.
4. The Energy Research Institute (TERI), New Delhi, Publications.
5. Rai, G.D , Non-conventional Energy Sources, Khanna Publications.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
6																									0
																								Total	100

Assessment Questions

Remember

1. Define Waste water
2. List the design and operational considerations of aerobic composting.
3. Define alum and its use.
4. State the EPA Hazardous waste designation system.
5. State the significance of power generation from wastes.
6. Define pyrolysis
7. Define Biomass
8. Define Photosynthesis
9. List three biogas plants
10. Define onsite handling
11. List the factors that affect bio-digestion
12. Define hazard
13. Define RDF

Understand

1. Classify the types of solid waste
2. Explain the physical and chemical properties of solid waste
3. Identify the sources of solid waste
4. Mention the possible ways of treating a contaminated soil.
5. Give out the composition of solid waste with examples
6. Explain the types of waste collection mechanism
7. Classify the conversion types of Biomass
8. Explain the process to derive energy from urban waste
9. Describe the classification of Land Fill Method of Disposal
10. Describe the chemical properties of solid waste

11. Describe the biological regulation of solid waste
12. Describe urban waste derived energy
13. Describe the method for disposal of radioactive elements
14. Describe the regulation of solid waste
15. Discuss on SARA

Analyse

1. Differentiate solid waste and Liquid waste
2. Differentiate sludge from slurry.
3. How will you monitor the Environmental quality at landfills?
4. Reveal the strategy of hazardous waste disposal
5. Examine the TS, BOD and COD of wastewater.
6. Compare wet and dry process of bio-mass conversion technologies
7. Compare agricultural waste derived energy and urban waste derived energy.
8. Distinguish RCRA and HSWA
9. Explain the types of waste collection mechanism
10. Discuss about CERCLA

Evaluate

1. Check the diagram of an activated sludge process and highlight its structure and applications
2. How many power stations are available in India?
3. How do you generate power from solid wastes?
4. Sketch anaerobic digestion
5. Sketch biogas plant

15BT0YB FOOD PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To know the processing of foods from harvesting to packaging
- To learn the preserving techniques of various food stuffs
- To study the storage and packaging techniques of foods

Course Outcomes (COs)

1. Understand the processing techniques to avoid post harvest losses.
2. Understand the preservation of food using various techniques to maintain quality.
3. Understand the packaging techniques to store the food

UNIT I **9 Hours**

POST HARVEST PROCESSING

Post harvest losses, cleaning, grading and sorting types. Moisture content free moisture, bound and unbound moisture, Role of moisture content - concept of water activity measurement direct and indirect method, equilibrium moisture content, EMC determination methods, hysteresis effect. Theory and mechanism of drying, constant rate and falling rate drying, Thin layer and deep bed drying, methods of drying agricultural materials - batch and continuous drying.

UNIT II **9 Hours**

PRESERVATION BY SALT, SUGAR AND CHEMICALS

Preparation of Juices and pulps, concentrates. Theory of gel formation, Preparation of jam, jellies, marmalades. Chemistry of salt preservation - Sauerkraut, and vinegar production, minimal processing, hurdle technology

UNIT III **9 Hours**

HIGH TEMPERATURE PROCSSSING/PRESERVATION

Methods of applying heat to food. Balancing, Pasteurization and Sterilization.Thermal death time relationships (D, Z and F values). Process calculations: general methods, Ball's formula method. terilization methods and equipments, UHT sterilization,

UNIT IV **9 Hours**

LOW TEMPERATURE PROCESSING/PRESERVATION

Chilling, cold storage and freezing.Thermodynamics of food freezing. Phase diagrams. Formation of ice crystals and its types.Properties of frozen foods.Freezing-time calculations. Freeze concentration,

UNIT V **9 Hours**

PACKAGING AND STORAGE

Testing of packaging material, printing on packages, Bar codes, Nutrition labeling and legislative requirements. Vacuum and Inert Gas Packaging, Gas and water vapour transmission rates. Principles of active packaging, modified atmosphere packaging,.Storage of food grains - factors affecting storage - Types of storage - bag and bulk storage - bag storage requirement. Storage under ambient conditions.

FOR FURTHER READING

Water activity and its importance, Osmotic dehydration, Freeze drying, Aseptic processing and packaging. Aseptic packaging and its applications

Total: 45 Hours

Reference(s)

1. P. J. Fellows, Food Processing Technology: Principles and practice, Third Edition Woodhead Publishing limited, 2009.
2. Paul Singh, R and Dennis R. Heldman, Introduction to Food Engineering, Fourth Edition.Academic Press, 2009.
3. K. M. Sahay, and K.K. Singh, Unit Operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., 2003.
4. R. L. Earle, Unit Operations in Food Processing, Pergamon Press, 1989.
5. Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, Seventh Edition, McGraw-Hill, 2005.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
6																									0
																								Total	100

Assessment Questions

Remember

1. List the five types of sorting followed during harvesting.
2. Retrieve the importance of water activity.
3. List the four methods of canning.
4. Reproduce the properties of frozen foods
5. Define osmotic dehydration.
6. State the theory of gel formation
7. List the five different types of packaging methods.
8. Recall the factors affecting storage of foods
9. Expand EMC
10. State Hysteresis effect
11. Recall Ball's Formula
12. Write about the process of UHT sterilization
13. List out the types of ice crystals
14. Define freeze concentration
15. Recall hurdle technology
16. List the proteins responsible for flavor of milk.
17. Define mycoflora.
18. Expand HACCP
19. List out the types of spoilage of food materials.
20. list out some examples of food flavours
21. Mention the sources of fat soluble vitamins

Understand

1. Interpret the role of moisture content in foods
2. How will you find Z- value?
3. Explain the process of UHT sterilization.
4. Classify the methods of applying heat to food
5. Illustrate the applications of aseptic packaging
6. Explain the steps used in the vinegar production
7. Describe D, Z, F values
8. Discuss the principle behind the rancidity that occurs in fat

Apply

1. How Chilling operation is implemented in industries?
2. Use of drying in industries

Analyse

1. Interpret on enrobing.
2. Differentiate between constant rate and falling rate of drying
3. Differentiate between D value and Z value
4. Differentiate between cold storage and freezing.
5. Differentiate bag and bulk storage.
6. What are the compounds responsible for roasted aroma of coffee?
7. How does flavor and color are produced by carbohydrates?
8. Why antioxidants are used in fats and oils?
9. Describe the role of soya flour in bread.

Create

1. Generate the protocol to prepare Sauerkraut
2. Generate the protocol to prepare Jelly

15BT0YC BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

Course Outcomes (COs)

1. Understand the Knowledge of various bio resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biofuels.
3. Understand the Mechanisms of improvising the quality and performance of engine using biofuels
4. Learn techno-economic analysis of various biofuel conversion technologies and their environmental attributes;
5. Design major unit processes/operations of an integrated biorefinery

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Transesterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic .Production of biomethane and biohydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

FOR FURTHER READING

Edible and non-edible oils as fuels - their extraction; Purification - washing and drying options (bubble and mist washing), storage; Comparison of biodiesel with high speed diesel; Enzymes employed in the fermentation of sugars to ethanol and ethanol estimation; Applicationof biorefinerie in chemical, pharmaceutical and polymer industries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008
2. Mousdale, Biofuels, CRC Press, 2008.
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3				6						8			3											20
2	3					4				4									5				4		20
3	3				2					5					5								5		20
4	3										6				4			5							18
5	3						3			4									6				6		22
6																									0
																								Total	100

Assessment Questions

Remember

1. Define Biogas
2. List the characteristics of vegetable oils
3. Define rancidity

4. List the four types of catalyst used for Biofuel
5. List the basic routes for biodiesel production from oils and fats
6. Define gasification.
7. Define iodine number and acid value.
8. Define cloud point
9. Mention the ASTM specifications for the quality biodiesel.
10. List the catalyst used for transesterification process.

Understand

1. Classify the fuels based on their physical state.
2. Interpret the basics chemistry of biodiesel
3. Formulate transesterification
4. Predict the various ways of blending fuels.
5. Classify the types of Biorefineries
6. Classify the enzymes employed in sugar fermentation with examples
7. Explain the Application of biorefinerie in chemical, pharmaceutical and polymer industries.
8. Discuss the different types of blending fuels
9. Local fuel for local flights in one of the fastest-growing markets. Discuss with a case study
10. Discuss the role of climatic conditions in biofuel production
11. Discuss on "Washing of biofuels"

Apply

1. Compute the equations involved in the conversion of simple sugars to ethanol
2. Assess how is biodiesel produced commercially
3. Interpret the performance of a diesel engine for a specific biofuel
4. Estimate the ethanol produced during the production of biofuels.
5. Interpret biodiesel and petroleum diesel
6. Relate cetane number with idnition delay

Analyse

1. Differentiate between Hydrogenolysis and hydrolysis
2. How climatic conditions affect biofuels?
3. Explicate with a case study on assessing biofuel crop invasiveness
4. Compare the efficiency of biofuels produced using agricultural wastes
5. Differentiate between anaerobic and aerobic gasification
6. Differentiate between edible and Non edible oils
7. Write the equations involved in the conversion of simple sugars to ethanol
8. Explain how biodiesel is produced commercially
9. Compare the efficiency of biofuels produced using various agricultural wastes.
10. Differentiate between transesterification and esterification.

Evaluate

1. Support that Biofuel as a renewable energy
2. Determine the ASTM specifications for the quality biodiesel.

Create

1. Generate the protocol for biodiesel production using vegetable oils
2. Generate protocol to purify glycerol in Biodiesel plant
3. Explicate with a case study on assessing biofuel crop invasiveness.

15BT0YD MUSHROOM AND VERMICULTURE TECHNOLOGY

3 0 0 3

Course Objectives

- To introduce the basic concepts, principles, potentials and limitations of Mushroom cultivation and vermiculture techniques
- To acquire knowledge of various mushrooms and its active compounds
- To develop mushroom cultivation skills and Verimiculture skills for entrepreneurial activity

Course Outcomes

1. Understand the mushroom cultivation techniques
2. Cultivation of mushrooms from different wastes
3. Separation of potential compounds from mushrooms
4. Understand the diversity of earthworms and their rearing techniques
5. Preparation of Verimicompost from various waste materials

UNIT I **9 Hours**

INTRODUCTION

Introduction and Importance of mushrooms; History of mushroom cultivation; Present status of mushroom industry in India; Cultivable edible mushroom; Biology of mushroom; Food value of edible mushrooms; Uses of mushrooms, Poisonous mushrooms, and Medicinal mushrooms.

UNIT II **9 Hours**

MUSHROOM CULTIVATION AND BIOLOGICAL IMPORTANCE

Mushrooms farm structure; design and layout; Spawn principles, techniques of spawn production; Principle and techniques of compost and compositing; Cultivation techniques of White button mushroom, oyster mushroom.

UNIT III **9 Hours**

DISEASE AND POST-HARVEST TECHNOLOGY

Management of fungal, bacterial and viral diseases in mushroom; Competitors, pests and nematodes in mushrooms. Post-harvest technology,: Freezing, Dry freezing , Drying, Canning.

UNIT IV **9 Hours**

VERIMICULTURE TECHNOLOGY

Permaculture Technology; organic farming, soil fertility; Distribution and Ecology of Earthworms Earthworm taxonomy -Morphological and Anatomical characteristics of Earthworm -Food habits, excretion and life cycle. Types of Earthworms -Exotic and native species

UNIT V **9 Hours**

METHODS OF VERMICOMPOSTING

Collection and preservation of earthworms for vermicomposting and culturing techniques of earthworms. Preparation of vermicomposting requirement, different methods of Vermicompositing (Heap method, Pot method, and Tray method). Changes during vermin compositing, Nutrient value of Vermicompositing; Problems in vermicomposting preparation; Earthworm as bioreactors. Influence of chemical inputs on earthworms activities. Large scale manufacture of Vermicomposting, packaging; financial supporting (Government and NGOs for vermi culture work)

FOR FURTHER READING

Nutritional value of mushrooms, South Indian and North Indian species used for vermicompositing, Vermicomposting and its marketing

Total: 45 Hours

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3					6					8			3											20
2	3					4				4									5			4			20
3	3					2				5				5									5		20
4	3										6			4				5							18
5	3						3			4									6				6		22
																								Total	100

Assessment Questions

Remember

1. List the species used for vermicompositing
2. List the problems in vermicompost preparation
3. List the culturing of earthworms
4. Define competitors in mushroom
5. List some poisonous mushrooms
6. List some medicinal mushrooms
7. Define Spawn Principle
8. Mention the medicinal uses of mushrooms
9. List the types of earthworms
10. Enlist the various post harvest techniques in mushroom cultivations

Understand

1. How are mushrooms classified?
2. Describe the uses of mushroom
3. List few edible mushrooms
4. Describe the cultivation technique for white button mushroom
5. Identify the techniques used in spawn production
6. Discuss the influence of chemical inputs on earthwarm activities
7. Identify the Soth Indian and North Indian species used for vermicompositing
8. Discuss pot method of vermicompositing
9. Discuss about the morphological characteristics of earthworm
10. Discuss the requirements for vermicompositing

Apply

1. Interpret the nutritional value of vermicompost
2. Compare all the three methods used in vermicompositing
3. Sketch the lifecycle of earthworms

Analyse

1. Differentiate the cultivation technque for white button mushroom and oyster mushroom
2. Differentiate Heap method and pot method
3. Differentiate heap method and tray method of vermicompositing
4. Distinguish pot method and tray method of vermicompositing

15BT0YE FORENSIC BIOTECHNOLOGY 3 0 0 3

Course Objective

- The Forensic Technology Program is designed to prepare students for entry-level positions in the fields of forensic technology
- To create deeper understanding of Biotechnology application in forensic science
- To render knowledge of how to perform research in interdisciplinary fields like forensic studies

Course Outcomes (COs)

1. Recognize forensic science and crime investigation
2. Understand the principles and operation of analytical instruments
3. Analyze various biological samples for forensic studies
4. Organize non biological sample characteristics
5. Implement forensic examination

UNIT I **9 Hours**

BASICS OF FORENSIC SCIENCE

History and Development; Crime Scene Management and Investigation- Collection, preservation, packing and forwarding of physical and trace evidence for analysis; Legal and Court procedure pertaining to Expert Testimony.

UNIT II **9 Hours**

ANALYTICAL INSTRUMENTATION

Microscopy-Polarising, Fluorescent and Electron microscopes; Spectrophotometry- UV, Visible, IR atomic absorption; Chromatographic techniques- TLC, GLC, GCMS, HPLC; Electrophoresis- High and Low voltage electrophoresis, Gel electrophoresis and Immunoelectrophoresis.

UNIT III **9 Hours**

ANALYSIS OF BIOLOGICAL SAMPLES

Fresh Blood-Grouping and typing of fresh blood samples; Analysis of stains of blood and allied body fluids for their groups; Cases of disputed paternity and maternity problems; DNA profiling; Identification of hair, determination of species origin, sex, site and individual identification from hair; Examination and identification of saliva, Urine, Faecal matter and milk

UNIT IV **9 Hours**

CHARACTERIZATION OF NON BIOLOGICAL SAMPLE

Physical analysis - soil, glass, paints, lacquers, cement, inks, paper, tool marks, tyre marks, shoe prints, forensic examination of vehicles in cases of accident; Identification of individuals from bodily features; Examination and identification of deceased from skeletal remains.

UNIT V **9 Hours**

FORENSIC EXAMINATION

Preliminary examination of documents-Identification of hand writing, signatures and detection of forgeries; Reproduction of documents through photographic and mechanical means and their examination; Physical and chemical erasures, obliterations, additions, alterations, indentations, secret writings and charred documents; Inks, papers and their scientific examinations including instrumental analysis.

Total: 45 Hours

FOR FURTHER READING

Classification and identification of fibres; Identification and individualization from foot prints and teeth; Age of documents- Examination of typescripts, printed matter including currency notes and mechanical impressions; Lifting and examination of fingerprints, Development of latent fingerprints by various methods; Crime records and computerization of fingerprints.

Reference(s)

1. William G. Eckert, *Introduction to Forensic Sciences*, 2nd Ed. New York: CRC press, 2000.
2. S.H.James, and J.J. Nordby, *Forensic Science an Introduction to Scientific and Investigative Techniques*. London: CRC Press, 2003
3. B. D Alberts Bray, J. Lewis, K. Roberts and J.D. Watson. *Molecular Biology of Cell*, 2nd ed. New York: Garland Publishing, 1989
4. Simon, Ball. *Environment Law: The Law and Policy Relating to Protection of Environment*. Delhi: Universal Law Publishing, 1991

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					6				4				4											18
2	2					4				4	2			4				2				4			22
3	2					4				3				3				4				4			20
4	2					4				4	2			4				4				2			22
5	2					3				4	2			4				3							18
																								Total	100

Assessment Questions

Remember

1. Define Forensic science.
2. Recognize the importance of crime investigation
3. Recall the instrumentation used in forensic examination
4. List out the types of analysis techniques
5. State the roles of electrophoresis in forensic science
6. Define Spectrometry
7. List the different molecular techniques used in forensics
8. Define: Non biological samples
9. List out the preliminary analysis used in biological samples
10. State the role of non biological evidences in crime investications

Understand

1. Interpret identification of individualization
2. Classify different types of fiber
3. Identify the importance of photographic and mechanical examination.
4. Summarize the development of latent fingerprints by various methods
5. Illustrate Inks, papers and their scientific examinations including instrumental analysis.
6. How the trace samples analyzed in forensics?
7. Classify the DNA Profilling methods
8. Identify the chromatographic methods used in forensic analysis
9. How spectrometry used in sample detection?

Apply

1. Predict the cases of disputed paternity and maternity problems
2. Demonstrate species origin, sex, site and individual identification from hair.
3. Choose the robust molecular method of identification of individual.
4. Application of biotechnology in forensic science

Analyze

1. Differentiate between physical and chemical erasers.
2. Analyze Inks, papers and their scientific examinations.
3. Compare and contrast the fingerprint and document examination
4. Analyze Grouping and typing of fresh blood samples

Evaluate

1. Critique the criterion Legal and Court procedure pertaining to Expert Testimony
2. Judge the roles of instrumentation in forensic examination of samples.
3. Evaluate the roles of DNA profiling
4. Critique the significance of TLC,GC and GCMS in examination of forensic samples

Create

1. Generalize the specific diagnostic tests for individual identification
2. Relate Examination of typescripts and secret writing
3. Generalize the assays for biological sample analysis.

15BT0XA MOLECULAR MARKER TECHNOLOGIES - - - 1

Course Objectives

- To understand the role of molecular marker technology in breeding of animals and Plants
- To understand the sequencing and mapping techniques

Course Outcomes (COs)

1. Understand different marker system which will build their carrier on DNA finger printing
2. Mapping technique in genomics and bioinformatics research field in the animal and agricultural science

UNIT I **4 Hours**

MOLECULAR MARKERS INTRODUCTION

Organization & Molecular dissection of different genomes (Nuclear, Chloroplast and Mitochondrial Morphological, Physiological and Genetic markers and their role in evolution and Taxonomy Merits and demerits

UNIT II **4 Hours**

HISTORY AND TYPES

History of Molecular markers and Types of Molecular markers - Hybridization based markers RFLP and it's applications

UNIT III **4 Hours**

PCR BASED MARKERS

PCR based markers RAPD, AFLP, SSR and STS markers, new generation marker and their application - Development of new DNA markers - Principles of genetic linkage - Linkage relationship among different markers - Construction of linkage maps with different markers

UNIT IV **4 Hours**

MICROARRAY TECHNOLOGY

Microarray technology and application - Synteny among different genome with respect to markers -QTL mapping with molecular markers and related software - Finger printing of fungi, insects and other organisms - Tagging of economic importance using molecular markers MAS success story

UNIT V **4 Hours**

PRACTICAL SESSION

Demonstration of molecular marker usage in the laboratory

Total: 20 Hours

Reference(s)

1. Brown. T. A. Genomes, 3rd edition. University of Manchester, U.K. Garland Sciences. 2006
2. Phillips and I.K. Vasil. DNA based markers in plants. Second Edition, Klewer academic Publishers, and London. 2001.
3. Henry, R. J. Plant genotyping The DNA finger printing of plants. CABI Publications. New York. 2001.
4. Patterson, Molecular dissection of complex traits. CRC Publication. Washigton. 1998
5. Rastogi, S.C. N. Mendiratta, and P. Rastogi. Bioinformatics Methods and application Pretice Hall Pvt. New Delhi. 2006.

15BT0XB TRANSLATIONAL RESEARCH AND TECHNOLOGY TRANSFER

- - - 1

Course Objectives

- To enable students to get an insight of translating Ideas and to evaluate and predict the role of technology in creating wealth or value
- To empower graduates and researchers to distinguish between Abrasive/Breakthrough technologies and lay a foundation for productive research for societal transformation.

Course Outcomes

1. Know how to value his invention/idea. One will know how his invention/invention will address the questions/challenges/problems/ pain statements of the society or demand area
2. Aware of the tools (Software and Legal instruments) for evaluating the technology
3. Build and stimulate a business model around ones idea/invention, which will enable to decide the best mode of translating idea/invention to value or wealth

UNIT I **4 Hours**

TECHNOLOGY TRANSFER INTRODUCTON

Technology Transfer as a process Stages of Technology Transfer

UNIT II **4 Hours**

TRANSLATIONAL RESEARCH

Translational Research defined- Basic Components of Translational Research - Stages of invention and where does Translational research fit

UNIT III **4 Hours**

CLASSIFICATIONS OF INVENTIONS

Classifications of Inventions overview of protecting technology Strategies of Transferring technology Technology Valuation Methods Communication in Technology Transfer

UNIT IV **4 Hours**

MARKETING

Documentation for Technology Transfer Technology Landscaping- Technology Presentation for Marketing Legal Instruments Involved in Technology Transfer.

UNIT V **4 Hours**

PRACTICAL SESSION

Ability to write a model technology transfer/ translational document procedure

Total: 20 Hours

Reference(s)

1. Technology Transfer: A Communication Perspective (1990), Eds. Frederick Williams and David V. Gibson, SAGE Publications (ISBN:0-8039-3741-5
2. Biotechnology Intellectual Property Manual (2001) Spruson and Ferguson Patent Attorneys. (ISBN:0-642-72129-7)
3. Journal of Commercial Biotechnology http://www.palgrave-journals.com/jcb/index.html.
4. Intellectual Property in Health and Agricultural Innovations A Hand Book of Best Practices

15BT0XC MARINE FOOD TECHNOLOGY - - - 1

Course Objectives

- To provide a concise and unified approach to marine flora, fauna and molecular properties
- To impart knowledge on various sea foods and its medicinal and nutritional values

Course Outcomes (COs)

1. Get an knowledge about marine environment
2. Understand different techniques followed for marine resource assessment and evaluation.

UNIT I **4 Hours**

MARINE ENVIRONMENT

Marine environment -Marine Bioresources, Biodiversity-Marine Flora and fauna -Phytoplankton

UNIT II **4 Hours**

BIODIVERSITY

seaweeds, sea grasses and mangroves -Ocean Technology Tides,Currents and remote sensing techniques -Marine resource assessment and evaluation -Marine pharmacology-Terms and definitions,

UNIT III **4 Hours**

MEDICINAL COMPOUNDS FROM MARINE FLORA

Medicinal compounds from marine flora and fauna, toxins, antiviral and antimicrobial agents -Sea foods shrimps, prawns, skewers, octopus, crabs, fish, squid and its processing with nutritional values

UNIT IV **4 Hours**

CERTIFICATIONS

Certifications like HACCP, EU, USFDA, ISO, BRC, ACC for sea foods

UNIT V **4 Hours**

PRACTICAL SESSION

Exposure to the marine biotechnology applications

Total: 20 Hours

Reference(s)

1. M. Fingerman, Recent advances in Marine Biotechnology, Science Publishers, 2000.
2. D. L. Krichman, Microbial Ecology of the Oceans,Wiley-Liss, 2000

15BT0XD BEVERAGE, BAKING AND CONFECTIONERY TECHNOLOGY

- - - 1

Course Objectives

- To impart knowledge to the students about food processing and various unit operations
- To apply the technology in processing, preservation, and packaging.
- To acquire practical knowledge on value addition of food products

Course Outcomes (COs)

1. Get an knowledge about beverage industry.
2. Understand different techniques followed in beverages., baking and confectionery technology

UNIT I **4 Hours**

BASIC INDUSTRIAL CALCULATIONS

Basic industrial calculation and procedures, Entrepreneurship development

UNIT II **4 Hours**

METHODOLOGY IN FOOD PROCESSING

Methodology in Food Processing, Technologies in food processing - High Pressure Processing, Pulsed electric fields processing, Osmotic dehydration,

UNIT III **4 Hours**

FOOD PROCESSING

At hermal membrane concentration of liquid foods and colours, Ultrasound processing, alternate thermal processing, Radiofrequency processing,

UNIT IV **4 Hours**

ADVANCE INDUSTRIAL TECHNOLOGY

Hybrid drying technologies. Value addition of fruit and vegetable products-squashes, pickles, jam, sauce, Ready to serve Beverages. Baking& Confectioner products- bread, rusk, cookies, chikkies.

UNIT V **4 Hours**

PRACTICAL SESSION

Making of beverage, baking and confectionery

Total: 20 Hours

Reference(s)

1. P. J. Fellows, Food Processing Technology: Principles and practice, Third Edition Woodhead Publishing limited, 2009.
2. Paul Singh, R and Dennis R. Heldman, Introduction to Food Engineering, Fourth Edition.Academic Press, 2009
3. M.Lewis and N.Heppell, Continuous Thermal Processing of Foods, Aspen Publisher,2000
4. V. A. Vaclavik and E. W. Christian, Essentials of Food Science, Springer, 2007
5. G. Campbell-platt, Food Science and Technology, Wiley-Blackwell, 2009
6. C.M.Weaver and J.R.Daniel, The Food Chemistry Laboratory: A Manual for Experimental foods, Dietetics, Food Scientists. CRC Press, 199

15BT0XE APPLIED SYSTEMS BIOLOGY - - - 1

Course Objectives

- To provide students practical applications of system biology in biotechnology
- To understand the modeling theories, databases and tools

Course Outcomes (COs)

1. Modeling theory and practical which will build their carrier on systems biology
2. The Simulation Techniques and Toolswill help for working in genomics and bioinformatics research filed which is fast developing in the biotechnology..

UNIT I **4 Hours**

INTRODUCTION TO SYSTEMS BIOLOGY

Systems biology - Systems level understanding of biological systems - Basic principles and concepts Applications, Scope and Future.

UNIT II **4 Hours**

MODELING THEORY

Linear Algebra - Ordinary differential equations - Difference Equations - Numerical Integration Graph and Network Theory Stochastic processes Statistics

UNIT III **4 Hours**

CASE STUDIES:

Systems biology Approaches for Enhanced Biofuel Production, Models for Recombinant Protein Production, Systems approaches for Host Pathogen Interactions, Systems Biology Approaches for Drug Discovery, Systems Approaches for Personalized Health Care

UNIT IV **4 Hours**

AVAILABLE DATABASES AND TOOLS FOR MODELLING:

Internet Databases Modelling-Pathway databases - Kinetics databases Model database Gene expression databases and other data resources.

UNIT V **4 Hours**

PRACTICAL SESSION

Simulation Techniques and Tools-Petri nets - Mathematica -Matlab - Systems biology platforms: Copasi, CellDesigner, PyBioS, ScrumPy. Data formats for Modelling-Systems Biology Markup Language (SBML) BioPAX Systems Biology Graphical Notation Standards of Systems Biology Computer Practical-Mathematical modelling using Copasi (or) Matlab

Total: 20 Hours

Reference(s)

1. Systems Biology,EddaKlipp, Wolfram Liebermeister, ChristophWierling, Axel Kowald, Hans Lehrach, Ralf Herwig,ISBN: 978-3-527-31874-2,2009, Wiley-Blackwell
2. An Introduction to Systems Biology Design Principles of Biological Circuits,UriAlon,ISBN:1584886420, 2006, Chapman&Hall/CRC, Taylor and Francis Group
3. Foundations in Systems Biology,Kitano, H.(ed.),ISBN 0262112663,2001 The MIT Press
4. Systems Biology : Properties of Reconstructed Networks,BernardPalsson ISBN: 0521859034,2006, Cambridge Univ. Press
5. Stochastic Modelling for Systems Biology,Darren James Wilkinson ISBN:1-58488-540-8,2006, Chapman & Hall/CRC Press

15BT0XF HPLC FUNDAMENTALS IN BIOTECH INDUSTRY - - - 1

Course Objectives

- To provide students practical applications of HPLC in biotechnology
- To understand the practical familiarization of HPLC

Course Outcomes (COs)

1. Apply the industrial concepts of HPLC in advance purification process
2. The chromatography techniques will help the students to equip themselves for enhancing the kills of analyzing the biotechnology products.

UNIT I **4 Hours**

BASICS OF HPLC

HPLC instrumentation, theory of chromatography, properties of stationary phase, selectivity, efficiency, Retention, resolution, Vandeemter equation, Isocratic/gradient mode of elution, mobile phase and importance of ion pairing reagent

UNIT II **4 Hours**

MODES OF CHROMATOGRAPHY

Reverse phase chromatography, hydrophobic interaction chromatography, Ion exchange chromatography, size exclusion chromatography, and affinity chromatography

UNIT III **4 Hours**

DETECTORS USED IN HPLC

UV-vis, PDA/DAD, CAD, refractive index, fluorescence

UNIT IV **4 Hours**

APPLICATION AND ADVANCEMENT OF LIQUID CHROMATOGRAPHY

Separation and quantification of proteins and related substances, process control, Advances application by using LCMS and 2D liquid chromatography

UNIT V **4 Hours**

PRACTICAL SECTION

Familiarization of HPLC setup

Total: 20 Hours

Reference(s)

1. Basic HPLC and CE of biomolecules by Robert L. Cunico, Karen M. Holding and Tim Wehr.

15BT0XG PROCESS VALIDATION AND QUALITY ASSURANCE FOR BIOPRODUCTS - - - 1

Course Objectives

- To understand the importance of quality assurance and validation strategies in food and Pharmaceutical industries
- To appreciate the skills / devices / practices which assures the safety and quality of the finished products

Course Outcomes (COs)

1. Appreciation of HACCP principles and Validation in the Food and Pharmaceutical industries
2. To get a vast inspiration in the arena of Quality Assurance

UNIT I **8 Hours**

QUALITY ASSURANCE

Quality Assurance introduction, Regulatory compliance - FDA regulations, EU directives Certification systems - ISO 22000:2009 and BRC Global Standard for Food Safety Issue. The Fundamentals of Regulatory Compliance with respect to Good Clinical Practice (GCP), Good Manufacturing Practice (GMP) & Good Laboratory Practice (GLP).

UNIT II **12 Hours**

PROCESS VALIDATION

Validation introduction, HACCP Principles and Hazard Analysis.Concepts of Process Validation & how it Differs from Qualification (IQ, OQ & PQ) Procedures, A Review of Prospective, Concurrent, Retrospective Validation & Revalidation including the use of Statistical Process Control (SPC) Techniques.Audits - Requirements. Process Validation for pharmaceutical industries, Pilot Plant, Scale-Up Techniques.Analytical methods and tests for various drugs -Physicochemical and bioanalytical considerations. Validation of analytical methods. Product Development Strategies in food and Pharmaceutical industries. Shelf Life Evaluation, Data Analysis, Documentation, Registration, and Diagnostics Start-Ups.

Total: 20 Hours

Reference(s)

1. Pharmaceutical Process Validation by Robert Nash and Alfred Wachter, Marcel Dekker.
2. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control from Manufacturer to Consumer, Sidney J. Willig, Marcel Dekker.
3. Validation of Pharmaceutical Processes: Sterile Products, Frederick J. Carlton (Ed.) and James Agalloco (Ed.), Marcel Dekker.
4. Handbook of Food science, Technology and Engineering, (Vol 1) Y.H. Hui, Taylor and Francis Publications

15GE0XA HEALTH AND FITNESS - - - 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts.
2. Understand the fundamental concepts of yogic practice and physical fitness.
3. To acquire the knowledge about nutrition and health consciousness.

Fitness: Meaning & Definition – Need & importance of Physical fitness – Types Physical fitness - Exercise, Training and Conditioning and it is important.
Yoga: Meaning and definition – Principles of practicing – Basic Asana and it important – Pranayama and Meditation - Relaxation Techniques.
Nutrition and Balance Diet: Needs and Important – Significant of Nutritional Food - Tips for balance diet.
Common Diseases for IT professionals: Common diseases - cause – prevention – First aid for common sports injuries.

Total: 15 hours

References

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). *Getting in Shape Workout Programs for Men&Women*. Mumbai: Jaico Publishing House.
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). *Essentials of Strength Training and Conditioning*. Champaign: Human Kinetics.
3. Iyengar, BKS., (2003). *The Art of Yoga*. New Delhi: Harper Collins Publishers.
4. Singh, Hardayal, (1995). *Science of Sports training*. New Delhi: D.V.S. Publications.
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited.

15GE0XB FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY - - - 1

Course Objective

- The course focuses on community radio technology and various program productions techniques for radio broadcasting.

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording
2. Examine the available options for telephony interfaces for radio
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

INTRODUCTION TO COMMUNITY RADIO

Evolution of Community Radio (CR) in India- principles behind setting up of CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

STUDIO TECHNOLOGY
Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio

AUDIO PRODUCTION
Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production- telephony interfaces for radio- audio Post Production

STUDIO OPERATIONS
Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

RADIO TRANSMISSION TECHNOLOGY
Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, "Other Voices: The Struggle for Community Radio in India", SAGE Publications India,2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Seán Ó Siochrú, "Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation", University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.procosound.com

15GE0XC VEDIC MATHEMATICS - - - 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills.

Course outcome (CO)

1. Solve problems creatively in mathematics and its applications.

Vedic Mathematics
Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations-

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014.
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997.

15GE0XD INTRODUCTION TO ALGORITHM - - - 1

Course Objectives

- Analyze the asymptotic performance of algorithms, Divide and conquer and Dynamic Problems.
- Use Sorting and Searching algorithms for arranging the data.
- Apply important algorithmic techniques to solve the real world Problems.

Course Outcomes (COs)

1. Apply Divide and conquer and Dynamic Programming Algorithm techniques to Provide the solutions for simple Problems.
2. Design algorithms for Performing Sorting and Searching of data.
3. Construct the Graph, Heap and BST for the given Data information.

Algorithm Design Techniques: Divide and Conquer, Dynamic Programming, Sorting and Searching, Basic graph algorithms –Simple Data Structures: Heaps, Balanced Search Trees.

Total: 15 Hours

References

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015.
2. Thomas H. Cormen. Charles E. Leiserson. Ronald L. Rivest. Clifford Stein, Introduction to Algorithms, Second Edition, MIT Press, 2014.
3. J.P.Tremblay and P.G.Sorenson, An Introduction to Data Structures with Application II Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

15GE0XE ETYMOLOGY - - - 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language;
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic;
- To demonstrate the importance of a broad-based vocabulary for effective oral and writtencommunication

Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

CONVENTIONS &VOCABULARY

Acronyms – Abbreviations – Initialisms – Jargon – Neologisms - Idiomatic Expressions – Euphemisms – Spoonerisms – Malapropisms – Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym – Apheresis - Blend word Assimilation - Colloquial language Clipped word

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics -

Loan words Metathesis – Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 hours

Reference(s)

1. Norman, Lewis. *Word Power Made Easy*,Goyal Publisher. Edition 2.2014.
2. C T Onions. *The Oxford Dictionary of English* Etymology.Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont.Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library.1961

15GE0XF HINDUSTANI MUSIC - - - 1

Course Objectives

- To have an awareness on aesthetic and therapeutic aspects of Hindustani music
- To identify and differentiate the various styles and nuances of Hindustani music
- To apply the knowledge accumulated throughout the duration of the course by way of improvisation, composition and presentation

Course Outcome (CO)

1. Have Basic knowledge of aesthetic and therapeutic value of Hindustani Music

Aesthetics

Introduction to music - Aesthetics of Hindustani Music - Classification (Raga, instruments, style as per the presentation and the gharaanaas) - Folk music, Dhamaar, Dhrupad

Composition and Therapeutic Value

Taal and Raga - Bandeesh, Taraanaa – Madhya and drut laya, Vilambit khyaal as demonstration - Therapeutic benefits of Hindustani music - Stage performance

Total : 20 hours

Reference(s):

1. Devdhar B.R., Raga bodh (Part 1 & 2), Devdhar School of Indian Music, Mumbai, 2012.
2. Vasant, Sangeet Vishaarad , Hathras, Uttar Pradesh, 2015.

Websites:

1. raag-hindustani.com/
2. play.raaga.com/Hindustani
3. raag-hindustani.com/Scales3.html
4. www.poshmaal.com/ragas.html
5. www.soundofindia.com/raagas.asp
6. https://www.quora.com/Which-is-the-toughest-raga-in-Indian-classical-music
7. www.likhati.com/2010/10/20/popular-ragas-for-the-beginner-ear-durga

15GE0XG CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

- - - 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious.

Vermicomposting Technology **15 Hours**

Ecological roles and economic importance of earthworms - need for earthworm culture – scope and importance of vermiculture – limiting factors - types of worm culturing and the relative benefits – Small scale and commercial methods: process & advantages – Vermicomposting equipments, devices – Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle) – vermicastings in organic farming/horticulture - Marketing the products of vermiculture – quality control, market research, marketing techniques – Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives – Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times – Scientists Hope to Cultivate and Immune System for Crops

15GE0XH AGRICULTURE FOR ENGINEERS - - - 1

Course Objectives

- To impart the basic knowledge of agricultural and horticultural crops, cropping systems
- To study the weed and nutrient management, irrigation water requirement and its quality

Course Outcomes (COs)

1. Understand the science of Agriculture
2. Summarize and apply the methodologies needed in agriculture based on the field conditions.
3. Develop enough confidence to identify the crop patterns in real world and offer appropriate solutions.

Agronomical practices and Crops 5 hours

Definition and scope of agronomy , Classification of Crops, agricultural and horticultural crops Effect of Different Weather Parameters on Crop Growth and Development , Principal of Tillage, Tilth and Its Characteristics, Role of Water in Plant and Its Absorption, Conduction and Transpiration of Water and Plant Processes, Soil Water Extraction Pattern and Plant Response. Introduction to weeds, Weeds Control.

Crop rotation, cropping systems, relay and mixed cropping 5 hours

Crop Rotation, Different Cropping Systems – I, Different Cropping Systems – II, Scope of Horticultural Crops, Soil Requirement for Fruits, Vegetables and Flowers Crops, Climatic Requirement for Fruits, Vegetables and Flowers Crops.

Plant nutrients 5 hours

Essential Plant Nutrients, Nutrient Deficiency, Toxicity and Control Measures. Chemical fertilizers, fertilizer Reaction in Soil and Use Efficiency

Quality of irrigation water and irrigation methods 5 hours

Quality of Irrigation Water, Poor Quality of Irrigation Water and Management Practices. Surface Irrigation methods, and micro irrigation methods

Total : 20 hours

Reference(s)

1. SP. Palaniappan, and S. Sivaraman, Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.
2. S.Sankaran and V.T Subbaiah Mudaliar, Principles of Agronomy, The Bangalore Printing and Pubg Co, Bangalore, 1993.
3. P.Balasubramain and SP. Palniappan, Principles and Practices of Agronomy, Agrobios publishers, Ludhiana, 2001.
4. T.Yellamanda Reddy, Principles of Agronomy, Kalyani publishers, Ludhiana, 2005
5. B.Chandrasekaran, B. , K. Annadurai and E. Somasundaram, A Text book of Agronomy, Scientific publishers, Jodhpur, 2007
6. George Acquaah, Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd.,

15GE0XI INTRODUCTION TO DATA ANALYSIS USING SOFTWARE - - - 1

Course Objectives

- To familiarize students on the features of MS Excel.
- To enable the students to use Excel in the area of critical evaluation.
- Facilitate the student to construct graphs.

Course Outcomes (COs)

1. Create versatile Excel document.
2. Apply built in functions for data analysis.
3. Prepare dynamic Charts.

Excel Fundamentals and Editing **4 Hours**

Starting and Navigating a Worksheet– Entering Information – Hyperlinks – Saving – Editing Techniques – Entering a Series of Labels, Numbers and Dates – Checking Errors.

Formatting **4 Hours**

Formatting Cells – Changing Column Widths and Row Heights – Creating Conditional Formatting – Using Styles – Creating and Modifying Templates – Changing Page Breaks.

Power Organizing and Customizing Excel **4 Hours**

Managing Worksheets – Referencing Cells in Other Worksheets – Using More than One Work Book – Managing Shared Work Books – Protecting Worksheets and Workbooks.
Adjusting Views – Setting Printing Options – Using Multiple Panes – Customizing Excel Using the Options Dialog Box.

Crunching Numbers **5 Hours**

Building a Formula – Using Basic Built-in Functions – Using Functions to Analyze Data – Using Names in Functions – Array Functions

Work Sheet Charts **3 Hours**

Planning a Chart – Creating Chart – Formatting a Chart – Adding Labels and Arrows.

Total: 20 Hours

References

1. Michael J. Young, Michael Halvorson, "Office System 2007 Edition", Prentice-Hall of India (P) Ltd., New Delhi, 2007
2. John Walkenbach, "Microsoft Office Excel 2007", Wiley Publishing, Inc. 2007
3. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007
4. Mark Dodgeand Craig Stinson, "Microsoft Office Excel 2007 Inside Out", Microsoft Press, 2007

15GE0XJ ANALYSIS USING PIVOT TABLE - - - 1

Course Objectives

- To familiarize students on the features of Pivot Table.
- To enable the students to use Pivot Table in the area of data analysis.
- Facilitate the student to construct the charts for visualization of data.

Course Outcomes (COs)

1. Able to construct the Pivot Table and Group, Sort, Filter the Data to do the analysis.
2. Able to do the Calculation with in Pivot Table for advance analysis.
3. Capable of Constructing Pivot Charts to make visual presentation.

Pivot Table Fundamentals **4 Hours**
Introduction about Pivot Table, Why and When to use the Pivot Table, Anatomy of the Pivot Table, Limitations, Preparing the Source Data, Creating the Pivot Table.

Grouping Pivot Table Data **4 Hours**
Grouping the Items in a Report Filter, Grouping Text Items, Grouping Dates by Month, Grouping Dates Using the Starting Date, Grouping Dates by Fiscal Quarter, Grouping Dates by Week, Grouping Dates by Months and Weeks, Grouping Dates in One Pivot Table Affects Another Pivot Table, Grouping Dates Outside the Range.

Sorting and Filtering Pivot Table Data **4 Hours**
Sorting a Pivot Field: Sorting Value Items, Sorting Text Items, Sorting Items in a Custom Order. *Filtering a Pivot Field:* Manual Filter, Label Filter, Value Filter, Multiple Filters.

Calculations within the Pivot Tables **5 Hours**
Using Formulae: Creating a Calculated Field with and without "IF Condition, Calculated Item, Using Custom Calculations: % of Column, % of Row, % of Total, % Of, Running Total, Difference From, % Difference From, Index.

Pivot Charts **3 Hours**
Creating a Normal Chart from Pivot Table Data, Filtering the Pivot Chart, Changing the Series Order, Changing Pivot Chart Layout Affects Pivot Table, Changing Number Format in Pivot Table Affects Pivot Chart, Converting a Pivot Chart to a Static Chart, Refreshing the Pivot Chart, Creating Multiple Series for Years

Total: 20 Hours

Reference(s)

1. Debra Dalgleish, "Excel 2007 - PivotTables Recipes A Problem-Solution Approach", Apress, 2007, (ISBN-13 (pbk): 978-1-59059-920-4)
2. Bill Felen and Michael Alexander, "Pivot Table Data Crunching for Microsoft Office 2007", Pearson Education, Inc., QUE Series.
3. Wayne L. Winston, "Microsoft Office Excel 2007: Data Analysis and Business Modeling", Microsoft Press, 2007
4. John Walkenbach, "Microsoft Office Excel 2007", Wiley Publishing, Inc. 2007
5. Mark Dodgeand Craig Stinson, "Microsoft Office Excel 2007 Inside Out", Microsoft Press, 2007
6. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007

15BTB01 FUNDAMENTALS OF BIOTECHNOLOGY

Course Outcomes (COs)

1. Acquire in depth knowledge in fermentation, product recovery and its instrumentation.
2. Learn about the production of primary and secondary metabolites
3. Have the basic knowledge about the production of enzymes, vaccines and other recombinant products in biotechnology
4. Know about the genetically modified plants for various applications
5. Exploit microbes for eco-cleanup and biofuel production

UNIT I **6 Hours**

INTRODUCTION TO BIOTECHNOLOGY

Biotechnology - definition and historical development, applications of Biotechnology, substrates for Biotechnology - biomass, natural raw materials, by-products, chemical and petrochemical feedstocks.

UNIT II **6 Hours**

BIOPROCESS / FERMENTATION TECHNOLOGY

Introduction of Bioprocess technology, bioprocess and downstream and scale up, solid substrate fermentation.

UNIT III **6 Hours**

ENZYME TECHNOLOGY

Nature of enzymes, industrial applications of enzymes, technology of enzyme production, immobilized enzymes.

UNIT IV **6 Hours**

AGRICULTURAL AND ENVIRONMENTAL BIOTECHNOLOGY

Transgenic plants for pest and weed resistance, biocontrol agents, genetic engineering of transgenic animals, bioremediation.

UNIT V **6 Hours**

BIOTECHNOLOGY IN FOOD AND ENERGY

Food and beverage fermentations, dairy fermented products, production of ethanol and methane from biomass, safety aspects in Biotechnology.

FOR FURTHER READING

Photosynthesis for energy production, single cell protein - from wastes, agricultural crops and algae, antibiotics, vaccines and monoclonal antibodies, biopharmaceutical products

Total: 30 Hours

Reference(s)

1. John E Smith, Biotechnology, Cambridge University Press, 5th Edition, 2006
2. W.Crueger, and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation, 2003
3. Colin Ratledge and Bjorn Kristiansen, Basic Biotechnology, Cambridge University Press, 2001
4. L.E.Casida, Industrial Microbiology, New Age International (P) Ltd, 2005

15BTB02 ENGINEERING DRAWING & GRAPHICS

Course Outcomes (COs)

1. Recognize the conventions and apply dimensioning concepts while drafting simple objects.
2. Develop the two dimensional drawings from three dimensional model and vice versa.
3. Utilize the visualization skill to convert simple drawing into the computer aided drawing.

UNIT I **6 Hours**

CONVENTIONS AND BASIC DRAWINGS

Importance - conventions - ISO and BIS - drawing tools and drawing sheets - lettering, numbering, dimensioning, lines and symbols

UNIT II **6 Hours**

PROJECTIONS

Principles-first and third angle projections - Points - first angle projection of points Straight lines - parallel, perpendicular and inclined to one reference plane

UNIT III **6 Hours**

ORTHOGRAPHIC PROJECTIONS AND SECTION OF SOLIDS

Orthographic Projections - concepts - front view, top view and side view of simple solids -Section of Solids-simple illustrations.

UNIT IV **6 Hours**

ISOMETRIC PROJECTIONS AND DEVELOPMENT OF SURFACES

Importance- orthographic to isometric projection- simple and truncated solids

UNIT V **6 Hours**

INTRODUCTION TO AUTOCAD

Basics commands of AutoCAD- two dimensional drawing, editing, Drawing practice - orthographic views of simple solids using AutoCAD.

Total: 30 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, BUREAU OF INDIAN STANDARDS-SP46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V.Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

15BTV01 PHARMACEUTICAL MICROBIOLOGY

Course Objectives

- To understand the importance of microbes in the synthesis of pharmaceutical products
- To appreciate the skills / devices / practices associated with the Pharmaceutical product development using microorganisms

Course Outcomes (COs)

1. Appreciation of the role of microorganism in the biopharmaceutical industries.
2. It will be an eye opener for quality assurance practices in Pharmaceutical sector.

INTRODUCTION **5 Hours**

History and Development of pharmaceutical microbiology, control of microbial infections - vaccines & other agents, GMP in pharmaceutical industries.

ANTIBIOTICS **5 Hours**

Types of antibiotics and other synthetic antimicrobial agents, mechanism of action of antibiotics, bacterial resistance to antibiotics, manufacture of antibiotics - Penicillin & Cephalosporin.

PHARMACEUTICAL PRODUCTS **5 Hours**

Applications of microorganisms in the partial synthesis of pharmaceuticals, mode of action and evaluation of non-antibiotic antimicrobial agents.

MICROORGANISMS IN PHARMACEUTICAL INDUSTRY **5 Hours**

Sterile pharmaceutical products, Ecology of microorganisms and their effects in the pharmaceutical industry.

SPOILAGE AND PRESERVATION **5 Hours**

Microbial spoilage and preservation of pharmaceutical products, sterilization control and sterility assurance

Lab Component **15 Hours**

1. Staining techniques (Capsule, Endo spore, Flagella)
2. Growth of microorganisms on differential media (SS, EMB & Macconkey agar)
3. Determination of Minimum Inhibitory and Minimum Lethal Concentration (MIC & MLD) for agiven antimicrobial substance
4. Assessment of microbial contamination in pharmaceutical formulations (Injections/Syrups/Creams)
5. Evaluation of disinfectant by phenol coefficient method

Total: 40 Hours

Reference(s)

1. G.J. Tortora, *Microbiology: An Introduction*, Benjamin Cummings, 2012.
2. Prescott and Dunn, *Industrial Microbiology*, CBS Publishers, 2004.
3. W.B. Hugo and A.D. Russel, *Pharmaceutical Microbiology*, Blackwell Scientific, 2004.