**Academic Regulations**

**Course Structure**

**And**

**Detailed syllabus**

**For**

**B. Tech Four Year Degree Course – III and IV Year**

**In**

BIOTECHNOLOGY

(BT)

(Applicable for the Batches admitted from 2017-2018)



Sreenidhi Institute of Science AND Technology

**(An Autonomous Institution approved by Ugc and affiliated to JNTUH)**

Yamnampet, Ghatkesar, R.R.District-501 301. Telangana State

June 2019

**ABOUT THE DEPARTMENT OF BIOTECHNOLOGY**

The biotechnology industry harnesses advances in molecular biology, genomics, proteomics, metabolomics, bioinformatics and nanotechnology to move discoveries and ideas out of the laboratory and into the product development pipeline. Biotechnology continues to expand rapidly with new discoveries at a breathtaking pace. This industry, a merger of science and business, demands a multi-disciplinary workforce skilled in basic-research, product development, regulatory affairs and commercialization.

Students of B. Tech. (Biotechnology) learn to advance their careers by broadening their skill base and understanding of this dynamic field. Recognizing this wider impact of biotechnology education and research in the 21st century, and the limitations of the existing programmes elsewhere in India, the University School of Biotechnology at SNIST has placed due emphasis in the curriculum on interdisciplinary convergence in modern biology, engineering and technology, applied orientation, quantitative approach, practical training, awareness of the broader social, economic, environmental, ethical, legal and managerial issues in biotechnology. Some of the distinguishing features of the School include highly qualified faculty, quality laboratory infrastructure for teaching and research, individual projects, good library, etc.

Department of Biotechnology, SNIST offers students the ability to learn, advance and succeed in this exciting field with a variety of learning opportunities designed to meet the needs of working adults.

**Objectives:**

* To provide impetus to the activity of knowledge acquisition and education of students in basic sciences and technological know-how associated with the field of biotechnology, and other relevant areas.
* To focus our teaching and research activities strategically around national economic goals.
* To facilitate comprehensive learning combining the scientific, technological and social aspects.
* To seek new models of collaboration with other institutes, universities and industries.
* To combine academic study and the obtain the thrill of doing Research and development leading to innovation.
* Research on pathogenesis of tuberculosis and prevalence of asthma and transplantation biology is being carried out in Medical biotechnology domain
* Research on toxicity of heavy metals, nano-materials and endocrine disrupting chemicals, antimicrobial peptides using mammalian cell lines and zebra fish is being carried out in Animal and Environmental Biotechnology domain
* Research on Molecular modeling, Drug designing and molecular dynamic simulations of selected disease targets with hands on training using relevant software in bioinformatics domain
* Research on Qualitative and Quantitative analysis of phytochemicals of Indian medicinal plants is being executed in plant biotechnology domain
* Research on Enhancement of lipid content from Microalgal species for biodiesel production along with value added bioproducts and waste water treatment is being carried out in the Bioprocess engineering domain.

**Mission and Vision of the Department**

**VISION**

To emerge as a premier Centre in Biotechnology with scientific pursuits and focusing on human values & professional ethics

**MISSION**

1. Imparting knowledge of the fundamentals of Engineering, Science and Technology in students by providing good academic environment to pursue undergraduate, Post graduate and Doctoral programmes in Biotechnology for a successful professional career

2. Developing liaison with Academia, R & D institutions and Biotechnology Industry for exposure in practical aspects in engineering and solution of the industry oriented and societal problems, entrepreneurial pursuit and project management

3. Inculcating interpersonal skills, team work, professional ethics, IPR and regulatory issues in students to improve their employability in changing global environment

4. Promoting strong research culture in students for life – long learning

**PROGRAMME EDUCATIONAL OBJECTIVES**

1. Graduates will have a strong foundation in fundamentals of mathematics, physical and biological sciences, and engineering sciences, to solve problems in health care, environment, Bioprocess Engineering and food security and successfully pursue higher studies
2. Graduates will have successful professional career by demonstrating good scientific and engineering breadth to comprehend the problems, conduct experiments, analyze the results and design novel products and solutions to the real life problems, promote entrepreneurship and skills in project and finance management
3. Graduates will be trained in biosafety, regulatory and Intellectual Property related issues in broader social context and sustainable development, Professional ethics, communication skills, team work skills, leadership and multidisciplinary approach
4. Graduates will be motivated to achieve academic excellence and pursue research to develop life – long learning in a world of constantly evolving technology

**PROGRAM OUTCOMES (POs) OF B. TECH BIOTECHNOLOGY**

1. **Engineering knowledge:** Apply the knowledge of mathematics, natural sciences, and chemical engineering fundamentals in biotechnology to provide solutions for engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze engineering problems in key areas of Biotechnology – bioprocess engineering, plant biotechnology, medical biotechnology and environmental biotechnology.
3. **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.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods in the area of Biotechnology including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools available in Biotechnology and related areas including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively about Biotechnology 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.
11. **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 finalize technical and financial aspects of a project and to manage in multidisciplinary environments.

**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes through individual/group assignments such as technical seminars, lab projects, group projects, mini and main projects in the area of Biotechnology or in multi disciplinary areas.

**ACADEMIC REGULATIONS FOR B.TECH. REGULAR STUDENTS**

**WITH EFFECT FROM THE**

**ACADEMIC YEAR 2017-18 (A-17)**

**1.0 Under-Graduate Degree Programme in Engineering & Technology (UGP in E&T)**

**1.1** SNIST offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree

programme, under Choice Based Credit System (CBCS) with effect from the academic year 2017-18 in the following branches of Engineering.

|  |  |
| --- | --- |
| **Sl. No.** | **Branch** |
|  | Civil Engineering |
|  | Electrical and Electronics Engineering |
|  | Mechanical Engineering |
|  | Electronics and Communication Engineering |
|  | Computer Science and Engineering |
|  | Information Technology |
|  | Electronics and Computer Engineering |
|  | Biotechnology |

**1.2. Credits (Semester system from I year onwards)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl.No.** | **Type of Subject** | **Periods / Week** | **Credits** |
| 1 | Theory | 03/04 | 03/04 |
| 2 | Practical | 02/03/04 | 01/02 |
| 3 | Engineering drawing - I | 01 L/04D (I year I Sem) | 03 |
| 4 | Engineering drawing - II | 01 L/02D (I year II Sem) | 02 |
| 5 | Group Project | 03 | 02 |
| 6 | Industry oriented Mini Project | 4 weeks in summer vacation at the end of III year – II sem | 02 |
| 7 | Project Phase -I | IV year – I sem | 02 |
| 8 | Technical Paper writing and seminar | Iyear – I sem to IV year II Sem\* | 01 each |
| 9 | Project Phase – II | IV year - II Sem | 12 |
| 10 | Comprehensive Viva Voce - I | At the end of II, III, IV year - II Sem\* | 01 |

\*According to the syllabus approved by the Academic Council as per Board of Studies recommendations.

**2.0 Eligibility for admission**

**2.1** Admission to the under merit rank obtained by

graduate programme shall be made either on the basis of the the qualified candidate in entrance test conducted by the

Telangana State Government (EAMCET) or the University or on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the government from time to time.

**2.2** The medium of instructions for the entire under graduate programme in E&T will be

**English** only.

**3.0 B.Tech. Programme structure**

**3.1** A student after securing admission shall pursue the under graduate programme in B.Tech. in a minimum period of **four** academic years (8 semesters), and a maximum period of **eight** academic years (16 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech course. However, the student can take two more years for appearing the examinations.

Each semester is structured to provide 24 credits, totaling to 192 credits for the entire

B.Tech. programme.

Each student shall secure 192 credits (with CGPA ≥ 5) required for the completion of the under graduate programme and award of the B.Tech. degree.

**3.2 UGC/ AICTE** specified definitions/ descriptions are adopted appropriately for various

terms and abbreviations below.

**3.2.1 Semester scheme**

used in these academic regulations/ norms,

which are listed

Each under graduate programme is of 4 academic years (8 semesters) with the academic year being divided into two semesters of 22 weeks ( 90 instructional days) each, each semester having - ‘Continuous Internal Evaluation (CIE)’ and ‘Semester End Examination (SEE)’. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and curriculum / course structure as suggested by AICTE are followed.

**3.2.2 Credit courses**

All subjects/ courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

One credit for one hour/ week/ semester for theory/ lecture (L) courses.

One credit for two hours/ week/ semester for laboratory/ practical (P) courses or tutorials (T).

Courses like Environmental Science, Professional Ethics, Gender Sensitization lab and other student activities like NCC/NSO and NSS are identified as mandatory courses. These courses will not carry any credits.

**3.2.3 Subject Course Classification**

All subjects/ courses offered

for the under graduate programme in E&T

(B.Tech. degree

programmes) are broadly classified as follows. The university has followed almost all the guidelines issued by AICTE/UGC.

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No.** | **Broad Course**  **Classification** | **Course Group/ Category** | **Course Description** |
| 1 | Foundation  Courses  (FnC) | BS – Basic Sciences | Includes mathematics, physics and chemistry subjects |
| 2 | ES - Engineering  Sciences | Includes fundamental Engineering subjects |
| 3 | HS – Humanities and  Social sciences | Includes subjects related to humanities, social sciences and management |
| 4 | Core Courses  (CoC) | PC – Professional  Core | Includes core subjects related to the parent discipline/ department/ branch of Engineering. |
| 5 | Elective Courses (EℓC) | PE – Professional  Electives | Includes elective subjects related to the parent discipline/ department/ branch of Engineering. |
| 6 | OE – Open Electives | Elective subjects which include inter- disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering. |
| 7 | Core Courses | Project Work | B.Tech. project or UG project or UG major project |
| 8 | Industrial training/ Mini- project | Industrial training/ Internship/ UG Mini-project/ Mini-project |
| 9 | Seminar | Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering. |
| 10 | Minor courses | - | 1 or 2 Credit courses (subset of HS) |
| 11 | Mandatory  Courses (MC) | - | Mandatory courses  (non-credit) |

**4.0 Course registration**

**4.1** A ‘faculty advisor or counselor’ shall be assigned to a group of 15 students, who will advise student about the under graduate programme, its course structure and curriculum, choice/option for subjects/ courses, based on their competence, progress, pre-requisites and interest.

**4.2** The academic section of the college invites ‘registration forms’ from students before the beginning of the semester through ‘on-line registration’, ensuring ‘date and time stamping’. The on-line registration requests for any ‘current semester’ shall be **completed before the commencement of SEEs (Semester End Examinations) of the ‘preceding semester’**.

**4.3** A student can apply for **on-line** registration, **only after** obtaining the ‘**written approval**’

from faculty advisor/counselor, which should be submitted to the college academic section

through the Head of the Department. A copy of it shall be retained

Department, faculty advisor/ counselor and the student.

with Head of the

**4.4** A student may be permitted to register for the subjects/ courses of **choice** with a total of 24 credits per semester (minimum of 20 credits and maximum of 28 credits per semester and permitted deviation of ± 17%), based on **progress** and SGPA/ CGPA, and completion of the ‘**pre-requisites’** as indicated for various subjects/ courses, in the department course structure and syllabus contents. However, a **minimum** of 20 credits per semester must be registered to ensure the ‘**studentship**’ in any semester.

**4.5** Choice for ‘additional subjects/ courses’ to reach the maximum permissible limit of 28 credits (above the typical 24 credit norm) must be clearly indicated, which needs the specific approval and signature of the faculty advisor/ counselor.

**4.6** If the student submits ambiguous choices or multiple options or erroneous entries during

**on-line** registration for

the subject(s) / course(s) under a given/ specified course group/

category as listed in the course structure, only the first mentioned subject/ course in that category will be taken into consideration.

**4.7** Subject/ course options

exercised through **on-line** registration are final and **cannot** be

changed or inter-changed; further, alternate choices also will not be considered. However, if the subject/ course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the head of the department, with due notification and time-framed schedule, within the **first week** after the commencement of class-work for that semester.

**4.8** Dropping of subjects/ courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor (subject to retaining a minimum of 20 credits), ‘**within a period of 15 days**’ from the beginning of the current semester.

**4.9 Open electives**: The students have to choose one subject each from (OE-I), (OE-II) and (OE-III) from the list of open electives given. However, the student cannot opt for an open elective subject offered by their own (parent) department, if it is already listed under any category of the subjects offered by parent department in any semester.

**4.10 Professional electives**: students have to choose five professional electives from the list of professional electives given. However, the students may opt for professional elective subjects offered in the related area.

**5.0 Subjects/ courses to be offered**

**5.1** A typical section (or class) strength for each semester shall be 60.

**5.2** A subject/ course may be offered to the students, **only if** a minimum of 20 students (1/3 of the section strength) opt for it. The maximum strength of a section is limited to 80 (60 + 1/3 of the section strength).

**5.3** More than **one faculty member** may offer the **same subject** in any semester. However, selection of choice for students will be based on - ‘**first come first serve** basis and CGPA criterion’ (i.e. the first focus shall be on early **on-line entry** from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

**5.4** If more entries for registration of a subject come into picture, then the Head of Department concerned shall decide, whether or not to offer such a subject/ course for **two (or multiple) sections**.

**6.0 Attendance requirements:**

**6.1** A student shall be eligible to appear for the semester end examinations, if student acquires

a minimum of 75% of

attendance in aggregate of all the subjects/ courses (excluding

attendance in mandatory courses Environmental Science, Professional Ethics, Gender

Sensitization Lab, NCC/NSO and NSS) for that semester.

**6.2** Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each

semester may be condoned by the college academic committee on

genuine and valid

grounds, based on the student’s representation with supporting evidence.

**6.3** A stipulated fee shall be payable towards condoning of shortage of attendance.

**6.4** Shortage of attendance below 65% in aggregate shall in **no** case be condoned.

**6.5 Students whose shortage of attendance is not condoned in any**

**semester are not**

**eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the**

**next semester.** They may seek re-registration for all those subjects

registered in that

semester in which student was detained, by seeking re-admission into that semester as and

when offered; in case if

there are any professional electives and/ or open electives, the

same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

**6.6** A student fulfilling the

attendance requirement in the present semester shall not be

eligible for readmission into the same semester.

**7.0 Academic requirements**

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no.**6.**

**7.1** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% marks (26 out

of 75 marks) in the semester end examination, and a minimum of 40% of marks in the

sum total of the CIE

(Continuous Internal Evaluation) and SEE

(Semester End

Examination) taken together; in terms of letter grades, this implies securing **‘C’** grade or above in that subject/ course.

**7.2** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to UG mini-project and seminar, if student secures not less than 40% marks (i.e. 40 out of 100 allotted marks) in each of them. The student would be treated as failed, if student (i) does not submit a report on UG mini-project, or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) does not present the seminar as required in the IV year I Semester, or (iii) secures less than 40% marks in UG mini-project/ seminar evaluations.

Student may reappear once for each of the above evaluations, when they are scheduled again; if student fails in such ‘one reappearance’ evaluation also, student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

**7.3 Promotion Rules**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Promotion** | **Conditions to be fulfilled** |
| 1 | First year first semester to first year second semester | Regular course of study of first year first semester. |
| 2 | First year second semester to second year first semester | i. Regular course of study of first year second semester.  ii. Must have secured at least 24 credits out of 48 credits i.e., 50% of credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 3. | Second year first semester to second year second semester | Regular course of study of second year first semester. |
| 4 | Second year second semester to third year first semester | i. Regular course of study of second year second semester.  ii. Must have secured at least 58 credits out of 96 credits i.e., 60% of |

|  |  |  |
| --- | --- | --- |
|  |  | credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 5 | Third year first semester to third year second semester | Regular course of study of third year first semester. |
| 6 | Third year second semester to fourth year first semester | i. Regular course of study of third year second semester.  ii. Must have secured at least 86 credits out of 144 credits i.e., 60% of credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 7 | Fourth year first semester to fourth year second semester | Regular course of study of fourth year first semester. |

**7.4** A student shall register for all subjects covering 192 credits as specified and listed in the

course structure, fulfills

all the attendance and academic requirements for 192 credits,

‘earn all 192 credits’ by securing SGPA 5.0 (in each semester) and CGPA (at the end of each successive semester) 5.0 to successfully complete the under graduate programme.

**7.5** After securing the necessary 192 credits as specified for the successful completion of the entire under graduate programme, the student can avail exemption of two subjects up to 6 credits, that is, one open elective and one professional elective subject or two professional elective subjects for optional drop out from these 192 credits earned; resulting in 186 credits for under graduate programme performance evaluation, i.e., the performance of the student in these 186 credits shall alone be taken into account for the calculation of

‘the final CGPA (at the end of under graduate programme, which takes the SGPA of the IV year II semester into account)’ , and shall be indicated in the grade card of IV year II semester. However, the performance of student in the earlier individual semesters, with the corresponding SGPA and CGPA for which grade cards have already been given will not be altered.

**7.6** If a student registers for some more ‘**extra subjects’** (in the parent department or other departments/branches of engg.) other than those listed subjects totaling to 192 credits as

specified in the course

structure of his department, the performances

in those ‘ **extra**

**subjects**’ (although evaluated and graded using the same procedure as that of the required

192 credits) will not be taken into account while calculating the SGPA and CGPA. For such ‘**extra subjects’** registered, % of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 6 and 7.1 – 7.5 above.

**7.7** A student eligible to appear in the end semester examination for any subject/ course, but

absent from it or failed (thereby failing to secure **‘C’** grade or above)

may reappear for

that subject/ course in the supplementary examination as and when conducted. In such cases, CIE assessed earlier for that subject/ course will be carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating performance in that subject.

**7.8** A student **detained in a semester due to shortage of attendance, may be re-admitted when the same semester is offered in the next academic year for fulfillment of**

**academic requirements**. The academic regulations under which student has been

readmitted shall be applicable. However, no grade allotments or

SGPA/ CGPA

calculations will be done for the entire semester in which student has been detained.

**7.9** A student detained **due to lack of credits, shall be promoted to the next academic year only after acquiring the required academic credits.** The academic regulations under which student has been readmitted shall be applicable to him.

**8.0 Evaluation - Distribution and Weightage of marks**

8.1 The performance of a student in each semester shall be evaluated subject-wise for a maximum of 100 marks for a theory and 100 marks for a practical subject. In addition, industry-oriented mini-project, group project, Project Phase –I will also be evaluated for 100 marks, Project Phase – II for 200 marks, Technical Paper writing and Seminar and comprehensive viva for 100 marks each.

8.2 For all the subjects the distribution of marks shall be 25 for Continuous Internal Evaluation (CIE) and 75 for the Semester End-Examination (SEE).

**8.3 Theory Subjects**

1. **Pattern for Continuous Internal Evaluation** 
   1. **Subjects except Foreign languages (16+5+4=25 Marks)**

* There shall be two mid session examinations in every theory course. 16 **marks** are earmarked for each mid session examination. The marks shall be awarded considering the average of two mid session examination marks in each course. If any candidate is absent for any subject in a mid test and/or wishes to improve the performance, a Third Mid test will be conducted for the Student by the College in the entire syllabus on the same day of the main examination on payment fee as decided by the finance committee of SNIST. The result will be treated equal to Third mid test and average of better two tests will be considered. Each mid test will have compulsory questions without choice and long answer questions as detailed in the following paragraphs.
* The mid test is conducted for 64 marks reduced to 16 marks, test is for two hours duration consisting of two parts, i.e. Part ‘A’, and Part ‘B’.
* **Part–A:** Part Ashall have no choice and will have four short answer questions set for 16marks and reduced to 4 marks.
* **Part–B:** Part B of the question paper shall have subjective type questions set for 48 **marks** reduced to 12 marks and shall have 4 questions out of which 3 are to be answered. At least one question must appear from each unit and fourth question must be with 3 bits each bit from one unit
* Each Mid session examination in theory subjects will be restricted to three units, out of the total of 6 units of syllabus, i.e. Mid test – I will be on Units 1 to 3, Mid test – II will be on Units 4 to 6.
* Two assignments shall be given for a total weightage of 5 marks. Assignment-I is to be submitted before the first mid examination for award of 2 marks and for assignment-II which is to be submitted before the second mid test, for award of 2 marks. Students will be given back the assignment before mid session examinations. One mark is allotted for class notes which are to be signed by concerned teacher every fortnight.
* Five marks for each theory course shall be given for those students who put in attendance in a graded manner as given below:

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Attendance Range** | **Marks Awarded** |
| 1. | 65 and above but less than 75% | 1 |
| 2. | 75% and above and up to 82% | 2 |
| 3. | More than 82% and up to 90% | 3 |
| 4 | More than 90% | 4 |

* Marks for attendance shall be added to each subject based on average of attendance of all subjects put together.
* Award of final sessional marks: Attendance, average marks of two assignments, marks for class notes and mid-examination marks shall be added and the total marks are awarded as final sessional marks.

**(ii) Foreign languages**

|  |  |
| --- | --- |
| 2 written tests (Average of two to be taken) | 12 marks |
| Oral Comprehension | 04 marks |
| Assignment & Class notes | 05 marks |
| Attendance | 04 marks |

**b) Pattern for External Examinations (75 marks)**

* There shall be external examination in every theory course it shall consists of two parts (part-A & part-B). The total time duration for this semester end examination will be 3 hours.
* Part-A shall have 25 marks, which is compulsory. It will have 10 short questions out of which 5 questions are set with 3 marks each and another 5 questions are set with 2 marks
* Part-B of the question paper shall have subjective type questions for 50 marks and shall have 8 questions out of which 5 are to be answered. At least one question must appear from each Unit. . Seventh question must have 2 to 3 bits taking from 1st, 2nd, and 3rd units and 8th question also with 2 to 3 bits taken from 4th, 5th and 6th units. And not more than 2 questions from any one unit. All the questions carry equal marks.

**iv.** **Pattern of Evaluation for Lab subjects** **(100 marks)**

For practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 75 marks for semester end examination. Out of the 25 marks for Continuous Internal Evaluation, the distribution is as follows

|  |  |  |
| --- | --- | --- |
| 1. | Day to Day work | 05 marks |
| 2. | Final Record and viva | 05 marks |
| 3. | Average of two tests including viva | 05 marks |
| 4. | Lab Based Project Report viva and demo | 06 marks |
| 6. | Attendance | 04 marks |
| Total | | 25 marks |

The semester end examination for 75 marks shall be conducted by an external examiner and an internal examiner appointed by the Chief Superintendent of Examinations of the college. The marks are distributed as follows:

|  |  |  |
| --- | --- | --- |
| 1. | Procedure to experiment and calculation | 15 marks |
| 2. | Conduct of experiment, observation, Calculation | 30 marks |
| 3. | Results including graphs, discussions and conclusion | 20 marks |
| 4. | Viva voce and Record | 10 marks |
| Total | | 75 marks |

**In case computer based examinations**

|  |  |  |
| --- | --- | --- |
| 1. | Flow chart and algorithms | 15 marks |
| 2. | Program writing and execution | 30 marks |
| 3. | Result and conclusions | 20 marks |
| 4. | Viva voce and Record | 10 marks |
| Total | | 75 marks |

8.5 For the subject having design and/or drawing, (such as Engineering Drawing I, Engineering Drawing II and Machine Drawing), the distribution shall be 25 marks for internal evaluation (10 marks for day-to-day work including drawing, home assignment work, 10 marks for average of two internal tests and 5 marks for attendance) and 75 marks for end semester examination. There shall be two internal tests in a Semester and the average of the two shall be considered for the award of marks for internal tests. Third test facility can be availed as mentioned above (5.3 (a) 1)

8.6 Group Project (25+75=100 Marks) – This can be Inter disciplinary

A group project shall be carried out by a group of students consisting of 2 to 3 in number in third year first semester. This work shall be carried out under the guidance of teacher(s) and shall involve design, fabrication, software development or any other significant activity. This can be of interdisciplinary nature also. There will be 100 marks in total with 25 marks of Continuous Internal Evaluation.

**The continuous internal evaluation shall consist of:**

|  |  |
| --- | --- |
| Day to day work | 10 marks |
| Report | 05 marks |
| Demonstration / presentation | 10 marks |
| Total sessional marks | 25 marks |
| Semester End Examination | 75 Marks |

The semester end examination will be carried out by a committee consisting of an external examiner, Head of the department or his nominee, a senior faculty member and the supervisor for 75 marks.

Student shall be deemed to have satisfied the requirement for the subject concerned, if the student secures not less than 35% marks in the semester end examination and minimum of 40% of marks in the sum total of the Continuous Internal Evaluation and semester end examination taken together.

**8.7 Industry oriented mini project (25+75=100 Marks)**

There shall be an industry-oriented mini-Project in their specialization that may be carried out in collaboration with an industry / R & D organization / Academic Institution, to be taken up during the vacation after III year II Semester examination. However, the mini project and its report shall be evaluated during IV year I Semester. The industry oriented mini project shall be evaluated for a total of 100 marks with 25 marks for internal assessment and 75 marks for semester end examination. The mini project must be submitted in report form and should be presented before a committee, consisting of an external examiner, Head of the department or his nominee, a senior faculty member of the department and supervisor of the mini project when IV year I semester end examinations are carried out.

**The pattern of Continuous Internal Evaluation** is as follows:

|  |  |
| --- | --- |
| Work in progress as evaluated by internal guide | 5 marks |
| Work in progress as evaluated by External guide | 5 marks |
| Report | 5 marks |
| Seminar presentation and defense of project | 10 marks |
| Total | 25 marks |

If the mini project is conducted within the college, the work in progress is evaluated by the supervisor for 10 marks.

**Student shall be deemed to have satisfied, if the student secures not less than 35% marks in the semester end examination and minimum of 40% of marks in the sum total of the Continuous Internal Evaluation and end examination taken together.**

**8.8. Project Phase -I (25+75=100 Marks)**

A project Phase I in fourth year first semester will be evaluated for 100 marks as follows. This is aimed at the students to identify and show progress in a project on which they are likely to continue for their project in final year second semester.

The Continuous Internal Evaluation shall consist of:

|  |  |
| --- | --- |
| Literature survey and presenting  seminar at the end of 6 weeks | 10 marks |
| Report | 05 marks |
| Demonstration / presentation  at the end of 12 weeks | 10 marks |
| Total sessionals marks | 25 marks |

Semester End Examination 75 marks

**Pattern of external evaluation for project Phase – I.**

|  |  |
| --- | --- |
| Final Project Report | 15 marks |
| Presentation | 10 marks |
| Demonstration / Defense of Project | 50 Marks |
| **Total** | **75 marks** |

**There shall be end semester evaluation in project phase – I. Student must secure 40% marks i.e. 30 marks out of 75 marks to be successful.**

**8.9. Project Phase – II (50+150=200 Marks)**

Out of total 200 marks for project work (in the final year second semester), 50 marks shall be for Continuous Internal Evaluation and 150 marks for the External Evaluation at the end of the Semester.

**The pattern of Continuous Internal Evaluation is as follows:**

**Division of marks for internal assessment – 50 marks**

|  |  |
| --- | --- |
| Progress of Project work and the corresponding interim report  as evaluated by internal guides at the end of 5 weeks | 05 marks |
| Seminar at the end of 5 weeks | 05 marks |
| Progress of Project work as evaluated by guides at the end of 10 weeks | 05 marks |
| Seminar at the end of 10 weeks | 05 marks |
| Evaluation by the Guides ( at the end of 15 weeks) | 10 marks |
| Final Project Report | 05 marks |
| Final presentation and defense of the project | 15 marks |
| Total | 50 marks |

External Evaluation of the project (viva-voce) shall be conducted by a committee appointed by the chief superintendent. The committee consists of an external examiner, HoD, a senior faculty member and internal guide.

If the project is carried out internally the marks supposed to be given by external guide will be given by internal guide himself.

**Division of Marks for External Evaluation – 150 Marks**

**Pattern of External Evaluation for Project Phase -II**

|  |  |
| --- | --- |
| Final Project Report | 30 marks |
| Presentation | 20 marks |
| Demonstration / Defense of Project | 100 Marks |
| **Total** | **150 marks** |

Student shall be deemed to have satisfied, if the student secures not less than 35% marks in the semester end examination and minimum of 40% of marks in the sum total of the Continuous Internal Evaluation and semester end examination taken together. i.e 80 marks to be successful in this subject.

**8.10. Technical Paper writing & Seminars I to VIII (100 Marks) each**

There shall be a technical Paper writing &seminar evaluated for 100 marks in every Semester from I year I Sem to IV year II Sem\*. The evaluation is purely internal and will be conducted as follows:

Content : 20 marks

Presentation including PPT : 20 marks

Seminar Notes : 10 marks

Interaction : 10 marks

Report : 25 marks

Attendance : 10 marks

Punctuality : 05 marks

Total **100 marks**

\* According to the syllabus approved by the Academic Council as per Board of Studies recommendations

Student must secure 40% i.e. 40 marks to be successful

**8.11 Comprehensive Viva-voce (II-II, III-II and IV-II\*)**

There shall be comprehensive viva voce as stated above which will be evaluated for 100 marks. Out of 100 marks, 50 marks are internal and 50 marks are external. The evaluation is purely internal and will be conducted by a committee consisting of Head of the Department or his nominee and two senior teachers.

|  |  |
| --- | --- |
| First mid-sessional viva at the end of 5 weeks (Internal) | 25 marks |
| Second mid-sessional viva at the end of 10 weeks (Internal) | 25 marks |
| Final viva during practical examinations (External) | 50 marks |
| Total | 100 Marks |

\* According to the syllabus approved by the Academic Council as per Board of Studies recommendations

**8.12** The evaluation has to be carried out by two teachers independently and average be taken. The sessional marks awarded by the Department are not final. They are subject to scrutiny by a committee constituted by the college and scaling is done wherever necessary. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective departments as per the college norms and shall be produced to the Committee of the college or any external agency like NBA etc. as and when the same are called for.

**9.0 Grading procedure**

**9.1** Marks will be awarded

to indicate the performance of student in each theory subject,

laboratory / practicals, seminar, UG mini project and UG major project. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End

Examination, both taken grade shall be given.

together) as specified in item 8 above, a corresponding letter

**9.2** As a measure of the performance of student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks shall be followed:

|  |  |  |
| --- | --- | --- |
| **% of Marks Secured in a Subject/Course**  **(Class Intervals)** | **Letter Grade**  **(UGC Guidelines)** | **Grade Points** |
| Greater than or equal to 90% | O  (Outstanding) | 10 |
| 80 and less than 90% | A+  (Excellent) | 9 |
| 70 and less than 80% | A  (Very Good) | 8 |
| 60 and less than 70% | B+  (Good) | 7 |
| 50 and less than 60% | B  (Average) | 6 |
| 40 and less than 50% | C  (Pass) | 5 |
| Below 40% | F (FAIL) | 0 |
| Absent | Ab | 0 |

**9.3** A student obtaining ‘**F’**

grade in any subject shall be deemed to have ‘**failed’** and is

required to reappear as a ‘supplementary student’ in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as

those obtained earlier.

**9.4** A student who has not

appeared for examination in any subject, ‘**Ab’** grade will be

allocated in that subject, and student shall be considered ‘**failed’**. Student will be required to reappear as a ‘supplementary student’ in the semester end examination, as and when offered.

**9.5** A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.

**9.6** A student earns grade point (GP) in each subject/ course, on the basis of the letter grade secured in that subject/ course. The corresponding ‘credit points’ (CP) are computed by multiplying the grade point with credits for that particular subject/ course.

**Credit points (CP) = grade point (GP) x credits …. For a course**

**9.7** The student passes the subject/ course only when **GP 5 (‘C’ grade or above)**

**9.8** The semester grade point average (SGPA) is calculated by dividing the sum of credit points (CP) secured from all subjects/ courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to two decimal places. SGPA is thus computed as

SGPA = { Ci Gi } / {  Ci } …. For each semester

where ‘i’ is the subject indicator index (takes into account all subjects in a semester), ‘N’

is the no. of subjects ‘**registered’** for the semester (as specifically required and listed

under the course structure of the parent department), Ci the no. of credits allotted to the

ith subject, and Gi represents the grade points (GP) corresponding to the letter grade awarded for that ith subject, and Gi represents the grade points (GP) corresponding to the letter grade awarded for that ith subject.

**9.9** The cumulative grade point average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the

ratio of the total credit points secured by a student in all registered courses in all semesters, and the total number of credits registered in all semesters, and the total number of credits registered in all the semesters. CGPA is rounded off to two decimal places. CGPA is thus computed from the I year II semester onwards at the end of each semester as per the formula.

**CGPA =** { Cj Gj } / {  Cj } …. For all S semesters registered

**(i.e., up to and inclusive of S semesters, S 2),**

where ‘**M’** is the **total** no. of subjects (as specifically required and listed under the course structure of the parent department) the student has ‘**registered’** i.e., from the 1st semester onwards up to and inclusive of the 8th semester, ‘j’ is the subject indicator index (takes into account a subjects from 1 to 8 semesters), CJ is the no. of credits allotted to the Jth subjects and Gj represents the grade points (GP) corresponding to the letter grade awarded for that Jth subject. After registration and completion of the first year first semester, SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

**Illustration of calculation of SGPA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course/Subject** | **Credits** | **Letter**  **Grade** | **Grade**  **Points** | **Credit**  **Points** |
| Course 1 | 4 | A | 8 | 4 x 8 = 32 |
| Course 2 | 4 | O | 10 | 4 x 10 = 40 |
| Course 3 | 4 | C | 5 | 4 x 5 = 20 |
| Course 4 | 3 | B | 6 | 3 x 6 = 18 |
| Course 5 | 3 | A+ | 9 | 3 x 9 = 27 |
| Course 6 | 3 | C | 5 | 3 x 5 = 15 |
|  | 21 |  |  | 152 |

SGPA = 152/21 = 7.24

**Illustration of calculation of CGPA:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course/Subject** | **Credits** | **Letter Grade** | **Grade Points** | **Credit Points** |
| **I Year I Semester** | | | | |
| Course 1 | 4 | A | 8 | 4 x 8 = 32 |
| Course 2 | 4 | A+ | 9 | 4 x 9 = 36 |
| Course 3 | 4 | B | 6 | 4 x 6 = 24 |
| Course 4 | 3 | O | 10 | 3 x 10 = 30 |
| Course 5 | 3 | B+ | 7 | 3 x 7 = 21 |
| Course 6 | 3 | A | 8 | 3 x 8 = 24 |
| **I Year II Semester** | | | | |
| Course 7 | 4 | B+ | 7 | 4 x 7 = 28 |
| Course 8 | 4 | O | 10 | 4 x 10 = 40 |
| Course 9 | 4 | A | 8 | 4 x 8 = 32 |
| Course 10 | 3 | B | 6 | 3 x 6 = 18 |
| Course 11 | 3 | C | 5 | 3 x 5 = 15 |
| Course 12 | 3 | A+ | 9 | 3 x 9 = 27 |
|  | Total Credits =  42 |  |  | Total Credit Points =327 |

CGPA = 327/42 = 7.79

**9.10** For merit ranking or comparison purposes or any other listing, **only** the ‘**rounded off’**

values of the CGPAs will be used.

**9.11** For calculations listed in regulations 9.6 to 9.9, performance in failed subjects/ courses

(securing **F** grade) will

also be taken into account, and the credits

of such subjects/

courses will also be included in the multiplications and summations. After passing the failed subject(s) newly secured letter grades will be taken into account for calculation of SGPA and CGPA. However, mandatory courses will not be taken into consideration.

**10.0 Passing standards**

**10.1** A student shall be declared successful or ‘passed’ in a semester, if student secures a GP ≥

5 (‘C’ grade or above) in every subject/course in that semester (i.e. when student gets an SGPA 5.00 at the end of that particular semester); and a student shall be declared successful or ‘passed’ in the entire under graduate programme, only when gets a CGPA

5.00 for the award of the degree as required.

**10.2** After the completion of each semester, a grade card or grade sheet (or transcript) shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, and grade earned etc.), credits earned, SGPA, and CGPA.

**11.0 Declaration of results**

**11.1** Computation of SGPA and CGPA are done using the procedure listed in 9.6 to 9.9.

**11.2** For final percentage of formula may be used.

**12.0 Award of degree**

marks equivalent to the computed final CGPA, the following

**% of Marks = (final CGPA – 0.5) x 10**

**12.1** A student who registers

for all the specified subjects/ courses as listed in the course

structure and secures the required number of 192 credits (with CGPA 5.0), within 8 academic years from the date of commencement of the first academic year, shall be declared to have ‘**qualified’** for the award of the B.Tech. degree in the chosen branch of Engineering as selected at the time of admission.

**12.2** A student who qualifies for the award of the degree as listed in item 12.1 shall be placed in the following classes.

**12.3** Students with final CGPA (at the end of the under graduate programme) 8.00, and fulfilling the following conditions -

(i) Should have passed all the subjects/courses in ‘**first appearance’** within the first

4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(ii) Should have secured a CGPA 8.00, at the end of each of semesters, starting from first year first semester onwards.

(iii) Should not have been detained or prevented from writing the end semester examinations in any semester due to shortage of attendance or any other reason, shall be placed in ‘first class with distinction’.

**12.4** Students with final CGPA (at the end of the under graduate programme) 6.50 but <

8.00, shall be placed in ‘**first class’**.

**12.5** Students with final CGPA (at the end of the under graduate programme) 5.50 but <

6.50, shall be placed in ‘**second class’**.

**12.6** All other students who qualify for the award of the degree (as per item 12.1), with final

CGPA (at the end of the under graduate programme) 5.00 but < 5.50, shall be placed in

‘**pass class**’.

**12.7** A student with final CGPA (at the end of the under graduate programme) < 5.00 will not be eligible for the award of the degree.

**12.8** Students fulfilling the conditions listed under item 12.3 alone will be eligible for award of

‘**university rank**’ and ‘**gold medal**’.

**13.0 Withholding of results**

**13.1** If the student has not paid the fees to the university/ college at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

**14.0 Transitory regulations**

**14.1** A student who has discontinued for any reason, or has been detained for want of attendance or lack of required credits as specified, or who has failed after having undergone the degree programme, may be considered eligible for readmission to the same subjects/ courses (or equivalent subjects/ courses, as the case may be), and same professional electives/ open electives (or from set/category of electives or equivalents suggested, as the case may be) as and when they are offered (within the time-frame of 8 years from the date of commencement of student's first year first semester).

**15.0 Student transfers**

15.1There shall be no branch transfers after the completion of admission process.

15.2 The students seeking transfer to Sreenidhi Institute of Sc. & Tech. from various other Universities/institutions have to pass the failed subjects which are equivalent to the subjects of SNIST, and also pass the subjects of SNIST which the students have not studied at the earlier institution. Further, though the students have passed some of the subjects at the earlier semesters of SNIST, the students have to study substitute subjects in SNIST.

15.3 The transferred students from other Universities/institutions to SNIST who are on rolls to be provide one chance to write the CBT (internal marks) in the failed subjects and/or subjects not studied as per the clearance letter issued by the Institution.

15.4 The autonomous affiliated colleges have to provide one chance to write the nternal examinations in the failed subjects and/or subjects not studied, to the students transferred from other universities/institutions to SNIST who are on rolls, as per the clearance (equivalence) letter issued by the University.

16.0 Scope

16.1 The academic regulations should be read as a whole, for the interpretation. purpose of any interpretation.

16.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

16.3 The Institution may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the date notified by the Institution.

**Academic Regulations for B.Tech.**

**(Lateral Entry Scheme)**

**w.e.f the AY 2018-19**

**1. Eligibility for award of**

**B. Tech. Degree (LES)**

The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years failing which he will forfeit the seat.

**2.** The student shall register for 144 credits and secure 144 credits with CGPA ≥ 5 from II

year to IV year B.Tech. programme (LES) for the award of B.Tech. degree. **Out of the**

**144 credits secured, the student can avail exemption up to 6 credits**, that is, one open elective subject and one professional elective subject or two professional elective subjects

resulting in 138 credits for B.Tech programme performance evaluation**.**

**3.** The students, who fail

to fulfil the requirement for the award of the degree in six

academic years from the year of admission, shall forfeit their seat in B.Tech.

**4.** The attendance requirements of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

**5. Promotion rule**

|  |  |  |
| --- | --- | --- |
| **S. No** | **Promotion** | **Conditions to be fulfilled** |
| 1 | Second year first semester to second year second semester | Regular course of study of second year first semester. |
| 2 | Second year second semester to third year first semester | (i) Regular course of study of second year second semester.  (ii) Must have secured at least 29 credits  out of 48 credits i.e., 60% of credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 3 | Third year first semester to third year second semester | Regular course of study of third year first semester. |
| 4 | Third year second semester to fourth year first semester | (i) Regular course of study of third year second semester.  (ii) Must have secured at least 58 credits out of 96 credits i.e., 60% of credits up to third year second semester from all the  relevant regular and supplementary examinations, whether the student takes  those examinations or not. |
| 5 | Fourth year first semester to fourth year second semester | Regular course of study of fourth year first semester. |

**6.** All the other regulations as applicable to B. Tech. 4-year degree course (Regular)

will hold good for B. Tech. (Lateral Entry Scheme).

**MALPRACTICES RULES**

**DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS**

|  |  |  |
| --- | --- | --- |
|  | **Nature of Malpractice/Improper conduct** | **Punishment** |
|  | If the student: |  |
| 1. (a) | Possesses or keeps accessible in  examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which student is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. |
| (b) | Gives assistance or guidance or receives  it from any other student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him. |
| 2. | Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing. | Expulsion from the examination hall and  cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year.  The hall ticket of the student is to be cancelled and sent to the university. |
| 3. | Impersonates any other student in connection with the examination. | The student who has impersonated shall be  expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and UG major project) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation |

|  |  |  |
| --- | --- | --- |
|  |  | of the course by the student is subject to the  academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him. |
| 4. | Smuggles in the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. |
| 5. | Uses objectionable, abusive or offensive  language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | Cancellation of the performance in that subject. |
| 6. | Refuses to obey the orders of the chief  superintendent/assistant – superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them. |

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|  |  |  |
| --- | --- | --- |
| 7. | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and  cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. |
| 8. | Possess any lethal weapon or firearm in the examination hall. | Expulsion from the examination hall and  cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat. |
| 9. | If student of the college, who is not a student for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the  examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.  Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them. |
| 10. | Comes in a drunken condition to the examination hall. | Expulsion from the examination hall and  cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. |
| 11. | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of the performance in that subject  and all other subjects the student has appeared including practical examinations and UG major project of that semester/year examinations. |

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12.

If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the university for

further action to punishment.

award suitable

**Malpractices identified by squad or special invigilators**

1. Punishments to the students as per the above guidelines.

2. Punishment for institutions: (if the squad reports that the college is encouraging malpractices)

a. A show cause notice shall be issued to the college. b. Impose a suitable fine on the college.

c. Shifting the examination centre from the college to another college for a specific period of not less than one year.

\* \* \*

**B. TECH - BIOTECHNOLOGY**

**I YEAR I SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6H101 | English-I | 2 | - | - | 2 | 25 | 75 |
| 2 | 6H112 | Fundamentals of Mathematics  or  Fundamentals of Biology | 3 | 2 | - | 3 | 25 | 75 |
| 6G101 |
| 3 | 6H121 | Engineering Physics – I | 3 | 1 | - | 3 | 25 | 75 |
| 4 | 6H131 | Engineering Chemistry | 2 | 1 | - | 2 | 25 | 75 |
| 5 | 6F101 | Computer Programming | 3 | 1 | - | 3 | 25 | 75 |
| 6 | 6B101 | Engineering Drawing - I | 1 | 1 | 4 | 3 | 25 | 75 |
| 7 | 6H171 | English Language Communication skills Lab | - | - | 2 | 1 | 25 | 75 |
| 8 | 6H181 | Engineering Physics Lab-I | - | - | 2 | 1 | 25 | 75 |
| 9 | 6H186 | Engineering Chemistry Lab | - | - | 2 | 1 | 25 | 75 |
| 10 | 6F171 | “C” Programming Lab | - | - | 4 | 2 | 25 | 75 |
| 11 | 6B171 | Engineering Workshop-I | - | - | 2 | 1 | 25 | 75 |
| 12 | 6F172 | IT Workshop - I | - | - | 2 | 1 | 25 | 75 |
| 13 | 6G191 | Seminar on Current Affairs/Technical Topic | - | - | 2 | 1 | 100 | - |
| **Total** | | | **14** | **6** | **20** | **24** | **400** | **900** |

**L – Lecture, T- Tutorial, P/D – Practical /Drawing, C-Credit,**

**CIE – Continuous Internal Evaluation,**

**SEE – Semester End Examination**

**B. TECH - BIOTECHNOLOGY**

**I YEAR II SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Codes** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6H202 | English - II | 2 | 2 | - | 2 | 25 | 75 |
| 2 | 6H214 | Mathematics for Biotechnology-1 | 3 | 2 | - | 3 | 25 | 75 |
| 3 | 6AC41 | Elements of Electrical Engineering | 3 | 1 | - | 3 | 25 | 75 |
| 4 | 6E201 | Data Structures | 3 | 1 | - | 3 | 25 | 75 |
| 5 | 6B202 | Engineering Drawing – II | 1 | 1 | 2 | 2 | 25 | 75 |
| 6 | 6H232 | Environmental and Applied Chemistry | 2 | 1 | - | 2 | 25 | 75 |
| 7 | 6BC04 | Elements of Mechanical Engineering | 3 | 1 | - | 3 | 25 | 75 |
| 8 | 6ZC03 | Gender Sensitization, Values, Ethics and Yoga | 1 | 1 | - | 1 | 25 | 75 |
| 9 | 6E271 | Data structure lab (C, C++) | - | - | 4 | 2 | 25 | 75 |
| 10 | 6AC91 | Electrical Engineering Lab | - | - | 2 | 1 | 25 | 75 |
| 11 | 6F273 | IT Workshop – II | - | - | 2 | 1 | 25 | 75 |
| 12 | 6G292 | Seminar on Science and its impact / Technical topic | **-** | **-** | 2 | 1 | 100 | - |
| **Total** | | | **18** | **10** | **10** | **24** | **375** | **825** |

B. TECH - BIOTECHNOLOGY

II Year I Semester Course Structure

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6G302 | Biochemistry | 3 | 1 | - | 3 | 25 | 75 |
| 2 | 6G303 | Microbiology | 3 | 1 | - | 3 | 25 | 75 |
| 3 | 6G304 | Cell Biology | 3 | 1 | - | 3 | 25 | 75 |
| 4 | 6G305 | Momentum and Heat Transfer | 3 | 1 | - | 3 | 25 | 75 |
| 5 | 6CC09 | Elements of Electronics Engineering | 3 | 1 | - | 3 | 25 | 75 |
| 6 | 6H317 | Mathematics for Biotechnology-II | 3 | 2 | - | 3 | 25 | 75 |
| 7 | 6H373 | Functional and Communicative English  (FCE) | 1 | 2 | - | 1 | 25 | 75 |
| 8 | 6G371 | Biochemistry Lab | - | - | 3 | 2 | 25 | 75 |
| 9 | 6G372 | Microbiology and Cell Biology Lab | - | - | 3 | 2 | 25 | 75 |
| 10 | 6CC76 | Electronics Engineering Lab | - | - | 2 | 1 | 25 | 75 |
| 11 | 6G393 | Seminar on Technology and its impact / Technical topic | - | - | 2 | 1 | 100 | - |
| **Total** | | | **19** | **9** | **10** | **25** | **350** | **750** |

**B. TECH - BIOTECHNOLOGY**

**II YEAR II SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6G406 | Genetics and Molecular Biology | 3 | 2 | - | 3 | 25 | 75 |
| 2 | 6ZC01 | Managerial Economics and Financial Analysis | 2 | 1 | - | 2 | 25 | 75 |
| 3 | 6G407 | Process Engineering Calculations | 3 | 2 | - | 4 | 25 | 75 |
| 4 | 6G408 | Analytical Techniques in Biotechnology | 3 | 1 | - | 3 | 25 | 75 |
| 5 | 6EC70 | Java programming | 2 | 2 | - | 2 | 25 | 75 |
| 6 | 6HC18 | Probability and Statistics | 3 | 1 | - | 3 | 25 | 75 |
| 7 | 6G473 | Analytical Techniques in Biotechnology Lab | - | - | 4 | 2 | 25 | 75 |
| 8 | 6EC74 | Java programming lab | - | - | 2 | 1 | 25 | 75 |
| 9 | 6G474 | Comprehensive Viva-voce - I | - | - | - | 1 | 25 | 75 |
| 10 | 6G494 | Technical Seminar | - | - | 2 | 1 | 100 | - |
| **Total** | | | **16** | **9** | **8** | **22** | **325** | **675** |

**B. TECH - BIOTECHNOLOGY**

**III YEAR I SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6G509 | Thermodynamics for Biotechnologists | 3 | 1 | - | 3 | 25 | 75 |
| 2 | 6G510 | Genetic Engineering | 3 | 1 | - | 3 | 25 | 75 |
| 3 | 6G511 | Bioinformatics | 3 | 1 | - | 3 | 25 | 75 |
| 4 | 6G512 | Biochemical Reaction Engineering | 3 | 1 | - | 2 | 25 | 75 |
| 5 |  | **Professional Elective-I** | 3 | 1 | - | 3 | 25 | 75 |
| 6 |  | **Open Elective – I** | 2 | 1 | - | 2 | 25 | 75 |
| 7 | 6H576 | Quantitative Aptitude | - | - | 2 | 1 | 25 | 75 |
| 8 | 6HC74 | Effective English Communication and Soft Skills (EECSS) | 1 | - | - | 1 | 25 | 75 |
| 9 | 6G575 | Bioinformatics Lab | - | - | 4 | 2 | 25 | 75 |
| 10 | 6G576 | Molecular Biology and Genetic Engineering Lab | - | - | 4 | 2 | 25 | 75 |
| 11 | 6G577 | Group Project | - | - | 2 | 1 | 25 | 75 |
| 12 | 6G595 | Technical Literature Review and Seminar -I | - | - | 2 | 1 | 100 | - |
| **Total** | | | **17** | **7** | **16** | **24** | **375** | **825** |

**L – Lecture, T- Tutorial, P/D – Practical /Drawing, C-Credit,**

**CIE – Continuous Internal Evaluation,**

**SEE – Semester End Examination**

**B. TECH - BIOTECHNOLOGY**

**III YEAR II SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6G618 | Plant Biotechnology | 3 | 1 |  | 3 | 25 | 75 |
| 2 | 6G619 | Immunology | 3 | 1 | - | 3 | 25 | 75 |
| 3 | 6G620 | Bioprocess Engineering | 3 | 1 | - | 3 | 25 | 75 |
| 4 |  | **Professional Elective-II** | 3 | 1 | - | 2 | 25 | 75 |
| 5 |  | **Open Elective – II** | 2 | 1 | - | 2 | 25 | 75 |
| 6 |  | **Open Elective-III** | 2 | 1 | - | 2 | 25 | 75 |
| 7 | 6H677 | Logical Reasoning | - | - | 2 | 1 | 25 | 75 |
| 8 | 6G678 | Plant Biotechnology Lab | - | - | 4 | 2 | 25 | 75 |
| 9 | 6G679 | Immunology lab | - | - | 4 | 2 | 25 | 75 |
| 10 | 6G680 | Bioprocess Engineering Lab | - | - | 4 | 2 | 25 | 75 |
| 11 | 6G681 | Comprehensive Viva Voce-II | - | - | - | 1 | 25 | 75 |
| 12 | 6G696 | Technology Literature Review & Seminar II | - | - | 2 | 1 | 100 | - |
| **Total** | | | **18** | **6** | **16** | **24** | **375** | **825** |

**B. TECH - BIOTECHNOLOGY**

**IV YEAR I SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **CIE** | **SEE** |
| 1 | 6G726 | Industrial and Environmental Biotechnology | 3 | 1 | - | 3 | 25 | 75 |
| 2 | 6G727 | Downstream Processing | 3 | 1 | - | 3 | 25 | 75 |
| 3 | 6G728 | Animal Biotechnology | 3 | 1 | - | 3 | 25 | 75 |
| 4 | 6G729 | Mass Transfer and Separations | 3 | 1 | - | 3 | 25 | 75 |
| 5 |  | **Professional Elective-III** | 3 | 1 | - | 3 | 25 | 75 |
| 6 |  | **Professional Elective-IV** | 3 | 1 | 2 | 3 | 25 | 75 |
| 7 | 6G782 | Downstream Processing Lab | - | - | 4 | 2 | 25 | 75 |
| 8 | 6G783 | Animal Biotechnology Lab | - | - | 4 | 2 | 25 | 75 |
| 9 | 6G784 | Project Phase - I | - | 1 | 4 | 3 | 100 | - |
| 10 | 6G785 | Industry Oriented Mini Project | - | - | - | 2 | 25 | 75 |
| 11 | 6G797 | Technical Literature Review and Seminar -III | - | - | 2 | 1 | 100 | - |
| **Total** | | | **18** | **7** | **16** | **28** | **425** | **675** |

**IV YEAR II SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject Code** | **Subject** | **L** | **T** | **P/D** | **C** | **Max Marks** | |
| **Int** | **Ext** |
| 1 | 6ZC02 | Management Science | 3 | - | - | 3 | 25 | 75 |
| 2 |  | **Professional Elective – V** | 3 | - | - | 3 | 25 | 75 |
| 3 | 6G886 | Project Phase – II | - | - | 20 | 12 | 50 | 150 |
| 4 | 6G887 | Comprehensive Viva-voce- III | - | - | - | 1 | 25 | 75 |
| 5 | 6G898 | Technical Literature Review and Seminar -IV | **-** | **-** | 2 | 1 | 100 | - |
|  |  | **Total** | **6** | **-** | **22** | **20** | **225** | **375** |

**List of Open Electives**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Minor Stream** | **Subject Code** | **Open Elective –I** | **Subject Code** | **Open Elective - II** | **Subject Code** | **Open Elective -III** |
| **Computer stream** | 6FC32 | Data Base Systems (DBS) | 6FC35 | Python Programming for Biotechnology | 6FC33 | Data Analytics |
| **Entrepreneurship Stream** | 6ZC22 | Basics of Entrepreneurship | 6ZC24 | Innovations and Design Thinking | 6ZC23 | Advanced Entrepreneurship |
| **Finance Stream** | 6ZC05 | Banking Operations, Insurance and Risk Management | 6ZC19 | Entrepreneurship Project Management and Structured Finance | 6ZC15 | Financial Institutions, Markets and Services |
| **Technology Entrepreneurship** | 6ZC20 | Product and Services | 6ZC24 | Innovations and Design Thinking | 6ZC21 | General Management and Entrepreneurship |

**List of Professional Electives**

|  |  |  |  |
| --- | --- | --- | --- |
| **Professional Elective-I** | | | |
| **S. No.** | **Stream** | **Subject Code** | **Subject Name** |
| 1 | Medical Biotechnology | 6G513 | Molecular Pathogenesis |
| 2 | Plant Biotechnology | 6G514 | Plant Metabolic Engineering |
| 3 | Environmental Biotechnology | 6G515 | Biosafety, Bioethics, IPR |
| 4 | Bioprocess Engineering | 6G516 | Instrumentation and Bioprocess control |
| 5 | Nanobiotechnology | 6G517 | Nanomaterials synthesis and characterization |
| **Professional Elective-II** | | | |
| 1 | Medical Biotechnology | 6G621 | Molecular Toxicology |
| 2 | Plant Biotechnology | 6G622 | Phytochemicals & Herbal medicine |
| 3 | Environmental Biotechnology | 6G623 | **Green Manufacturing Technology** |
| 4 | Bioprocess Engineering | 6G624 | Optimization and numerical methods in biotechnology |
| 5 | Nanobiotechnology | 6G625 | Biosensors and Bioelectronics |
| **Professional Elective-III** | | | |
| 1 | Medical Biotechnology | 6G730 | Applied Virology |
| 2 | Plant Biotechnology | 6G731 | Food Biotechnology |
| 3 | Environmental Biotechnology | 6G732 | **Enzyme Engineering** |
| 4 | Bioprocess Engineering | 6G733 | Advanced Bioprocess Control |
| 5 | Nanobiotechnology | 6G734 | Nanomaterials in medical applications |
| **Professional Elective-IV** | | | |
| 1 | Medical Biotechnology | 6G735 | Cancer Biology |
| 2 | Plant Biotechnology | 6G736 | Molecular Markers and crop Improvement |
| 3 | Environmental / Genomics | 6G737 | Computational Molecular Biology |
| 4 | Bioprocess Engineering | 6G738 | Bioprocess economics and plant design |
| 5 | Nanobiotechnology | 6G739 | Nanotoxicology |
| **Professional Elective-V** | | | |
| 1 | Medical Biotechnology | 6G840 | Clinical Trials & Regulatory Affairs |
| 2 | Plant Biotechnology | 6G841 | Biopharmaceutical technology |
| 3 | Environmental Biotechnology | 6G842 | Bioremediation and **metagenomics** |
| 4 | Bioprocess Engineering | 6G843 | Advanced Mass transfer separations |
| 5 | Nanobiotechnology | 6G844 | Nanoelectronics MEMS and NEMS |

**III Year I Semester (6G509) THERMODYNAMICS FOR BIOTECHNOLOGISTS**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | c | d | e | f | g | h | i | j | k | l |
| X | X | X |  |  |  |  |  |  |  |  |  |

**L T P/D C**

**3 1 - 3**

**Course Objective:** The objective of this course is to familiarize the students with basics of thermodynamics and enables them to calculate material and energy balances involved in design of biological processes

**Unit I: CONCEPTS AND DEFINITIONS**

System, Surroundings, Intensive and extensive properties, Thermodynamic equilibrium: Thermal, mechanical and chemical equilibrium, Process, work, pure substance, concept of phase, Equations of state: Ideal gas, Vander waals equation of state, critical constants

**Unit II: FIRST LAW OF THERMODYNAMICS**

First law of thermodynamics, consequences of first law of thermodynamics, constant volume, constant pressure, constant temperature process. Adiabatic processes, Calculation of heat , work, internal energy and enthalpy

**Unit III : FIRST LAW ANALYSIS**

First law of thermodynamics for a continuous system and a control volume, Steady state flow processes, Fuels and Combustion: Standard Heat of Reaction, Standard enthalpy of formation, standard enthalpy of Combustion, Effect of Temperature on standard heat of reaction,

**Unit IV: SECOND LAW OF THERMODYNAMICS**

First law of thermodynamics limitation, Statements of Second Law, Equivalence of Kelvin-Planck and Clausius statements, Entropy concept, Carnot cycle, Carnot power cycle, Rankine cycle, practical Rankine cycle, Refrigeration cycles, calculation of COP, Calculations of Entropy change, Second law analysis of control volume.

**Unit V: THERMODYNAMIC RELATIONS**

Maxwells relations, Thermodynamic potentials: Internal Energy, Helmholtz Potential, Enthalpy, Gibb free Energy . entropy as function of temperature and pressure , entropy as function of temperature and specific volume, Specific heat relations, Clasius-Clapeyron equation

**Unit VI: SOLUTION THERMODYNAMICS**

Concepts of chemical potential and fugacity, Ideal and non ideal solutions, Activity Coefficient, Criteria for phase equilibrium; Vapor-liquid equilibrium calculations for binary mixtures from Raoult’s law and Henry’s law

**TEXT BOOKS:**

1. Y.V.C.Rao An introduction to Thermodynamics, University Press.
2. J.M.smith, H.C.Van Ness and M.M.Abbott. Introduction to chemical Engineering Thermodynamics McGraw Hill.

**References:**

1. P.K.Nag “ Engineering thermodynamcs” ,The McGraw Hill Companies, IV ed.

**COURSE OUTCOMES**

1. Student ables to understand the terminology associated with engineering and thermodynamics.
2. Student understands the concepts of heat, work and energy conversion and can calculate heat and work for industrial processes.
3. Student understand the applications of First law of thermodynamics, basics of enery calculations involved with thermodynamics.
4. Reiterate the first and second law of thermodynamics and understands the practical implications of these laws in engineering design.
5. Student can calculate the properties of ideal and real gases mixtures based on thermodynamic principles.
6. Can able to understand the Maxwell relations and principles underlying the phase equilibrium, Partial molar properties.

**III year I Semester, B. Tech – Biotechnology**

**(6G510) GENETIC ENGINEERING**

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| a | b | c | d | e | f | g | H | i | j | k | l |
|  | x | x | x |  | x |  |  |  |  |  | x |

**L T P/D C**

**3 1 - 3**

**OBJECTIVE:** This course introduces students to the concept of genetic engineering and biotechnology. It then examines the molecular cloning methods, the various cloning vectors and their hosts, and how to find the right vector for molecular cloning. Aspects of DNA amplification and analysis techniques, cloning and expression of mammalian and plant genes in bacteria and practical applications of genetic engineering and biotechnology are covered under this course.

**Unit I: GENE REGULATION:** Introduction to Gene regulation,Prokaryotic Gene regulation: The operon model- Lactose, Arabinose & Tryptophan. Regulation of Eukaryotic Gene Expression; Repetitive DNA, Gene Rearrangement, Promoters, Repressors, Activators and Enhancer Elements, Gene Amplification

**Unit II:** **PLASMIDS AND TRANSPOSONS:** Definition, Types, Classification, Identification, and Transfer of Plasmids. Isolation and purification of plasmids; Transposons: Definition, Types of Bacterial transposons, mechanisms of transposition and excision, Applications of transposons: Retrotransposons

**Unit III:** **DNA MANIPULATIONS:** Purification of DNA**,** Introduction to Gene manipulation. DNA modifying enzymes Nucleases, Types of Nucleases, Types of Endonucleases. Host restriction and transfer in bacteria. DNA Ligases - Linkers, Adaptors, Homo polymer tailing. Introduction of DNA into living cells- Gene transfer methods- Chemical transformation, Electroporation and Gene Gun

**Unit IV: VECTORS AND EXPRESSION:** Properties of ideal vectors and types of vectors. Plasmid Vectors, construction of prototype plasmid vector -pBR 322 & pUC 19. Bacteriophage vectors -M13,λ vector, Cosmid, SV40 and Baculoviruses, Expression vector-pGem, Yeast cloning vectors- 2μm Plasmid, YEp, YAC. Expression of heterologus protein in Bacteria (Insulin), Yeast (Hepatitis surface antigen), and Mammalian cells (Tissue plasomogen activator)

**Unit V: CLONE SELECTION *&* PCR TECHNOLOGIES:** Genomic and cDNA library construction and its screening. DNA Hybridization, Blot Analysis - Dot Blot, Southern, Northern & Western blot. Principle involved in PCR, designing of primers, PCR methodology, RT - PCR, Multiplex PCR, PCR based Site Directed Mutagenesis

**Unit VI:** **APPLICATIONS OF GENETIC ENGINEERING:** Molecular Markers: RFLP, RAPD, AFLP and 16s r-RNA Typing, Gene Therapy (Case Study- ADA) Gene Silencing (RNAi) Introduction to CRISPR.

**TEXT BOOKS:**

1. Principles of Gene Manipulation, an Introduction to Genetic Engineering Old R. W. Primrose S B, - Blackwell Scientific Publications
2. Gene Cloning and DNA Analysis: An Introduction, T A Brown, *6th edition.* Wiley-Blackwell publications

**Reference Books:**

1. DNA cloning 1 and 2. Glover, D.M. and Hames, B.D. 1995. IRL Press Oxford University Press.
2. Benjamin Lewin: Gene VII, Oxford University Press, Oxford,
3. An Introduction to Genetic Engineering by Desmond S.T. Nicholl, Cambridge University Press
4. Recombinant DNA. By James D Watson and Michael Gilman. 2nd Edition, (2001). W. H Freeman and Company NY.
5. Molecular Biotechnology: Principles Application of Recombinant DNA by Bernard R Glick and Jack J. Pasternak, 2nd Edition. ASM press Washington DC.

|  |  |
| --- | --- |
| **COURSE OUTCOME (CO)** | |
| **CO:1** | To Analyze various operon in bacteria and have Knowledge about Promoters, Repressors, Activators and Enhancer elements, gene amplification |
| **CO:II** | Classify quantify and isolate different types of plasmids and transposons |
| **CO:III** | Classify and illustrate the different types of DNA manipulating techniques |
| **CO:IV** | Classy and illustrate methods of transfer of gene delivery vehicles |
| **CO:V** | To analyze screening and detection of clones and To Analyze and Identify DNA using PCR |
| **CO:VI** | To have a fair knowledge about various applications of Genetic Engineering |

**III Year I Semester (6G511) BIOINFORMATICS**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** |
| **X** | **X** | **X** | **X** | **X** |  |  |  | **X** |  |  | **X** |

**L T P/D C**

**3 1 - 3**

**Course Objective:**

To impart knowledge on basic techniques of Bioinformatics and to provide a practical description of the topics, tools, issues and current trends in the field including its impact on biology, biotechnology ,human health and medicine.

**Unit I: Scope Of Bioinformatics**: History, definition, importance and applications of bioinformatics, Elementary commands and protocols, ftp, telnet, http.

**Unit II: Biological Databases**: Introduction to biological data, Organization and management of databases, Nucleotide databases (NCBI, DDBJ, EMBL), Protein Databases (SWISS PROT, PDB, SCOP, CATH),pathway databases (KEGG), Drug Database (Zinc database)

**Unit III: Sequence Alignment**: Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, and paralogues. Dynamic Programming, Dot Matrix analysis, Smith-Waterman Algorithm, Neddleman-Wunsch Algorithm, Scoring matrices: PAM and BLOSUM matrices

**Unit IV: Multiple Sequence Alignment And Phylogenetic Analysis**: Basic concepts of various approaches for MSA (e,g. progressive, hierarchical etc.). Algorithm of CLUSTALW and its application, Taxonomy and phylogeny: Definition and description of phylogenetic trees and various types of trees.

**Unit V: Genomics And Proteomics**: Human Genome Project, DNA sequencing, Sanger and Shotgun Sequencing methods, Protein structure, secondary structure prediction and Homology Modeling.

**UNIT-VI: Molecular Simulations and Drug Design:** Molecular Docking by Argus lab, Auto dock software’s Protein-ligand interactions, Protein-protein interactions Drug discovery cycle, Role of Bioinformatics in Drug discovery.

TEXT BOOKS:

1. Bioinformatics. David Mount, 2000. CSH Publications

REFERENCES:

1. Bioinformatics: A Machine Learning Approach P. Baldi. S. Brunak, MIT Press 1988.
2. Genomics and Proteomics-Functional and Computational aspects. Springer Publications. Editor- Sandor Suhai.
3. Bioinformatics – A Practical guide to the Analysis of Genes and Proteins – Andreas D. Baxevanis, B.F. Francis Ouellette.

|  |  |  |
| --- | --- | --- |
| COURSE OUTCOME (CO) | | POs |
| CO:1 | Demonstrate knowledge and understanding of the biological, computational, engineering and mathematical sciences relevant to biotechnology | a |
| CO:II | Develop the ability to identify the computational problems within the living systems at molecular level | b,c |
| CO:III | To understand some basic computer science programming and bioinformatics software | c,e |
| CO:IV | Be familiar with tools for proteomic and genomic analyses. | c,e |
| CO:V | Gain an understanding of working in interdisciplinary teams of biologists, biochemists, medical researchers, geneticists, and computer engineers. | i,l |
| CO:VI | Gain an understanding of bioinformatics problems and their solutions and apply in health care | b,e,d |

**III year I Semester (6G512) BIOCHEMICAL REACTION ENGINEERING**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | c | d | e | f | G | h | i | j | k | l |
| X |  | X |  |  |  |  |  |  | X | X |  |

**L T P/D C**

3 1 - 2

**Course Objective:**

This course applies the concepts of reaction rate, stoichiometry and equilibrium to the analysis of chemical and biological reacting systems. Derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions. Design of chemical and biochemical reactors via synthesis of chemical kinetics, transport phenomena, and mass and energy balances.

**UNIT-I INTRODUCTION TO REACTION KINETICS:** Concepts of Reaction Kinetics, Types of reaction, order of reaction, Effect of temperature and pH on reaction rate. Rate equations and Reaction mechanisms; Interpretation of batch reactor data, constant volume batch reactor, integral method of analysis of data for reversible and irreversible reactions.

**UNIT- II :REACTION MECHANISM AND GROWTH KINETICS:** Searching for mechanism - Arrhenius equation - Batch reactor analysis for kinetics, (synchronous growth and its application in product production).Growth Kinetics in Fed batch and continuous mode , Chemostat growth

**UNIT- III: Multiple Reactions:** Parallel series, series – parallel reactions, calculation of yield and selectivity, role of thermodynamic parameters, maximizing the desired product in Parallel Reactions in Batch Reactor and P F R, maximizing the desired product in series Reactions in CSTR.

**UNIT- IV: IDEAL AND NON- IDEAL REACTORS:** Concepts of reactors based on flow characteristics, design of ideal reactors, Design of Batch bioreactor. Reason for Non-Ideality, RTD studies (E, C & F curves), Diagnosis of Ills of Flow reactors,

**UNIT-V Mechanisms** **of Enzyme Action** Mechanisms of Enzyme Action; Concept of active site and energetic of enzyme Kinetics, substrate complex formation; Specificity of enzyme action. Types of Inhibition- kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes;

**UNIT-VI ENZYME KINETICS**

Kinetics of single substrate enzyme catalyzed reactions,Michaelis-Menten equations. The Brigg’s Haden equation and estimation of constants using graphical techniques. Turnover number, kinetics of reversible reactions.Enzyme immobilization methods.

**TEXT BOOKS:**

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, II Edition, Prentice Hall of India Pvt. Ltd P.M.Doran

**REFERENCES:**

1. Blanch HW and Clark DS;Biochemical Engineering. CRC Press, 1995

2. M.L. Shuler and F. Kargi Bioprocess Engineering: basic concepts

**Course Outcome:**

|  |  |
| --- | --- |
| **UNIT** | **Outcomes** |
| **I** | Ability to demonstrate fundamentals of reaction mechanism, types of reactions, integral analysis of batch reactor data |
| **II** | Ability to understand the essential features that control microorganism growth and design fermenters for batch and continuous cultivation to apply a reaction engineering analysis to the controlled growth of microorganisms in biological reactors |
| **III** | Ability to demonstrate global or homogenous kinetic expressions to formulate material and energy balances for batch CSTR and plug flow reactors that exhibit ideal behaviour with reversible and multiple reaction steps |
| **IV** | Ability to demonstrate Non ideal flow reactor modules, design equations in biochemical reactors. |
| **V** | Ability to understand the basis of mechanisms of Enzyme Action and Types of Inhibitions – kinetic model |
| **VI** | Ability to understand the basis for Enzyme kinetics by Michaelis-Menten Equations and Brigg’s Haden equations . |

**III Year I Semester ` (6G513) MOLECULAR PATHOGENESIS**

**(PROFESSIONAL ELECTIVE-I)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | c | d | e | f | g | h | i | j | k | l |
|  | x | x | x | X | x |  |  |  |  |  | X |

**L T P/D C**

**3 1 - 3**

**OBJECTIVE:** The course helps in understanding the virulence of the pathogen and Host -parasite interactions for advanced academic and industrial research in molecular pathogenesis

**UNIT I MICROBIAL VIRULENCE FACTORS:** Components of microbial pathogenecity, Population diversity in microbes and methods to detect diversity.

**UNIT II** **HOST FACTORS IN PATHOGENESIS:** Host defense- physical (skin, mucosa), Chemical (pH, enzymes) and immunological (brief); modes of pathogen entry.

**UNIT III HOST-PATHOGEN INTERACTION:** Virulence, mechanisms of colonization, disease caused without colonization. Various damages induced in host by pathogen, virulent genes and their regulation and role of bacterial biofilms.

**UNIT IV** **EXPERIMENTAL METHODS TO STUDY HOST-PATHOGEN INTERACTION:** Selection of pathogen Model, measurement of virulence, Identification of potential virulence factors considering one example each from Bacteria, viral and parasite

**UNIT V MODULATION OF HOST RESPONSE:** Immune modulation and evasion, Interleukins (IL-4, IL-2, IFN gamma, IL-12), Chemokines (IL-8, RANTES, CCR/CXCR), Interferons (alpha, beta and gamma).

**UNIT VI PARADIGMS OF PATHOGENESIS:** Gastroduodenal ulcers, Tuberculosis and other mycobacterial infections, HIV/AIDS, hepatitis, malaria, round worm infestation.

**TEXT BOOKS**

1. Molecular basis of Bacterial Pathogenesis, Iglewski BH and Clark VL., Academic Press, 1993
2. Immunobiology, Janeway CA and Travers PT., Blackwell Scientific Publishers, 1994

**REFERENCE BOOKS**

1. Talaro K and Talaro A Foundations in Microbiology, WC Brown Publishers, 1993
2. Roitt I. Essentials of Immunology, 8th Edition, Blackwell Scientific Publishers, 1994
3. Austyn JM and Wood KJ. Principles of Cellular and Molecular Immunology, Oxford University Press, 1993

|  |  |  |
| --- | --- | --- |
| **COURSE OUTCOME (CO)** | | **POs** |
| **CO:1** | To explain various Components of microbial pathogenecity and methods to detect microbial diversity | b,c,d |
| **CO:II** | Examine the various methods of Host defense against pathogens and also mode of entry of pathogens | b,c,d |
| **CO:III** | Asses host-pathogen interaction and their importance in disease progression | b,c,d |
| **CO:IV** | Evaluate experimental methods to study host-pathogen interaction | b,c,d,e |
| **CO:V** | To explain the importance of host Immune modulation in response to the pathogen | b,c,d |
| **CO:VI** | To Determine paradigms of pathogenesis | b,c,d,f,l |

**III Year I Semester (6G514) PLANT METABOLIC ENGINEERING**

**(PROFESSIONAL ELECTIVE-I)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | c | d | e | f | g | h | i | j | k | l |
|  | x | x | x | X | x |  |  |  |  |  | X |

**L T P/D C**

**3 1 - 3**

**COURSE OBJECTIVES:**

This course provides insight into the fundamentals of metabolic engineering in strain improvement programs to increase the yield of a target product or reduce or eliminate the production of undesired impurities. And optimizing metabolic flux by up-regulation of a target pathway and/or knock-out of competing pathways and heterologous expression of foreign gene / gene cluster to introduce metabolites for biosynthesis of target product.

**UNIT I : Introduction**

Identification of metabolic regulation is a key point in metabolic engineering. Basic concepts of Metabolic Engineering – Overview of cellular metabolism – Different models for cellular reactions, induction – Jacob Monod model and its regulation, Differential regulation by isoenzymes, Feed back regulation.

**UNIT II : Biosynthesis of Primary Metabolites**

Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feed back regulation,

**UNIT III: Biosynthesis of Secondary Metabolites**

Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, Catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites, applications of secondary metabolites.

**UNIT IV: Regulation of Enzyme Production**

Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feed back repression, Catabolite Repression, optimization and control of metabolic activities. The modification of existing - or the introduction of entirely new - metabolic pathways

**UNIT V: Metabolic flux**

Integration of anabolism and catabolism, metabolic flux distribution analysis bioprocess, material balance, kinetic types, equilibrium reaction. Experimental determination method of flux distribution, Metabolic flux analysis and its applications, Thermodynamics of cellular processes

**UNIT VI: Metabolic engineering with Bioinformatics**

Bioinformatics for Metabolic Networks Systems biology frameworks for metabolic engineering; Concepts of metabolic networks; Establishment of metabolic flux analysis and metabolic control analysis, applications of Metabolic engineering with examples.

**Text Books**

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, Ist Edition, Oxford University Press, 2003)
2. Chrispeels, MJ and Sadava, DE, Plants Genes and Crop Biotechnology 2003 2nd Edition, American Society of Plant Biologists, Jones and Barlett Publishers, USA.
3. Arie Altman, Marcel Dekkers, Inc 2001 Agricultural Biotechnology
4. Biochemistry and Molecular Biology of Plants Edited by Buchanan, Gruissem and Jones 2000, American Society of Plant Biologists, USA.
5. G. Stephanopoulos, A. Aristidou and J. Nielsen, Metabolic Engineering Principles and

Methodologies, Academic Press, 1998.

1. David Fell, Understanding the Control of Metabolism, Portland Press, London, 1997.

**References :**

1. S. Y. Lee & E.T. Papoutsakis, Metabolic Engineering, Marcel Dekker, New York, 1999.
2. R.Heinrich and S. Schuster, The Regulation of Cellular Systems, Chapman & Hall,

1996.

1. E.O. Voit, Computational Analysis of Biochemical Systems. Cambridge University

Press, 2000

Course Outcomes

Ability to gain Knowledge of stoichiometry and energetics of metabolism.  
Ability to apply practical applications of metabolic engineering in chemical, energy, medical and environmental fields.  
Ability to integrate modern biology with engineering principles.  
Ability to design a system, component, or process to meet desired needs.

**III year I Semester, B. Tech – Biotechnology**

**(6G515) BIOETHICS, BIOSAFETY & IPR**

**(Professional Elective - 1)**

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**Unit I: Bioethics:**

Principles of Bioethics. Ethics in Clinical Research: History structure regulation impact of Ethics in all aspects of health care, historical cases, negligence, informed consent, mental competence, Bioethics in Microbial (Bioterrorism), Plant (GMO) & Animal (Stem Cells, Cloning, human embryos and IVF), shared responsibilities for decisions and the understanding of the risk.

**Unit II: Biosafety Concepts & Regulations:**

Definition of Biosafety, Biosafety for human health and environment, Assessment of Biological hazard, Levels of biosafety for microbes, plants & animals, Cartagena protocol, Use of genetically modified organisms and their release in to the environment. Special procedures for r-DNA based products. International dimensions in Biosafety. Biotechnology and food safety. Case study – Bt Cotton, Bt Brinjal

**Unit III: Introduction to IPR &Patents**:

Discovery, Creativity, Innovation, Invention, Need for IPR, Types of IPR, Genesis & development of IPR in India, Definition, Scope, Protection, Patentability Criteria, Types of Patents (Process, Product & Utility Models), Software Patenting. Types of searching, public & private searching Databases. Drafting & Filing of Patent applications, Patent Cooperation Treaty (PCT). Patent infringement.

**Unit IV: Other Types of IPR:**

Copyrights– Definition, granting, infringement, searching & filing, distinction between copy rights and related rights;Trade Marks - role in commerce, importance, protection, registration, domain names;Trade Secrets, Unfair competition; Industrial Designs – Scope, protection, filing, infringement; Semiconductors, Integrated Circuits& Layout design; Geographical Indications& Appellations of Origin; Case Studies.

**Unit V: IPRs and Biotechnology:**

Plant variety Protection, Farmers & Breeders Rights, Indian Biodiversity Act, Protection of Traditional Knowledge, Biopiracy & Bioprospecting, ITPGRFA, Budapest Treaty & IDA, Biotechnology Patenting issues, Gene Patenting, Case studies (Diamond vs Chakravarthy, Dimminaco AG vs. Controller of Patents, Basmati Rice, Turmeric, Neem, Harvard Oncomouse, Transgenic Plant Patents)

**Unit VI: International and National Conventions& Treaties:**

Overview, WTO, GATT, TRIPS, WIPO, Berne Convention, Universal Copyright Convention, the Paris Convention, Madrid Protocol, Rome convention, Budapest Treaty, Hague agreement, Locarno agreement, Indian Patents Law, Copyright Law,Trademark Law,Trade secret Law, GI Law, Designs Act.

**Text Books:**

1. Bioethics – Shaleesha A Stanley, Wisdom Educational Service, Chennai, 2008
2. V Sree Krishna. Bioethics & Biosafety in Biotechnology. New age International Publications, 2007
3. Deborah E. Bouchoux, Intellectual Property for Paralegals – The law of Trademarks, Copyrights, Patents & Trade secrets, 3rd Edition, Cengage learning, 2012
4. N.S. Gopalakrishnan& T.G. Agitha, Principles of Intellectual Property, Eastern Book Company, Lucknow, 2009.

**References**

1. Singer, Peter A.; Viens, A.M. (2008), Cambridge Textbook of Bioethics, Cambridge: Cambridge University Press, ISBN 978-0-521-69443-8
2. Anitha Rao R & Bhanoji Rao “Intellectual Property Rights – A Primer”, Eastern Book Company, 2008.
3. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
4. M. M. S. Karki , Intellectual Property Rights: Basic Concepts, Atlantic Publishers, 2009
5. Neeraj Pandey &KhushdeepDharni, Intellectual Property Rights, Phi Learning Pvt. Ltd
6. AjitParulekar and Sarita D’ Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd, 2006.
7. B. L. Wadehra. Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000.
8. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010

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| **Unit wise Course Outcomes** | **POs** |
| Student will be able to   1. Think ethically and to act morally to describe the legal, ethical, and emotional issues surrounding withholding and withdrawing medical therapies eg. cloning, and stem cell research 2. Understand the risk assessment and risk groups which includes examining laboratory containment levels & assessing containment level requirements 3. Understand different types of IPR and apply their knowledge in understanding Patents writing and filing.. 4. Understand and differentiate other types of IPR 5. Apply their Biotechnology knowledge towards patenting skills 6. Understand various IPR laws, treaties and agreements | a,c, h  a,c, j  a,c,j  a,c,j  a,c,g, j  a,c,g, j |

**III year I Semester (6G516) INSTRUMENTATION AND BIOPROCESS CONTROL**

**(Professional Elective - I)**

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**L T P/D C**

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**Course Objective**: This course aims at providing knowledge about different types of measuring instruments used in bioprocess industries. It also aims to provide an insight into basics of process control in bioreactors for controlling various process parameters.

**UNIT I:** **ELEMENTS OF INSTRUMENTS** :Basic concepts of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometer. Thermo electricity, industrial thermocouples, measurement of temperature using thermocouples

**UNIT II:** **MEASURING INSTRUMENTS:** Measurements of liquid level, pressure measurement in open vessels, level measurements in pressure vessels, Liquid column manometers, measuring elements for gauge pressure and vacuum,, indicating elements for pressure gauges, measurement of absolute pressure.

**UNIT III:** **BIOSENSORS** : Types, transducers in biosensors – calorimetric, optical, potentiometric / amphometric, conductometric / Resistometric, piezoelectric, semi conductor, mechanical and molecular electronics based, molecular wires and switches,

**UNIT IV:** **FIRST AND SECOND ORDER SYSTEMS:** Introduction to Laplace transform, Response of First order systems, Transfer function, Transient response to step, impulse, sinusoidal inputs, physical examples of First order systems, Liquid level, mixing process, concept of time constant. Transportation lag control systems, Servo and Regulatory control problems.

**UNIT V:** **CONTROLLERS AND STABILITY:** Introduction to block diagram, Ideal transfer function of operational, P, PI, PD and PID controllers. Reduction of physical control system to block diagram; Closed loop transfer functions for servo regulators problems. Overall Transfer function for multi loop control systems. Stability and control system by Routh’s criterion.

**UNIT VI:** **FREQUENCY RESPONSE**: Introduction, generalization and transportation lag, Bode diagrams - first order system, First order system in series, second order system, Controllers.

**TEXT BOOKS:**

1. Industrial Instrumentation, Donald P. Eckman.
2. Process Systems Analysis and Control Donald Coughnowr, Second edition McGraw Hill, International Ed.1991.

**REFERENCE:**

1. Chemical Process Control, stephanoupoulis G., Prentice Hall, N.Delhi, 1990.

**Course Outcomes:**

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| **CO : I** | Ability to solve the first order system in real situation, and will be able to grasp the basic terminology in Instrumentation and process control |
| **CO : II** | In this unit student will learn about different types of meters which are used to study flow rates, velocities, etc. |
| **CO : III** | Ability to demonstrate the knowledge on bioapplications of process control and various examples like applications of biosensors in environment biotech, sugar test, pregnancy test etc… |
| **CO : IV** | Ability to demonstrate different types of systems(first and second order),and physical interpretation of different forcing functions |
| **CO : V** | Ability to demonstrate knowledge in different types of controllers their applicability in practical situation |
| **CO : VI** | Ability to demonstrate the process control of biological systems using electronic controllers |

**III year I Semester, B. Tech – Biotechnology**

**(6G517) NANOMATERIAL SYNTHESIS AND CHARACTERIZATION**

**(PROFESSIONAL ELECTIVE-I)**

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**L T P/D C**

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**OBJECTIVE**

To gain knowledge in bionanotechnology and its application in the fields of medicine and environment, and to design and conduct experiment, analyze and interpret data in bionanotechnology for developing novel bionanoparticles and structures.

**Unit-I:** Introduction to synthesis of nanostructure materials, Physical methods: Inert gas condensation, Arc discharge, Ball milling, electrodeposition, rapid solidification (RSP), consolidation

**Unit-II:** Chemical methods**:** Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, nanocrystals of semiconductors and other materials by arrested precipitation, emulsion synthesis, sonochemical routes

**Unit-III:**, Biological methods – use of bacteria, fungi**,** actinomycetes for nano-particle sythesis-magnetotaticbacteria for natural synthesis of magnetic nano-particles, role of plants in nano particle synthesis

Thermolysis route - spray pyrolysis and solvated metal atom dispersion, sol-gel method, solvothermal and hydrothermal routes, solution combustion synthesis, CVD method and other variants

**Unit-IV:** Compositional and structural Characterization techniques**:** X-ray Photoelectron Spectroscopy (XPS), Electron probe microanalysis (EPMA),

**Unit-V:** Surface characterization Techniques: Scanning electron microscopy (SEM), Transmission electron microscopy, Spectroscopic techniques:UV-Visible spectroscopy, Infrared (IR) & Fourier Transform infrared (FTIR) spectroscopy,

**Unit-VI:**. Electrical characterization techniques: Hall measurement, Dynamic and static Current voltage (I-V) characteristics, Magnetic & dielectric characterization: SQUID, VSM

**Textbooks:**

1. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
2. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
3. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
4. “Nanoscience and Nanotechnology: Fundamentals to Frontiers” by M.S. Ramachandra Rao and Shubra Singh, Wiley Publishers, 2013.
5. Characterization of nanostructured materials by Z.L. Wang
6. Principles of Instrumental analysis by D.A. Skoog, F.J. Hollen and T.A. Niemann

**Reference books:**

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol I to X, Campus books.
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology – by T.Pradeep; Tata Mc.Graw Hill

**Course objectives**

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | To acquire knowledge about the synthesis of nanostructure materials |
| **CO:II** | To acquire knowledge about the chemical synthesis of nanostructure materials |
| **CO:III** | To acquire knowledge about the Biological synthesis of nanostructure materials |
| **CO:IV** | To acquire knowledge about the structural Characterization techniques: |
| **CO:V** | Demonstrate fair knowledge about Surface characterization Techniques |
| **CO:VI** | Demonstrate fair knowledge about Electrical characterization techniques |

**III year I Semester, B. Tech – Biotechnology**

**DATA BASE SYSTEMS**

**(Open Elective-I)**

**Code: 6FC32 L T P/D C 2 1 - 2**

**Course Objective**

* Define a Database Management System
* Give a description of the Database Management structure
* Define a Database
* Define basic foundational terms of Database
* Understand the applications of Databases
* Know the advantages and disadvantages of the different models
* Compare relational model with the Structured Query Language (SQL)
* Know the constraints and controversies associated with relational database model.
* Know the rules guiding transaction ACID
* Identify the major types of relational management systems.
* Compare and contrast the types of RDBMS based on several criteria.
* Understand the concept of data planning and Database design.
* Know the steps in the development of Databases.
* Trace the history and development process of SQL.
* Know the scope and extension of SQL.
* Identify the various functions of Database Administrator.

## UNIT I :Data Base Systems:

Data Vs Information, Data base System Applications, data base System VS file System – View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor, History of Data base Systems.

Data base design and ER diagrams – Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model –Data Modeling checklist.

Application- ER diagram for a tiny college

**UNIT II:**

Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.

Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

Application-Student database design.

**UNIT III:**

Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity’s – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers, Embedded SQL. Application-working with Aviation company database.

**UNIT IV:**

Schema refinement – Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

Application-Faculty Evaluation Report.

**UNIT V :**

Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity, Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems, Application-Production Management System.

**UNIT VI :**

Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing – Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure, Query Optimization techniques.

Application – Creating B+ tree on Instructor File.

**TEXT BOOKS :**

1. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition

3. Database Management Systems, Peter Rob, A.Ananda Rao,Carlos Coronel ,CENGAGE Learning

**REFERENCES:**

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.

2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education

3. Introduction to Database Systems, C.J.Date Pearson Education

## Course Outcomes

1. Explain the basic concepts and the applications of database systems.
2. Utilize the knowledge of basics of SQL and construct queries using SQL.
3. Use commercial relational database system (Oracle) by writing Queries using SQL.
4. Apply relational database theory, and be able to write relational algebra expressions for queries.
5. Explain & use design principles for logical design of databases, including the E ‐R method and normalization approach.
6. Compare the basic database storage structures and access techniques: file and page organizations, indexing methods including B ‐tree, and hashing.
7. Demonstrate the basics of query evaluation and apply query optimization techniques.
8. Explain basic issues of transaction processing and concurrency control.
9. Work successfully on a team by design and development of a database application system as part of a team

**III year I Semester, B. Tech – Biotechnology**

**BASICS OF ENTREPRENEURSHIP**

**(Open Elective-I)**

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**Code: 6FC22 L T P/D C 2 1 - 2**

**Course Objective:** The objective of the course is to make students understand the nature of Entrepreneurship, and its importance to business to the engineering students, which will allow them to get the required intuition and interest in starting their own start-up’s

**Unit – I: Introduction to Entrepreneurship: -** Define Entrepreneurship, Entrepreneurship as a Career option, Benefits and Myths of Entrepreneurship, Success Rate of Entrepreneurs related to Experience and Family Backup, Characteristics, Qualities and Skills of Entrepreneurship, Entrepreneurial Propensity, Life as an Entrepreneur, Impact of Entrepreneurship on Economy and Society.

**Unit – II: Opportunity & Customer Analysis: -** Identify your Entrepreneurial Style, Identify Business Opportunities, Methods of finding and understanding Customer Problems, Process of Design Thinking, Identify Potential Problems, Customer Segmentation and Targeting, Customer Adoption Process, craft your Values Proportions, Customer-driven Innovation.

**Unit – III: Business Model & Validation: -** Types of Business Models, Lean approach, the Problem-Solution Test, Solution Interview Method, difference between Start-up Venture and Small Business, Industry Analysis, Identify Minimum Viable Product (MVP), Build-Measure-Lean Feedback loop, Product-market fit test.

**Unit – IV: Economics & Financial Analysis: -** Revenue sources of Companies, Income Analysis, and Costs Analysis - Product Cost and Operations Cost, basics of Unit Costing, Break Even Analysis Profit Analysis, Customer Value Analysis, different Pricing Strategies, advantages and disadvantage of various Sources of Finance, Investors Expectations, Return on Investment , Practice pitching to Investors and Corporate.

**Unit – V: Team Building & Project Management: -** Leadership Styles, Shared Leadership Model, Team Building in Venture, Role of good team in venture, Roles and Respondents, Explore collaboration tools and techniques- Brainstorming, Mind mapping. Importance of Project Management, Time Management, Workflow, Network Analysis Techniques – Critical Path Method, Project Evaluation Review Technique and Gantt chart.

**Unit – VI: Marketing & Business Regulations: -** Positioning, Positioning Strategies, building Digital presence and leveraging Social Media, Measuring effectiveness of Channels, Customer Decision-making Process, Sales Plans and Targets, Unique Sales Proposition (USP), Follow-up and close Sales. Business regulations of starting and operating a Business, Start-up Ecosystem, Government schemes.

**References:**

* Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, Sixth Edition, New Delhi, 2006.
* Thomas W. Zimmerer, Norman M. Scarborough, Essentials of Entrepreneurship And Small Business Management, Fourth Edition, Pearson, New Delhi, 2006
* Alfred E. Osborne, Entrepreneur’s Toolkit, Harvard Business Essentials, HBS Press, USA, 2005.
* Madhurima Lall, Shikha Sahai, Entrepreneurship, Excel Books, First Edition, New Delhi, 2006.
* S.S. Khanka, Entrepreneurial Development, S. Chand and Company Limited, New Delhi, 2007.
* H. Nandan, Fundamentals of Entrepreneurship, Prentice Hall of India, First Edition, New Delhi, 2007.

• S.R. Bhowmik, M. Bhowmik, Entrepreneurship-A tool for Economic Growth   And A   
 key to Business Success, New Age International Publishers, First Edition,  (formerly   
 Wiley Eastern Limited), New Delhi, 2007.

**Course Outcomes:**

1. The students’ will acquire basic knowledge on Skills of Entrepreneurship.
2. The students’ will understand the techniques of selecting the customers through the process of customer segmentation.
3. Business Models and their validity are understood by the students’.
4. The basic cost structure and the pricing policies are understood by the students’.
5. The students’ will acquire knowledge about the project management and its techniques.
6. The students’ get exposure on marketing strategies for the Start up.

**III year I Semester**

**5ZC05 BANKING OPERATIONS, INSURANCE AND RISK MANAGEMENT**

**(OPEN Elective -I)**

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**L T P/D C**

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**Course Objectives:** To make the students understand the concepts and principles of Indian Banking Business, Insurance Business and Capital market business products and services, which facilitate them to understand the nature of market.

**Course Out Comes:**

1. Describe the new dimensions and products served by the banking system in INDIA.
2. Explain the credit control system and create awareness on NPA’s
3. Apply the knowledge of Insurance concepts in real life scenarios
4. Recognize the importance of regulatory and legal frame work of IRDA
5. Identify the risk management process and methods.
6. Calculate the diversity of risk and return

**UNIT I**

**INTRODUCTION TO BANKING BUSINESS:** Introduction to financial services - History of banking business in India, Structure of Indian banking system: Types of accounts, advances and deposits in a bank. KYC norms, New Dimensions and products- E-Banking: Mobile-Banking, Net Banking, Digital Banking, Negotiable Instruments: Cheque system.

**UNIT II**

**BANKING SYSTEMS AND ITS REGULATION: Banking Systems:** Branch Banking, Unit Banking, Correspondent Banking, Group Banking, Deposit Banking, Mixed Banking and Investment Banking - Banking Sector Reforms with special reference to Prudential Norms, Capital Adequacy Norms, Classification of Assets and NPA’s, Functions of RBI, Role of RBI in regulating Indian Banking. Banking Ombudsman scheme.

**UNIT III**

**INTRODUCTION TO INSURANCE:** Introduction to insurance, Need and importance of Insurance, principles of Insurance, characteristics of insurance contract, branches of insurance and types of insurance: Life insurance and its products, General Insurance and its variants.

**UNIT IV**

**INSURANCE BUSINESS ENVIRONMENT:** Procedure for issuing an insurance policy –Nomination - Surrender Value - Policy Loans – Assignment - Revivals and Claim Settlement; Insurance as a tax mitigation tool, Role of IRDA in Insurance Regulation.

**UNIT V**

**FINANCIAL MARKETS AND RISK MANAGEMENT:** Introduction to Financial Markets: Money Market – Capital market; Introduction to Risk Management, meaning and classification of risks, Risk management process, Risk Management Approaches and Techniques.

**UNIT VI**

**DERIVATIVES AS A RISK MANAGEMENT TOOL:** Introduction to Financial Derivatives, Advantages of Derivatives - types of Derivative Contracts - Forwards, Futures, Options and Swaps - Differences among Forwards, Futures and Option Contracts.

**Books Recommended:**

* Varshney, P.N., Banking Law and Practice, Sultan Chand & Sons, New Delhi.
* General Principles of Insurance Harding and Evantly
* Mark S. Dorfman: Risk Management and Insurance, Pearson, 2009.

**References:**

* Scott E. Harringam Gregory R. Nichanus: Risk Management & Insurance, TMH, 2009.
* Geroge E. Rejda: Principles of risk Management & Insurance, 9/e, pearson Education. 2009.
* G. Koteshwar: Risk Management Insurance and Derivatives, Himalaya, 2008.

**III year I Semester**

**6ZC20 PRODUCT & SERVICES**

**(OPEN Elective -I)**

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**L T P/D C**

**2 1 0 2**

**Course Objectives**: This course helps to provide the basic concepts of Product and Services. This course will enable the students to study areas of basic insights in product management and Services Design.

**Course Out Comes**:

1. The students will be introduced to basic concepts of product .
2. Will enlighten the students with the process of new product development and stages in the process.
3. Will help the students understand the concept of product testing, product planning and the preparatory groundwork for launching a new product
4. Will help the students to understand the nature of services, its differences with the goods and the application of marketing principles for services.
5. Will enlighten the students to understand the attributes of a good service design and the tools for producing and distributing the services.
6. To make the students understand about the importance of quality of services and also introduce some measurement scales to evaluate the service quality.

**UNIT- I**

**PRODUCT AS A COMMERCIAL FACTOR**

Product concept: premarketing, product definition, product dimensions. Product classification- by its nature, by final use by reasons for purchase, by consumer groups.

**UNIT- II**

**PRODUCT INNOVATION**

New products-What is a new product, Concept, Reasons, Succeed and failure factors, Launch process, Opportunities identification, Idea generation Systems, Evaluation, Check list, Financial analysis, Product concept.

**UNIT- III**

**PRODUCT MANAGEMENT**

Concept test, Product testing, Pre-launch, Market test, Final evaluation “Stage / Gate Process” A sequence system for a product launch. Product planning and development-Product planning, Price planning, Bake even point analysis, Communications Planning, Advertising Planning, Distribution planning

**UNIT - IV: INTRODUCTION TO SERVICE:**

Meaning and Definition of Service, Characteristics of Services, Classification of Service, Five levels of Service, Service verses Physical Goods, 7 P’s for Marketing of Services, Marketing Mix for Tourism, Hospitality, Education, and Health Industry.

**UNIT – V: SERVICE PROCESS DESIGN:**

Challenges & Critical Success Factors, Distribution Methods for Service, Process of Service Delivery, Tools for Service Design, Customer involvement in the Production Process, Tools for Innovation, Role of Intermediaries, Attributes of a Good Design.

**UNIT – VI: QUALITY OF SERVICE:**

Definition of Service Quality, Elements of Service Quality, Service Quality Measuring Tools; SERVQUAL Scale, Service Quality Gap Analysis, Objective Service Metrics, Cost of Quality in Service. Challenges and Problems of Service Quality in Inida.

**Essential Readings:**

* Dr. S.L. Gupta, Product Management, Wisdom Publications
* C.Merle Crawford ,New Product Management
* Valarie A.Zeithaml & Mary Jo-Bitner: Services Marketing—Integrating Customer Focus Across the Firm, 3/e, Tata McGraw Hill, 2007.
* Thomas J.Delong & Asish Nanda: Managing Professional Servies—Text and Cases, McGraw-Hill International, 2006.
* Christopher Lovelock: Services Marketing People, Technology, Strategy, Fourth Edition, Pearson Education, 2006

**III year I Semester, B. Tech – Biotechnology**

**QUANTITATIVE APTITUDE**   **L T P/D C**

**Code: 6H576 (Common to All Branches) 0 0 2 1**

**Pre Requisites**: Nil

**Unit I**

Number System: Test for Divisibility, Test of prime number, Division and Remainder – HCF and LCM of Numbers - Fractions.

**Unit II**

Average: Average of different groups, Replacement of some of the items - Percentage - Profit and Loss.

**Unit III**

Ratio and Proportion: Properties of Ratio, Comparison of Ratios, Useful Simple Results on Proportion – Partnership and Share.

**Unit IV**

Simple Interest: Effect of change of P, R and T on Simple Interest - Compound Interest: Conversion Period, Difference between Compound Interest and Simple Interest.

**Unit V**

Time and Work- Pipes and Cisterns, Time and Distance- Problems on Trains- Boats and Streams, Allegation or Mixtures.

**Unit VI**

Mensuration: Area of Plane Figures, Volume and Surface Area of Solid Figures.

Data Interpretation: Tabulation, Bar Graphs, Pie Charts, Line Graphs.

**Text Books:**

1. Quantitative Aptitude by R.S.Agarwal

2. Quantitative Aptitude by Abhijit Guha

3. Quantitative Aptitude for Competative Examinations, U.Mohan Rao, Scitech Publication

**Course Outcomes:** *Students will able to answer*

1. *The questions given on testing divisibility, prime number and questions of HCF and LCM*
2. *The questions given on averages, percentage and profit and loss.*
3. *The questions given on ratio and proportion.*
4. *The questions given on simple and compound interest.*
5. *The questions given on time and work, time and distance.*
6. *The questions given on mensuration and data sufficiency.*

**B. Tech III Year I semester**

**(6HC74) EFFECTIVE ENGLISH COMMUNICATION AND SOFT SKILLS (EECSS)**

**Subject Code: 6H374 Theory – Tutorial – Lab – Credit**

0 0 2 1

*Maximum Marks: 100*

*Internal – 25 / External – 75*

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**Course Objectives**

* **to analyze themselves and to practice the ways to overpower their weaknesses**
* **to enhance their soft skills and behavioral patterns**
* **to equip themselves with the skill of solving problems and taking effective decisions**
* **to build up conflicts and stress management skills**
* **to face interviews confidently and effectively**
* **to cultivate appropriate etiquette and manners to deal with personal and professional life**

UNIT-1: Know Yourself – SWOT / SWOC Analysis

1. Importance of Knowing Yourself

2. Benefits of SWOT/ SWOC analysis

3. How to go about SWOT analysis

4. SWOT/ SWOC analysis grid

UNIT-2: **Soft Skills**

* + - 1. Definition and importance of soft skills
      2. Positive attitude
      3. Goal setting
      4. Team building and Leadership qualities

UNIT-3: 1. Problem Solving

1. Decision Making
2. Time Management

UNIT-4: Conflict Management

* + - 1. Stress Management – IQ
      2. Emotional Intelligence – EI

UNIT-5: Interview Skills

Resume writing

a. Types of Résumé

b. Differences among Bio-data, Curriculum Vitaé and Résumé

c. Purpose of Curriculum Vitaé and Resume

e. Tips to write Curriculum Vitaé and Résumé

f. The DOs and the DON’Ts of Résumé preparation

g. Cover letter

2. Types of interviews (Face to Face / Panel Interviews, etc.)

3. Pre-interview preparation

4. Types of questions asked - FAQs

5. Mock Interviews

UNIT-6**: Etiquette and Manners**

Etiquette: Introduction

1. Classification of etiquette

2. Modern etiquette and social etiquette

3. Work etiquette and benefits of following work etiquette

Manners: Introduction:

1. Practicing good manners

**Course Outcomes:**

**Students become skilled at-**

* **identifying their strengths and weaknesses and realize the ways to overcome their weaknesses**
* **enhancing their soft skills and behavioral patterns**
* **solving problems and taking effective decisions**
* **managing the stress and conflicts**
* **facing interviews confidently and effectively**
* **cultivating appropriate etiquette and manners to deal with personal and professional life**

**Suggested Reading:**

1. Technical communication*- Meenakshi Raman and Sangeetha Sharma (Oxford Publications)*
2. Technical Writing Process and Product *by SharonJ Gerson:Fifth edition.Pearson Publishers.*
3. Developing Communication Skills *– Krishna Mohan and Meera Benarjee*
4. SOFT SKILLS *– Dr. K. Alex, S.Chand publications*
5. Advanced Technical communication *- Kavita Tyagi and Padma Mistri*
6. Developing Speaking-Listening Skills in English (With CD)
7. Basic Communication Skills For Technology- *Andrea J Rutherfoord- Pearson*
8. Developing Communication Skills- *Krishna Mohan- Macmillan*
9. Written Communication Skills- *Michael Hatton-iste*
10. Soft Skills Know Yourself And Know The World- *K Alex- S Chand*

**III year I Semester, B. Tech – Biotechnology**

**(6G575) BIOINFORMATICS LABORATORY**

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**L T P/D C**

**- - 4 2**

**COURSE OBJECTIVES**

Be familiar with, and have a working knowledge of the Molecular, Statistical and Database tools for Proteomic and genomic analyses.

Acquire knowledge in the area of Drug discovery and development, a process in which biological and chemical structural knowledge are exploited intelligently, using computational assistance

1. Retrieval of information from Biological databases NCBI,UNI PROT
2. Protein structure databases – PDB,SCOP,CATH
3. Pathway Databases – KEGG,BIOCYC
4. Demonstration of BLAST, FASTA and other search engines
5. Multiple sequence alignment Using ClustalW/ X,
6. Phylogenetic analysis using Tree View and NJ PLOT
7. ORF finder (Gene Prediction)
8. Restriction site analysis tools
9. Protein visualization tools RASMOL and PyMol
10. Protein structure and Function analysis using SPDBV
11. Cheminformatics tool - Mol Inspiration
12. Protein ligand docking using Argus Lab

**EQUIPMENTS:** Computers , Internet facility, Bioinformatics software

**REFERENCE BOOK:**

*BIOINFORMATICS*. A Practical Guide to the. Analysis of Genes and Proteins. SECOND EDITION. Andreas D. Baxevanis, B. F. Francis Ouellette

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|  | **COURSE OUTCOMES(CO)** | **PO’S** |
| **CO:1** | Ability to explore various bioinformatics resources and earn how to perform routine data analysis by using computational software | c,d,e,f,i |
| **CO:2** | Ability to perform sequence alignment using various online tools and assess the homology between various species. | c,d,e,f,i |
| **CO:3** | Ability to use Phylogenetic analysis softwares and interpret the Phylogenetic relationship at the molecular level. | c,d,e,f,i |
| **CO:4** | Ability to analyze the genome sequence information for gene prediction and restriction digestion. | c,d,e,f,i |
| **CO:5** | Ability to understand the spatial arrangement of various amino acids in protein three dimensional conformation using visualization softwares | c,d,e,f,i |
| **CO:6** | Ability to use drug designing softwares and apply them in drug discovery process | c,d,e,f,i |

**III year I Semester, B. Tech – Biotechnology**

**(6G576) Molecular Biology and Genetic Engineering Lab**

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**L T P/D C**

**- - 4 2**

**Course Objective**

This course provides necessary practical skills on Recombinant DNA technology and molecular biology and biotechnology techniques

1. Problems on Mendelian and Non Mendelian genetics
2. Isolation of Genomic DNA.
3. Separation of DNA by Agarose gel electrophoresis.
4. Yield analysis and Checking of purity of DNA samples.
5. Isolation of plasmid and visualization on Agarose gel.
6. Restriction Digestion of DNA
7. Ligation of DNA
8. Transformation of Bacterial Cells
9. Isolation of Total RNA
10. Southern Blotting of DNA
11. Characterization of Proteins by SDS-PAGE
12. Amplication of DNA using PCR

**TEXT BOOKS**

1. Molecular Cloning: A Laboratory Manual Fourth Edition, Green, Michael R. Cold Spring Harbor Laboratory Press, 2012

2. Current Protocols in Molecular Biology, Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, Kevin Struhl (eds.), 2003 John Wiley & Sons, Inc.

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|  | **COURSE OUTCOMES(CO)** |
| **CO:1** | Ability to solve the problems based on Mandelian and Non Mendelian Genetics |
| **CO:2** | Ability to isolate the Genomic DNA, Plasmid and RNA from different natural sources |
| **CO:3** | Ability to Separate and identify various DNA samples using DNA Gel electrophoresis |
| **CO:4** | Ability to analyze yield and Checking of purity of DNA samples |
| **CO:5** | Ability to restrict digest DNA Samples using type II endonucleases |
| **CO:6** | Ability to ligate two different fragments of DNA using enzyme DNA Ligase |
| **C0:7** | Ability to introduce foreign DNA into competent Bacterial cells by bacterial transformation |
| **Co:8** | Ability to transfer DNA from Argrose gel to nitrocellouse paper |
| **CO:9** | Ability to amplify the DNA samples using Polymerase chain reaction |

**III year I Semester, B. Tech – Biotechnology**

**(6G577) GROUP PROJECT**

**L T P/D C**

- - 2 1

**Course Objective:**

To acquaire basic knowledge on selecting a projcet , learn related tools and enhance programming and communication skills for employabilty.

Pre-Requisites: All Courses till this semester

A group project shall be carried out by a group of students consisting of 2 to 3 in number in third year first semester. This work shall be carried out under the guidance of the faculty assigned as internal guide and shall involve design, fabrication, software development or any other significant activity. This can be of interdisciplinary nature also.

There will be 100 marks in total with 25 marks of internal evaluation and 75 marks of external

The internal evaluation shall consist of:

Day to day work : 10 marks

Report : 05 marks

Demonstration / presentation : 10 marks

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25 marks

End examination : 75 Marks.

The end examination will be carried out by a committee consisting of an external examiner, head of the department, a senior faculty member and the supervisor.

**Course Outcomes: After completing this course, student shall be able to**

* Use the concepts learned in the courses, so far, in conceptualizing, designing and executing the modules of the projects.
* Exhibit the interest in learning the modern tools and technologies through the bridge courses arranged in the college, beyond the curriculum, and hence developing the software.
* Inculcate an enthusiasm to use the creative ideas to build the innovative projects which are meeting the current needs of the market and society as a whole.
* Improve their communicative skills and team skills largely improve.
* Work as an individual and in a team.

**III Year I Semester (6G595) Technical Literature Review & Seminar - 1**

**L T P/D C**

**- - 2 1**

**Pre-Requisites:** All Courses till this semester

**Course Objective :**

Learn basics of technical paper writing and enhance verbal and writing skills, which is useful for employabilty

**Pre-Requisites:** All Courses till this semester

**Course Outcomes: After completing this course, student shall be able to**

* Identify a topic from the current technologies of their choice in the Biotechnology domain and the allied fields, after surveying in the internet resources, journals and technical magazines in the library.
* Arrange the contents of the presentation and also write the report of the research paper..
* Present the technical topic in front of the panel and the fellow students, using the oratory skills and also submit the report of the research paper.
* Interact through answering the questions and also can add some points to the seminar

There shall be a Technical Paper writing and seminar evaluated for 100 marks in Third Year First Semester. The evaluation is purely internal and will be conducted as follows:

Content : 20 marks

Presentation including PPT : 20 marks

Seminar Notes : 10 marks

Interaction : 10 marks

Report : 25 marks

Attendance : 10 marks

Punctuality : 5 marks

Total 100 marks

**III year II Semester**

**(6G618) PLANT BIOTECHNOLOGY**

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**L L T P/D C**

**3 1 - 3**

**Objective:**

To learn the concepts, techniques and applications of Plant Cell, Tissue & Organ Culture and to apply them for crop improvement and new product development.

**UNIT I: INTRODUCTION TO CELL AND TISSUE CULTURE:** Concept of Totipotency, Tissue culture media (composition, preparation); Initiation and maintenance of asceptic culture, callus and cell suspension culture, Somatic embryogenesis, Organogenesis; Clonalpropagation

**UNIT II: TISSUE CULTURE APPLICATIONS:** Protoplast isolation, culture fusion and somatic hybridization; Haploid Production, its application and limitations; Somaclonal variations; Short term and long term Germplasm conservation (Cryopreservation)

**UNIT III: PRODUCTION OF PHYTOCHEMICALS:** Study of various culture types for production of secondary metabolites in vitro, Strategies for enhancing product yield; Bioreactor systems for mass cultivation of plant cells, Production of Phyto-pharmaceuticals at commercial level (Shikonin, Berberine, Vinca alkaloids)

**UNIT IV: TRANSFORMATION TECHNOLOGY:** Basic concept and essential steps of the genetic transformation process;Vector Mediated gene transfer:*Agrobacterium*, Vector less : Physical Methods - electroporation, microinjection and particle bombardment chemical methods – PEG , Ca2PO4

**UNIT V: TRANSGENIC PLANTS:** Production of transgenic plants forAbiotic (Drought, Temperature, Salinity) and Biotic Stress (Herbicide resistance, Insect resistance, Bacterial & Fungal Disease resistance, Virus resistance)

**UNIT VI: MOLECULAR FARMING:** Biotechnology for quality Oil, Transgenic plants as bioreactors, Edible vaccine and Plantibodies.

**TEXT BOOKS:**

1. H. S. Chawla, Introduction to Plant Biotechnology, 3rd Edition, Science publishers, 2009
2. Roberta Smith, Plant Tissue Culture: Techniques & Experiments. 2nd ed., Acad. Press, 2000.
3. Bhojwani, S.S. and Razdan, Plant Tissue Culture: Theory and Practice. Elsevier Science, 2004

**REFERENCES:**

1. Bhojwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier, 1990.
2. Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production & Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
3. Bernard R. Glick & John E. Thompson, Methods in Plant Mol. Biology & Biotechnology, CRC Press, 1993.

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| **S. No.** | **COURSE OUTCOMES** |
| **1** | **Understand** & **Explain** Totipotency, Aseptic Culture systems & Micropropagation |
| **2** | **Apply** *in vitro* concepts for protoplasts to generate hybrids, produce Haploids, & Somaclones and compare Germplasm conservation methods |
| **3** | **Synthesize** commercial Phytochemicals *in vitro* and **Enhance** their productivity |
| **4** | **Compare** and **Evaluate** Plant Genetic Transformation systems |
| **5** | **Create** Transgenic plants with increased productivity and performance |
| **6** | **Create** Transgenic plants with novel products by Molecular farming |

**III year II Semester, B. Tech – Biotechnology**

**(6G619) IMMUNOLOGY**

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**L T P/D C**

**3 1 - 3**

**OBJECTIVE**

To gain knowledge in various aspects of human immune system, its types, functioning and its response to foreign materials, and to design and conduct research investigations on transplantation and immunological disorders using modern engineering and IT tools.

**UNIT I: The Immune System and its biology:** Introduction, Innate and acquired immunity. **Immunochemistry:** Immunogens, antigens, their chemical nature, Properties influencing immunogenicity, Haptens, adjuvants. **Cells of the Immune System:** Haematopoiesis, lymphocyte trafficking, T and B lymphocytes, Macrophages, Dendritic cells, Natural killer cells, Eosinophils, Neutrophils, Mast cells.

**UNIT II: Organs of the Immune System:** Primary and Secondary lymphoid organs (Thymus, Bone Marrow, Spleen, Lymph nodes, MALT, GALT, SALT)

**UNIT III: Humoral Immunity:** B-lymphocytes, their lineage, Immunoglobulins, their structure function, classes, sub classes, generation of antibody diversity. Activation of B cells, their differentiation and effector functions., Activation of B cells, their differentiation and effector functions. Complement and its activation.

**UNIT IV: Antigen-antibody interactions and Hypersensitivity Reactions:**  Types of antigen-antibody reactions with suitable examples. Hybridoma Technology - Monoclonal antibodies their application. Immunotoxins, chimeric antibodies and abzymes. Types of hypersensitivity, Principle, mechanisms their relevance & significance in diseases.

**UNIT VI: Cell-mediated Immunity:** T-cells subclasses their lineage, maturation TCR diversity, MHC, Ag processing and presentation, T-cell activation, effector functions.

**UNIT VI: Transplantation**- Graft rejection evidence and mechanisms of graft rejection ,prevention of graft rejection, immuno suppressive drugs, **Autoimmunity** –autoimmune diseases and mechanisms and **Tumor immunology**- immunity to tumors and immune evasion by tumors

**TEXT BOOKS:**

1. E. Roitt Essential Immunology, Vaccines conventional, subunit and recombinant, antidiotypic vaccine, Blackwell Scientific publications, Oxford, 1991.
2. Kuby Immunology, 5th Edition . Richard A Goldsby, Thomas J Kindt Barbara A Osborne . W H Freeman and Company.

**REFERENCES:**

1. Benjamin E and Leskowitz S, immunology A short Course. Wiley LISS NY, 1991.

2. ELISA Immunological Techniques. DNA vaccines Immunotechnology

3. Cellular Molecular Immunology. Abul Abbas and Litchman, 2003

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | Ability to understand the differences between Innate and acquired immunity and immune system |
| **CO:II** | Ability to understand the structure and functional aspects of the primary and secondary lymphoid organs(bone marrow, thymus, spleen and others lymphoid organs |
| **CO:III** | Ability to Differentiate various immunoglobulin classes and subclasses basing on their structure and function and also understand the mechanism of generation of antibody diversity |
| **CO:IV** | Ability to understand the complement system and its role in immunity to pathogens. Classify different antigen-antibody reactions with suitable examples and acquire a comprehensive knowledge of hybridoma technology for monoclonal antibody production and their applications. |
| **CO:V** | Ability to understand the process of antigen presentation in the context of MHC resulting in T cell activation. and effector functions and also shall be able to classify hypersensitivity reactions and understand their mechanism and their relevance in diseases |
| **CO:VI** | Ability to demonstrate transplantation and graft rejection and their underlying mechanisms. Acquire a comprehensive understanding of tumour immunology and also shall be able to define autoimmunity and understand the models of autoimmune diseases |

**III Year II Semester B.TECH - BIOTECHNOLOGY**

**(6G620) BIOPROCESS ENGINEERING**

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**L T P/D C**

**3 1 - 3**

**COURSE OBJECTIVE**

To gain knowledge in the area of Bioprocess Engineering and to design and conduct experiment, analyze and interpret data in Bioprocess technology using research based knowledge and methods.

**UNIT I: INTRODUCTION TO BIOPROCESS**

An overview of traditional and modern applications of biotechnology industry, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets.

**UNIT II: FERMENTATION -I**

General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes; An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry, solid-substrate, slurry fermentation and its applications, whole cell immobilization

**UNIT III: MEDIA FORMULATION**

Medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation for optimal growth and product formation, examples of simple and complex media, design and usage of various commercial media for industrial fermentations.

**UNIT IV: STOICHIOMETRY**

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, Energy analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**UNIT V: GROWTH KINETICS**

Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non - growth associated (secondary) product formation Kinetics. Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

**UNIT VI: BIOREACTORS**

Differences and similarities between chemical and bioreactors, classifications of bioreactors, fluidized bed reactor, packed bed reactor, bubble column reactors air lift reactors. Bioreactor for plant and animals cells.

**All relevant units will have basic numerical problems.**

**TEXT BOOKS**

1. P.M. Doran, “Bioprocess Engineering Principles”, Academic Press, 1995.
2. Stanbury, Whitaker, Hall “Principles of fermentation Technology,.Second Edition

**References:**

1 M. L. Shuler and F. kargi “Bioprocess engineering”, Prentice Hall of India 1992.

**COURSE OUTCOMES**

1. Ability to use microorganisms to transform biological materials for production of fermented foods has its origins in antiquity, such as antibiotics, therapeutic proteins and vaccines which involves upstream and downstream processes.

2. Ability to focus on basic design, ancillaries of fermenter and various important parameters to be monitored and controlled in fermentation process. This enables the student to get a basic idea of fermenter ,operation and maintainance and about different types of reactors which improves their practical knowledge

3. Ability to demonstrate importance and different types of media and use statistical techniques like Plackett-Burman design to solve problems

4. Ability to apply stoichiometry to reactions in the fermentor, yield coefients and apply stoichiometric principles for macroscopic analysis of cell growth and product formation

5. Ability to demonstrate the growth curve of microbe in batch culture, difference between batch,continuos and fed batch culture and inhibition kinetics.

6. Ability to apply the knowledge of bioreactors for mass cultivation of cells

**III Year II Semester, B. Tech – Biotechnology**

**(6G621) MOLECULAR TOXICOLOGY**

**(Professional Elective-II)**

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**L T P/D C**

**3 1 - 2**

**OBJECTIVE**

To gain knowledge in various toxins, their metabolism and its application

**Unit I: Introduction to Toxicology** Definition, History and Scope, Classes of Toxicants, acute toxicity, chronic Toxicity, LC 50, LD 50, EC 50, ED 50, IC 50, NOAEL, MOAEL, Dose-response relationships, Bioaccumulation, Bioconcentration and biomagnifications

**Unit II: Absorption and Distribution of Toxicants:** Fate and mechanism of transport in vivo, Routes of absorption, Toxicant distribution-physico-chemical properties and protein-binding, volume of distribution

**Unit III: Metabolism and Excretion of Toxicants:** Phase-I and Phase-II reactions, Renal elimination, hepatic elimination and respiratory elimination

**Unit IV: Free radical induced Oxidative stress and its implications:** Concept of oxidative stress, free radicals, lipid peroxidation, role of oxidative stress in disease, biomarkers of oxidative stress – Superoxide Dismutase (SOD), Catalases, Lipid Peroxidases (LPO), Glutathione peroxidase , Glutathione-S-Reductase

**Unit V: Toxicity Testing Methods:** In vivo- algae, fish, mouse, In vitro-Cell lines, indicators of toxicity in cultured cells, Ames Mutagenity testing, micronuclei test, Genotoxicity-Comet Assay,

**Unit VI: Nanotoxicology**: Characteristics of Potentially toxic nanomaterials. Biological fate and distribution of engineered nanoparticles; In vitro toxicity studies of engineered nanomaterials-fullerene, copper oxide, titanium dioxide, evaluation of the toxicity of nanoparticles using zebra fish embryos and adult fish

**TEXT BOOKS**

1. A Text Book of Modern Toxicology- Edited by Ernest Hodgson, Wiley-Interscience.
2. Molecular Toxicology 2nd edition by P. David Josephy and Bengt Mannervia , oxford University press.

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| **COURSE OUTCOME (CO)** | | **POs** |
| **CO:1** | To acquire knowledge about the types of toxins and their measurements | b |
| **CO:II** | To able to access the absorption and distribution of toxins | b |
| **CO:III** | To able to access the metabolism and excretion of toxins | f, h ,i |
| **CO:IV** | To able to demonstrate the role of oxidative stress and free radical production of toxins | D |
| **CO:V** | Demonstrate fair knowledge about testing methods of various toxins | f, h ,i |
| **CO:VI** | Explain about various nanomaterials to evaluate the toxicology | f, h ,i |

**III Year II Semester, B. Tech – Biotechnology**

**(6G622) PHYTOCHEMICALS AND HERBAL MEDICINE**

**(Professional Elective-II)**

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**L T P/D C**

**3 1 - 3**

**Course Objective:**

A vast number of natural, plant-based extracts and chemicals are purported to have beneficial effects on humans.

**Unit I: Medicinal & Aromatic Plants**

Cultivation and Utilization of Medicinal & Aromatic Plants in India. Genetics as applied to Medicinal herbs.

**Unit II: Crude Drugs**

Crude Drugs – Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & processing of Crude Drugs.

**Unit III: Tissue Culture of medicinal Plants**

Plant Tissue Culture as source of medicines, Plant Tissue Culture for enhancing secondary metabolite production (Withania somnifera, Rauwolfia serpentina, Catheranthus roseus, Andrographis paniculata, Dioscorea sp.); Anticancer drugs, Biogenesis of Phytopharmaceuticals.

**Unit IV: Analysis of Phytochemicals**

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical). Preliminary screening, Assay of Drugs – Biological evaluation / assays, Microbiological methods

**Unit V: Chemical Methods of Analysis and Detection of Adulterants:** Chemical estimations, Spectrophotometry & Fluorescene analysis. Drug adulteration – Types of adulterants.

**Unit VI: Types of Phytochemicals**

Carbohydrates & derived products; Glycosides - extraction methods (Digitalis, Aloe, Dioscorea,); Tannins (Hydrolysable & Condensed types); Volatile Oils - extraction methods (Clove, Mentha);Alkaloids - extraction methods (Taxus, Papaver, Cinchona); Flavonoids- extraction methods, Resins- extraction methods.

**Books:**

1. Pharmacognosy, C. K. Kokate, A. P. Purohit & S. B. Gokhale (1996), Nirali Prakashan, 4th Ed.

2. Natural Products in medicine: A Biosynthetic approach (1997), Wiley.

**References**

1. Hornok,L. (ed.) (1992). Cultivation & Processing of Medicinal Plants, Chichister, U. K: J. Wiley & Sons.

2. Trease & Evans, Pharmacognosy – William Charles Evans, 14th ed. (1989), Harcourt Brace & Company.

**III Year II Semester, B. Tech – Biotechnology**

**(6G623) GREEN MANUFACTURING TECHNOLOGY**

**(Professional Elective-II)**

**L T P/D C**

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**Course Objectives:**

Impart knowledge to students in the latest technological topics on Production and sustainable Industrial Engineering and to provide them with opportunities in taking up advanced topics in the field of study.

**UNIT - I GREEN MANUFACTURING TRENDS**

Green Manufacturing: Fundamentals and Applications - basic definitions and issues surrounding green manufacturing at the process, machine and system - government motivations for green manufacturing - traditional manufacturing to green manufacturing

**UNIT - II ECONOMICS**

Green manufacturing economic issues- surrounding green manufacturing - the areas of automotive, semiconductor and medical areas as well as in the supply chain and packaging areas Green Manufacturing.

**UNIT - III SUSTAINABLE GREEN MANUFACTURING**

Introduction - sustainable green manufacturing -green manufacturing sustainability processes, requirements, and risk - The sustainable lean and green audit process. International green manufacturing standards and compliance. Green rapid prototyping and rapid manufacturing. Green flexible automation. Green collaboration processes . Alternative energy resources. Globally green manufacturing supply chains and logistic networks. Sustainable green manufacturing system design.

**UNIT - IV WASTE MANAGEMENT**

Sustainability and global conditions - Material and solid waste management - Energy management -chemical waste management and green chemistry - Climate change and air emissions management - Supply water and waste water management - Environmental business management .

**UNIT - V INDUSTRIAL ECOLOGY**

Introduction-Material flows in chemical manufacturing-Industrial parks-Assessing opportunities for waste exchanges and by product synergies-Life cycle concepts-Product shewardship and green engineering-Regulatory, social and business environment for green manufacturing.- Metrics and analytical tools.- Green supply chains.- Present state of green manufacturing.

**UNIT - VI GREEN PLASTICS MANUFACTURING**

Introduction to commercial plastics and elastomers -Natural Rubber (NR), modified NR and blends -Polyesters from microbial and plant biofactories (polylactic acid and poly hyroxyalkanoates) -Plastics from vegetable oils -Cellulose and starch based materials -Natural fillers, fibers, reinforcements and clay nanocomposites -Biodegradability, life cycle assessment and economics of using natural materials.

**References:**

1. T. David Allen and David R. Shonnard, Green engineering, Prentice Hall NJ, (2002).
2. David Dornfeld, Green manufacturing fundamental and applications, Prentice hall (2002).
3. G. Sammy Shinga, Green electronics design and manufacturing, Prince publications (2008).
4. James clark, Green chemistry, Blackwell publishing (2008).
5. Paulo Davim, Sustainable Manufacturing, Wiley publications (2010).
6. Frank Kreith, George Tchobanoglous, Solid waste management, McGraw Hill (2002).
7. E. S. Stevens, Green plastics, Princeton university press (2002).
8. U. Robert Ayres, A Handbook of Industrial Ecology, Edward elgar publishing (2002).

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | To acquire knowledge about government motivations for green manufacturing |
| **CO:II** | To able to access Green manufacturing economic issues |
| **CO:III** | To able to access green audit process |
| **CO:IV** | To able to demonstrate Material, Energy and solid waste management |
| **CO:V** | Demonstrate fair knowledge Material flows in chemical manufacturing |
| **CO:VI** | Explain about commercial plastics and elastomers |

**III year II Semester, B. Tech – Biotechnology**

**(6G624) OPTIMIZATION & NUMERICAL METHODS IN BIOPROCESSES**

**(Professional Elective - II)**

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**Course Objectives:**

This course aims at providing knowledge on basic concepts in Process Models and understanding of optimization methods in Bioprocessing.

**UNIT-I: Process Optimization**

Nature and organization, basic concepts and elements of Optimization, single variable functions, direct, indirect and random search methods – with and without acceleration Elimination methods for unrestricted and exhaustive search, Fibonacci search.

**UNIT-II :Media Optimization**

Placklett- Burmen Design, Response surface Method – Central Composite Design, Box Behnken Design.

**UNIT-III: Function Approximation**

Function Approximations by Linear and nonlinear least square analysis, Formulation Process Models leading to set of ordinary differential equations and solution procedures by Eulers, Modified Eulers and RungeKutta methods.

**UNIT-IV :Formulation of Process Models**

Formulation of Process Models leading to set of linear simultaneous equations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss-Seidel methods.

**UNIT-V:Process Models Leading to Transcendental and Polynomial Equations**

Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bi-section, Reguli-falsi, Newton Raphson,

**UNIT-VI : Development of Programs**

Development of program for all optimization technique using Excel, C, MATLAB, Mini Tab, Design Expert in bioprocess

**Text Books:**

1. Higher engineering mathematics by DR. B.S. Grewal, Khanna publishers (1998)
2. Numerical methods for Engineersby Steven C. Chapra and Raymond P Canale, 2nd edition, MCGraw Hill International edition, 1988.

**Suggested books:**

1. Computer Applications in Bioprocessing by Henry R. Bungay Volume 70/(2000) Springer.
2. Edger T.E., and Himmelbau D.M., “Optimization of chemical processes”, McGraw Hill international edition, 1988
3. Bioprocess engineering Enrique Galindo and Octavio T. Ramírez Volume 16, Issue 7, (1998).

**Course Outcomes:**

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| **CO : I** | Be able to distinguish between different process models |
| **CO : II** | Be able to formulate process models leading to set of ordinary differential equations and solution procedures numerical methods. |
| **CO : III** | Be able to formulate process models leading to set of linear simultaneous equations and solution procedures. |
| **CO : IV** | Be able to formulate process models leading to transcendental and polynomial equations and solution procedures. |
| **CO : V** | Understand the steps involved in optimization that are a prerequisite for the development of process flow sheets. |
| **CO : VI** | Be able to optimize biochemical process. |

**III Year II Semester (6G625) BIOSENSORS AND BIOELECTRONICS**

**(PROFESSIONAL ELECTIVE –II)**

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**OBJECTIVE**

To understand Biosensors required for the development of small, sensitive and selective biosensor devices and detection systems used in diagnostics, and detection systems to conduct investigations that operate in real time and in extreme environments using modern biotechnology engineering tools.

**UNIT I: INTRODUCTION:** Definition of Biosensors Advantages and limitations, various components of biosensors

**UNIT II: TYPES OF BIOSENSORS:** Biocatalysis based biosensors, bioaffinity based biosensors, biologically active material and analyte, Types of membranes used in biosensor constructions

**UNIT III: TRANSDUCER:** types, principles and applications-calorimetric, optical, potentiometric/amperometric conductrometric/resistometric, piezoelectric, bioluminescence and Chemiluminiscence-based biosensors

**UNIT IV: APPLICATION OF BIOSENSORS:** in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food, low cost biosensor for industrial processes on-line monitoring, biosensors for environmental monitoring

**UNIT V: NANO BIOSENSORS:** Nano optics for biosensors, DNA as tool for Nano bio sensing, Nanowire bio sensing. Implantable biosensors

**UNIT VI: MOLECULAR ELECTRONICS:** Introduction to molecular electronics, Development of molecular arrays, molecular wires and switches, mechanisms of unit assembly

**TEXT BOOKS:**

1. Biosensors: An Introduction by Brian R. Eggins Biosensors edited by AEG CASS OIRL press Oxford University John Wiley & Sons (1997). 2.
2. Bilitewski, U. Turner, A.P.F. 2000 Biosensors for environmental monitoring Harwood, Amsterdam.

**REFERENCE:**

1. Biosensors, Elizabeth A. H. Hall, open University Press Biotechnology Series

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | Ability to demonstrate knowledge of definition and make up of Biosensors |
| **CO:II** | Ability to demonstrate knowledge of various types of biosensors based on their detecting systems like enzyme, immune and bio affinity based biosensors |
| **CO:III** | Ability to understand the principle and working of various transducer used in biosensors |
| **CO:IV** | Ability to demonstrate knowledge of various application of biosensors in various fields such as clinical chemistry, medicine, agriculture, industrial bioprocess and for environmental monitoring |
| **CO:V** | Ability to demonstrate understanding about Nano biosensors and their makeup. |
| **CO:VI** | Ability to demonstrate knowledge about molecular electronics, development of molecular arrays, wire and switches |

**Syllabus for B.Tech III year I semester**

**Open Elective - II**

**PYTHON PROGRAMMING for BT**

**Code: 6FC35 L T P/D C**

**3 1 - 3**

**Course Objectives:-**

After taking this course, you should be able to:

Use Python interactively, execute a Python script at the shell prompt, use Python types, expressions, and None, use string literals and string type, use Python statements (if...elif..else, for, pass, continue, . . . ), understand the difference between expressions and statements, understand assignment semantics, write and call a simple function., utilize high-level data types such as lists and dictionaries, understand the difference between mutable and immutable types, write a simple class and access methods and attributes, import and utilize a module, read from and write to a text file.

**Unit -I:**

Introduction to Python: History, Features, Setting up path, working with Python Basic Syntax, Variable and Data Types, Operator. Conditional Statements (If, If- else, Nested if-else) Looping (for, While Nested loops) Control Statements (Break, Continue, Pass)

**Unit-II:**

**Functions:** Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables

**String Manipulation**: Accessing Strings, Basic Operations, String slices, Function and Methods

Lists: Accessing list, Operations, Working with lists Function and Methods

Tuple: Accessing tuples, Operations, Working.

Dictionaries: Accessing values in dictionaries, working with dictionaries, Properties Functions and Methods.

**Unit-III:**

Modules: Importing module, Math module, Random module, Packages, Composition

Input-Output: Printing on screen, Reading data from keyboard, Opening and closing file Exception Handling: Exception, Exception Handling, Except clause, Try? Finally clause User Defined Exceptions

**Unit-IV:** Advance Python- OOPs concept: Class and object, Attributes, Inheritance, Overloading Overriding, Data hiding.

Regular expressions---Match function, Search function, Matching VS Searching, Modifiers Patterns.

**Unit -V**: CGI: Introduction, Architecture, CGI environment variable, GET and POST methods Cookies, File upload.

Python for Database: Introduction, Connections, Executing queries, Transactions Handling error

**Unit -VI:** Working with NumPy/PlotPy/SciPy/GUI Programming, Introduction, Tkinter programming, Tkinter widgets

**Text books:**

1. Think Python: How to think like a Computer Scientist Allen B. Downey, O'Relly publications.

2. Learning with Python by Jeffrey Elkner, Chris Meyers Allen Downey, Dreamtech Press.

**Reference books:**

1. Introduction to Computation and Programming using Python, Revised and Expanded Edition, John V. Guttag, The MIT Press.

2. Programming Python, Fourth Edition by Mark Lutz, O'Relly

3. Python Programming using problem solving approach, Reema Thareja, Oxford Higher Education.

**Course Outcomes:**

CO1: Gains exposure towards Python versions and their specifications.

CO2: Build programs using primitive data types.

CO3: Write applications that include functions, modules, and packages along with respective exceptional handling mechanism.

CO4: Writes applications using OO features of Python

CO5: Develops web based applications to deal with data communication between client and server modules and also process data that is stored in possible databases.

CO6: Hands on exposure on SciPy/Tkinter/Plotpy modules.

**III Year II Semester 5ZC24 - INNOVATION & DESIGN THINKING**

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**L T P/D C**

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**Course Objective:** The objective of the course is to make students understand the nature of Innovation, creativity and IPRs, and to motivate the student to start his/her own enterprise with innovative skills.

**Unit – I: Introduction to Innovation: -**

Meaning of Innovation, Difference between innovation and invention, Difference between Innovation and Creativity, Need to be Creative , Importance of Innovation, Innovation as a Competitive Advantage, Innovation Continuum, Innovation Cycle, Disruptive Innovation, , Breakthrough innovations and its consequences on the society, Challenges in Innovation.

**Unit – II: Creative Thinking: -**

Types of Creative Thinking, Creative Thinking Process, Components of Creativity, Characteristics of a Creative Mindset, New product ideas, Idea generation methods, Principles of Idea Generation, Difference between Idea Generation and Brainstorming, Killing the ideas through Stage Gate Models, Process of Reverse Thinking. Intellectual Property Rights, Importance of IPR, Role of WIPO, Case Studies on Patents and Infringement of Rights.

**Unit – III: Design Thinking & Liberal Art: -**

Concept of Design Thinking, Difference between Designer and Scientist, Stages of Design Thinking, Difference between Convergent Thinking and Divergent Thinking. Definition of Liberal Art and its Importance of Liberal Art , Role of Art and Culture to Innovate Business.

**Unit – IV: Emerging Technologies: -**

Meaning of Internet of Things, Components of IoT, Benefits of IoT, Types of Product – Service hybrid, examples of IoT enabled Innovations, Impact of IoT on Business, Future of IoT. Case Study on IoT.Innovation Leadership &Network: - Leadership, Skills and Characteristics of an Innovation Leadership, Meaning of Innovation Network, Significant of Innovation Network, Define Social Media Analysis, Steps to Build an Innovation Network.

**Unit –V Building Startup**

Kelly Johnsons KISS Principle, Road map for building a startup, identify, analyze and evaluate

funding, advantages of crowd funding. Pricing strategies. Determining factors for Monetizing Innovation, Process of Monetization, Fixing the price of an Innovative Project . Detailed study on market potential, pitfalls and Negative effects of Monetizing innovation. Reasons for failure of Monetization of Innovation. Schemes of Government through Startup India, role of Institutional support and Commercial Banks.

**References:**

* Peter Drucker (1993), “Innovation and Entrepreneurship”, Hyper Business Book.
* C.K. Prahalad, M.S. Krishnan, The new age of Innovation – TATA McGRAW-HILL     Edition 2008.
* “Innovation by Design", Gerald H. (Gus) Gaynor, AMACOM {American Management Association), NYC, 2002
  + Bholanath Dutta: Entrepreneurship – Text and cases, Excel, 2009.
  + Vasanth Desai: Entrepreneurship, HPH, 2009
  + Barringer: Entrepreneurship, Pearson, 2009.
  + H. Nandan: Fundamentals of Entrepreneurship, PHI, 2009.
* John M Nicholas “Project Management for Business and Technology” Prentice Hall of India Pvt. Ltd.

Stay Hungry Stay Foolish, Rashmi Bansal and published by IIM., Ahmedabad

**Course Outcomes:**

1. The students gain the knowledge on the inputs required for innovation and also gain familiarity on Entrepreneurship.
2. The students will get exposure on creative methods of ideation and the importance of protecting the ideas.
3. The students gain knowledge on design thinking and types of thinking.
4. The students gain familiarity on emerging technologies like Internet of things (IOT).
5. The students understand the process of building the startup.
6. The students gain knowledge on various startup funding and also to branding building for the startup.

**B. Tech (BT) III Year - II sem**

**6ZC19 ENTREPRENEURSHIP, PROJECT MANAGEMENT AND STRUCTURED FINANCE**

**(Open Elective - II)**

**L T P/D C**

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**Course Objective:** The objective of the course is to make students understand the nature of Entrepreneurship, its importance and to create an awareness regarding the systematic planning and implementation of projects; highlight the components of structured finance and establish a framework of CMBS with respect to Servicing Agreements

**UNIT I**

**CONCEPTS OF ENTREPRENEURSHIP:** Definition of Entrepreneurship, Evolution of Entrepreneurship, Classification of Entrepreneurs**,** Characteristics of Entrepreneur**,** Selection of Product and the means required for starting an enterprise, Financing and Financial incentives available, Success rate of entrepreneurs – a case study.

**UNIT-II**

**BASICS OF PROJECT MANAGEMENT:** Concept and characteristics of a project - types of projects - Objectives of project management - Project Organizational structure - Project life cycle - Challenges and problems of project management - Qualities & functions of a project manager.

**UNIT III**

**PROJECT FORMULATION AND IMPLEMENTATION:** Generation of Project Ideas; Monitoring the environment; Preliminary Screening of Projects; Feasibility study; Project Selection. Detailed Project Report: Market, Technical, Financial and Economic aspects. Pre-requisites for Successful Project Implementation; Control of in-progress Projects (Gantt chart, PERT, CPM); Project Risk Management Process, Post-audit; Abandonment Analysis

**UNIT-IV**

**INTRODUCTION TO STRUCTURED FINANCE**: Term Loans, Bonds/Debentures, Types of debentures, Issue of debt instruments. Structured Finance: Evolution, Securitization process, characteristics, and structured finance products (ABS, CDO, MBS, CDS)

**UNIT-V**

**COMMERCIAL MORTAGAGE LOAN BASICS**: Definition and characteristics of CMBS, CMBS Vs other Mortgage Backed Securities, CMBS three level perspective: property level, loan level, bond level; Life cycle of commercial real estate loans – Loan cycle, Key players in loan cycle; Property types and characteristics, property performance.

**UNIT-V1**

**BASICS OF CRE SERVICING:** Introduction to servicing, Role of the Servicer, Servicing approaches, Influence of technology, Ethics in commercial servicing, Servicing – sources of income, Overview of servicing agreements, Pooling & Servicing agreement, Sub servicing agreement.

**Course Out Comes:**

1. Students will understand the nature of Entrepreneurship and its importance
2. Will gain knowledge regarding project, its life cycle and organization
3. Will gain knowledge relating to project formulation and implementation
4. Comprehend the components of structured finance
5. Establish a framework of CMBS
6. Students will gain knowledge relating to the CRE Servicing

**Books Recommended:**

* H. Nandan, Fundamentals of Entrepreneurship, Prentice Hall of India, First Edition, New Delhi, 2007.
* Jeffrey K. Pinto “Project Management”, 2nd edition, Pearson
* Dhandapani Alagiri “Structured Finance – Concepts & Perspectives”, ICFAI University press.

**References:**

* Projects by Prasanna Chandra, McGraw-Hill Publishing Co. Ltd
* Project Management: Systems approach to Planning Scheduling and Controlling, H. Kerzner.
* The Complete Real Estate Documents by Mazyar M. Hedayat, John J. Oleary
* The Fundamentals of Listing and Selling Commercial Real Estate - By Keim K. Loren (Author)

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**5ZC24 - INNOVATION & DESIGN THINKING**

**Open Elective -II**

**(Common to all Branches)**

**Course Objective:** The objective of the course is to make students understand the nature of Innovation, creativity and IPRs, and to motivate the student to start his/her own enterprise with innovative skills.

**Course Outcomes:**

1. The students gain the knowledge on the inputs required for innovation and also gain familiarity on Entrepreneurship.
2. The students will get exposure on creative methods of ideation and the importance of protecting the ideas.
3. The students gain knowledge on design thinking and types of thinking.
4. The students gain familiarity on emerging technologies like Internet of things (IOT).
5. The students understand the process of building the startup.
6. The students gain knowledge on various startup funding and also to branding building for the startup.

**Unit – I: Introduction to Innovation: -**

Meaning of Innovation, Difference between innovation and invention, Difference between Innovation and Creativity, Need to be Creative , Importance of Innovation, Innovation as a Competitive Advantage, Innovation Continuum, Innovation Cycle, Disruptive Innovation, , Breakthrough innovations and its consequences on the society, Challenges in Innovation.

**Unit – II: Creative Thinking: -**

Types of Creative Thinking, Creative Thinking Process, Components of Creativity, Characteristics of a Creative Mindset, New product ideas, Idea generation methods, Principles of Idea Generation, Difference between Idea Generation and Brainstorming, Killing the ideas through Stage Gate Models, Process of Reverse Thinking. Intellectual Property Rights, Importance of IPR, Role of WIPO, Case Studies on Patents and Infringement of Rights.

**Unit – III: Design Thinking & Liberal Art: -**

Concept of Design Thinking, Difference between Designer and Scientist, Stages of Design Thinking, Difference between Convergent Thinking and Divergent Thinking. Definition of Liberal Art and its Importance of Liberal Art , Role of Art and Culture to Innovate Business.

**Unit – IV: Emerging Technologies: -**

Meaning of Internet of Things, Components of IoT, Benefits of IoT, Types of Product – Service hybrid, examples of IoT enabled Innovations, Impact of IoT on Business, Future of IoT. Case Study on IoT.Innovation Leadership &Network: - Leadership, Skills and Characteristics of an Innovation Leadership, Meaning of Innovation Network, Significant of Innovation Network, Define Social Media Analysis, Steps to Build an Innovation Network.

**Unit –V Building Startup**

Kelly Johnsons KISS Principle, Road map for building a startup, identify, analyze and evaluate

funding, advantages of crowd funding. Pricing strategies. Determining factors for Monetizing Innovation, Process of Monetization, Fixing the price of an Innovative Project . Detailed study on market potential, pitfalls and Negative effects of Monetizing innovation. Reasons for failure of Monetization of Innovation. Schemes of Government through Startup India, role of Institutional support and Commercial Banks.

**References:**

* Peter Drucker (1993), “Innovation and Entrepreneurship”, Hyper Business Book.
* C.K. Prahalad, M.S. Krishnan, The new age of Innovation – TATA McGRAW-HILL     Edition 2008.
* “Innovation by Design", Gerald H. (Gus) Gaynor, AMACOM {American Management Association), NYC, 2002
  + Bholanath Dutta: Entrepreneurship – Text and cases, Excel, 2009.
  + Vasanth Desai: Entrepreneurship, HPH, 2009
  + Barringer: Entrepreneurship, Pearson, 2009.
  + H. Nandan: Fundamentals of Entrepreneurship, PHI, 2009.
* John M Nicholas “Project Management for Business and Technology” Prentice Hall of India Pvt. Ltd.

Stay Hungry Stay Foolish, Rashmi Bansal and published by IIM., Ahmedabad

**Syllabus for B. Tech III Year II semester**

**DATA ANALYTICS**

**Open Elective - III**

**(Common to ECE & BT)**

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**Code: 6FC33 L T P C**

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**Course Objectives:**

1. Obtain, clean/process and transform data.
2. Analyze and interpret data using an ethically responsible approach.
3. Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
4. Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.
5. Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges.
6. Perform well in a group.
7. Interpret data findings effectively to any audience, orally, visually and in written formats.

**Course Outcomes:**

1. Ability to Analyze and interpret data

1. Ability to formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges.
2. Ability to demonstrate proficiency with statistical **analysis of data.**
3. Ability to apply data science concepts and methods to **solve** problems in real-world contexts and will **communicate** these solutions effectively

**Unit-1**

**Introduction:**

What is data warehousing?, What is data mining?, Classification of Data Mining systems, Data pre-processing: Why data pre-processing is needed, Data Cleaning, Data Integration and Transformation, Data Reduction. Data Warehouse: Data Warehouse and OLAP Technology, Multidimensional Data Model, Data Warehouse Architecture.

**Unit-2**

**Data Mining Tasks:**

Association Analysis: Frequent Itemsets generation using Apriori Algorithm, Evaluation of Association Patterns, Classification: General approach to solving a classification problem, Decision Tree Induction, Model Overfitting, Clustering: Overview, k-means algorithm.

**Unit-3**

**Introduction to Big Data**

What is big data, why big data, convergence of key trends , unstructured data ,industry examples of big data ,web analytics, big data and marketing, fraud and big data ,risk and big data ,credit risk management, big data in medicine, introduction to Hadoop open source technologies , cloud and big data

**Unit-4**

**Frameworks of Big Data:**

The Map Reduce Framework; Uses of Map Reduce; Architecture, Storing Big Data with HBase, Role of HBase in Big Data Processing, NoSQL Databases.

**Unit-5**

**Introduction to Data Science**

Need for data scientists, Foundation of Data Science, What is Business Intelligence, What is Data Analysis, Machine Learning, Analytics VS Data Science, Types of Analytics, Life cycle probability, Analytics Project Lifecycle.

**Unit-6**

**Data Visualization:**

Introduction-Terminology-Basic charts and plots-Multivariate Data Visualization-Data Visualization Techniques-Explorative Data Analysis (EDA)-

Introduction to EDA, Needs of EDA, Goals of EDA, Types of EDA, Implementation of EDA, Boxplots, cor() in R ,EDA functions, Elements of Data Visualization, Info-graphics vs Data Visualization, Data Visualization and Graphical Functions in R, Plotting of Graphs.

**Textbooks:**

* Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011. **[FOR UNIT-1]**
* Introduction to Data Mining - First Edition, by Pang-Ning Tan, Michael Steinbach and Vipin Kumar, ISBN-13: 978-0321321367 **[FOR UNIT-2]**
* BIG DATA and ANALYTICS, Seema Acharya, Subhasinin Chellappan, Wiley publications. **[FOR UNITS – 3 & 4]**
* Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, Arno Meysman, Mohamed Ali, Manning Publications, 2016, ISBN 1633430030, 9781633430037 **[FOR UNITS - 5 & 6]**

**References:**

* Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly. 2014.
* Tom Mitchell. Machine Learning. Mc Graw Hill 1997.
* Jure Leskovek, Anand Rajaraman and Jefrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)
* BIG DATA, Black Book TM , DreamTech Press, 2015 Edition
* Seeing What Others Don’t. The Remarkable Ways We Gain Insights. Gary Klein. First Edition. Public Affairs Press.

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6**ZC23 - ADVANCED ENTREPRENEURSHIP**

**(Common to all Branches)**

**Course Objective:** The course is designed to impart the necessary managerial skills and tactics required for an emerging Entrepreneur for the Engineering students to enhance their prospects as an Entrepreneur.

**Course Outcomes:**

1. The Students’ gain knowledge on the stages of Startup and the turbulence environment it undergoes and the stages related to growth of the Startup.
2. The Students are exposed to the various business models and critically evaluating the effectiveness of the business models.
3. The students understand the method of business traction and the need of customer relationship management.
4. The students understand the various channels of revenue building and exploration of new revenue avenues.
5. The students understand the need of sales planning and sales management and also financial modeling
6. The students are exposed to the legal implications effecting the company’s prospects and the issues related to intellectual property rights.

**Unit – I Orientation to Growth:**

Stages of a Startup Company, Infant Mortality of Startup’s, Sustaining the Phase of Launching, Entrepreneurial Propensity, Locus of Control, First Generation Entrepreneur, Growth Opportunities, Diversification and Expansion of Business, Growth Assessment, SWOT Analysis, Growth strategies adopted by ideal startup, Ansoff Growth Matrix, Six ways of Adjacencies for Growth. Case Study of Nike

**Unit - II - Expanding Customer Base:**

Customer Segmentation: Division of Market into Segments, Evaluating the profitability of Segments. Developing Business Model in relation to the current customers. Changing customer segments and revisit of business models. Evaluation of Business Models for new customer segments. Critical evaluation of business models Old Vs New. Risk of changing the Business Models. Analyzing the scalability of business model using Break Even Analysis.

**Unit- III - Traction of Business:**

Meaning of Business Traction, Business Traction Process, and Metrics to Measure Business Traction, Customer Retention, Customer Churning, Relationship Business, Customer Life Time Value, Identifying the unnecessary moves in business traction. Traction of Business using Bull’s-eye framework. Measuring the effectiveness of selected channels. Budgeting and Planning.

**Unit- IV - Growing Revenues:**

Identifying Growing Revenues, stabilizing growing revenues, Developing additional revenues (licensing and franchising). Exploring New channels and Partnerships for growth revenues. Evaluating the Growth streams based on longevity. Lean Startup Canvas.

**Unit V - Sales Planning & Financial Modeling:**

Understanding the consumer buying decision behavior, setting sales plans, sales targets, Art of pitching the sales, Selling process, Building a professional sales team , Sales Management. Price Sensitivity of the market. Optimization of cost and operational expenses. Financial modeling of the Venture, Assessment of competitors and Peer’s financial models.

**Unit –VI - Support System:**

Legal Management in Startups: Issues and Legal constraints effecting the business. Need for professional services: Legal consultancy and Accounting. Need for proper documentation for fool-proof administration of business. Intellectual Property rights and their importance. Business Mentoring, role of experts in managing business.

**References:**

* Entrepreneurship Rajeev Roy “” oxford ,2012

Entrepreneurship Development Khanka, ,S.Chand 2012

* Small Scale industries and Entrepreneurship Vasanth Desai “Himalya publishing 2012
* Robert Hisrich et al “enterpreneruship TMH 2012
* Entrepreneurship Development Khanka, ,S.Chand 2012
* Entrepreneurship Development B.Janikairam and M Rizwana

**6ZC15 FINANCIAL INSTITUTIONS, MARKETS AND SERVICES**

**(Open Elective -III)**

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**L T P/D C**

**2 1 0 2**

**Course Objective:** The objective of the course is to provide to students an understanding of Financial Markets, the major Institutions involved and the Services offered within this framework.

**UNIT I**

**INTRODUCTION:** The structure of financial system, Equilibrium in financial markets, Indicators of Financial Development, Financial system and Economic Development, Financial Sector Reforms after 1991.

**UNIT II**

**BANKING INSTITUTIONS**: Structure and Comparative performance, Functions and Role of RBI, Competition, Interest rates, Spread; Bank Capital Adequacy norms; Banking Innovations – BPLR to Base rate, Core Banking System, Financial Inclusion, Current rates: Policy rates, Reserve Ratios, Exchange rates, Lending/ Deposit rates.

**UNIT III**

**NON BANKING FINANCIAL INSTITUTIONS:** Structure and functioning of Unit Trust of India and Mutual Funds, Growth of Indian Mutual funds and their Regulation, Role of AMFI. Performance of Non-Statutory Financial Organizations: IFCI, IRBI, NABARD, SIDBI and SFCs.

**UNIT IV**

**FINANCIAL AND SECURITIES MARKETS**: -, Role and functions of SEBI, Structure and functions of Call Money Market, Government Securities Market – T-bills Market, Commercial Bills Market, Commercial paper and Certificate of Deposits; Securities Market – Organization and Structure, Listing, Trading and Settlement, SEBI and Regulation of Primary and Secondary Markets.

**UNIT V**

**ASSET/FUND BASED FINANCIAL SERVICES:** Lease Finance, Consumer Credit and Hire purchase Finance, Factoring - Definition, Functions, Advantages, Evaluation, Forfeiting, Bills Discounting, Housing Finance, Venture Capital Financing. Fee-based Advisory services: Stock Broking, Credit Rating.

**UNIT VI**

**INVESTMENT BANKING AND MERCHANT BANKING**:

Investment Banking: Introduction, Functions and Activities, Underwriting, Banker to an Issue, Debenture Trustees and Portfolio managers, Challenges faced by Investment Bankers.

Merchant Banking: Definition, Merchant Banks Vs Commercial Banks, Services of Merchant Banks.

**References:**

* L.M. Bhole: Financial Institutions and Markets, TMH, 2009.
* E. Gordon, K. Natarajan: Financial Markets and Services, Himalaya Publishing House, 2013.
* Vasant Desai: Financial Markets and Financial Services, Himalaya,2009
* Pathak: Indian Financial Systems, Pearson, 2009
* M.Y. Khan: Financial Services, TMH, 2009.
* S. Gurusamy: Financial Services and System, Cengage,2009
* Justin Paul and Padmalatha Suresh: Management of Banking and Financial Services, Pearson, 2009.
* Gomez, Financial Markets, Institutions and Financial Services, PHI, 2012.
* R M Srivatsava: Dynamics of Financial Markets and Institutions in India, Excel, 2013.

**Course Outcomes:**

1. 1.This unit enables the students to understand the financial structure and the financial sector reforms after 1991.
2. The unit gives the exposure on the role of RBI and the Regulating and credit policies adopted by the RBI.
3. The students get awareness on the role of Non-Banking financial institutions and the role of financial institutions in India.
4. The unit educates the students to know the role of regulatory bodies like SEBI and also to know the capital and money market instruments
5. The unit equips the students to understand about the asset fund based financial services
6. The students will get exposure about the investment banking and merchant banking.

**5ZC21 GENERAL MANAGEMENT AND ENTREPRENEURSHIP**

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**L T P/D C**

**2 1 0 2**

**Course Objective:** The course is designed to impart the necessary managerial skills and tactics required for an emerging Entrepreneur for the Engineering students to enhance their career prospects and ambitions of starting a new Enterprise.

**Pre-requisites**: This course shall require a student to have knowledge in Managerial Economics and Financial analysis, Management Science, Operations management**.**

**Course Outcomes:**

1. Describe the necessary managerial skills and tactics required for an emerging Entrepreneur.
2. Distinguish various methods for business process and product development
3. Demonstrate the skills required for the project planning, implementing and controlling
4. Outline the legal aspects and applying for Intellectual Property Rights
5. Illustrate the various sources of finance for venturing a business project.
6. Designing production plant and quality management system.

**UNIT I**

**INTRODUCTION TO MANAGEMENT AND ENTREPRENEURSHIP:** Changing Face of Management-Entrepreneurship, Modern Management with Entrepreneurial Orientation.. Meaning of Entrepreneurship. Benefits and Drawbacks of Entrepreneurship Reasons feeding the Entrepreneurial fire. Understanding Entrepreneurship as a Process. Multiple roles of Entrepreneur: Intrapreneur, Inventor, Coordinator, Manager and Controller. Psychological and behavioral aspects of First-Generation Entrepreneur. Case Studies

**UNIT II**

**PROCESS DEVELOPMENT AND INNOVATION PROJECT MANAGEMENT:** Business Process Model, Value chain for Manufacturing industries and Service Industries. Frugal Innovation. Creativity process in developing Innovation.. Types of New Products, Forecasting of New Products, Stages in the New Product Development, Prototype building and pitching Going ahead with ideas, killing the ideas through Stage Gate Models, pitching of full fledged idea. Choosing the Start-Up Team.

**UNIT III**

**PROJECT MANAGEMENT AND FEASIBILITY REPORT:** Project Inception, Project Implementation, and Project control. Analyzing the project by employing capital budgeting techniques, Risk Management, tools and techniques. Methods of Appraising the Project. Industry Analysis pertaining to the Product, Competitive Analysis and Market analysis. Preparation of feasibility report, Contents of Feasibility Report. Exercise to write an effective Feasibility report. Case Studies.

**UNIT IV**

**PROTECTION OF IDEAS AND MECHANISM:** Exposure to intellectual property rights to the entrepreneur in the Indian and the World context. Registration process for Patents, Copyrights, Trademarks, Geographical indicators. Legal Framework in administration of Intellectual property rights. Meaning of Infringement, consequences of Infringement. Cases on Infringement. Case Studies.

**UNIT V**

**VENTURE FINANCING AND ISSUES RELATED TO PRICING:** Meaning of Venture Capitalist, Process of Venture Capital, Seed Funding, First Phase Funding, Second Phase Funding and Final Phase funding. Cost analysis, Preparation of standard costing, Finalizing the output, fixing the pricing based on market structure, Monopoly, oligopoly market structures and marketing pricing practices for attracting customers. Case Studies

**UNIT VI**

**MANUFACTURING AND QUALITY MANAGEMENT:** Plant Layout, Process and Product Layout, Service Factory. Introduction to Quality Circles, Quality inspection, ISO Certification, process of certification and exposure to the entrepreneurs of the need for certification. Quality certification for Manufacturing industrial. Case Studies

**References:**

* "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review", Prasanna Chandra, TMH, New Delhi, 2012
* "Project Management", Jeffrey K. Pinto, Pearson, 2011
* Small Scale industries and Entrepreneurship Vasanth Desai “Himalya publishing 2012
* Innovation by Design", Gerald H. (Gus) Gaynor, AMACOM {American Management Association), NYC, 2002
* Entrepreneurship Rajeev Roy “” oxford ,2012
* Fundamentals of Entrepreneurship Nandan H,

**B. Tech. III Year II semester**

**LOGICAL REASONING**

**(Common to All Branches)**

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**L T P/D C**

**Code: 6H677 2**  0 **0 1**

**Pre Requisites**: Nil

**Course Outcomes:** *Students will able to answer*

1. *The questions given on series completion and analogy.*
2. *The questions given on odd one out in classification and coding and decoding.*
3. *The questions given on blood relations.*
4. *The questions given on directions and Arithmetical reasoning.*
5. *The questions given on Venn diagrams, cubes and dice. .*
6. *The questions given on clocks and calendar.*

**Unit–I:** Series Completion: Number Series, Alphabet Series, Alpha – Numeric Series.

Analogy: Completing the Analogous Pair, Simple Analogy, Choosing the Analogous pair, Double Analogy, Word Analogy, and Number Analogy.

**Unit–II:** Classification / Odd One Out: Word Classification, Number Classification and Letter Classification. Coding – Decoding: Letter Coding, Number Coding, Matrix Coding, Substitution, Deciphering Message Word Codes, Jumbled Coding.

**Unit–III:** Blood Relations, Deciphering Jumbled up Descriptions, Relation Puzzle – Direction sense test. Number, Ranking & Time Sequence Test –Mathematical Operations.

**Unit –IV:** Directions, Arithmetical Reasoning. Puzzle Test: Classification Type Questions, Seating Arrangements Comparison Type Questions, Sequential Order of Things, Selection Based on given conditions, Family – Based Puzzles, Jumbled Problems.

**Unit –V:** Assertions and Reason– Logical Venn Diagrams – Alpha Numeric Sequence Puzzle. Cubes and Dice – Analytical Reasoning .Logical Deduction: Logic, Statement – Arguments,

**Unit – VI:** Clocks & Calendar .Data Sufficiency and Syllogism.

**Text Books:**

1. Verbal and Non Verbal Reasoning by R.S.Agarwal.
2. Quantitative Aptitude and Reasoning, R.V.Praveen, Second Edition, PHI Learning Pvt.

**III year II Semester (6G678) PLANT BIOTECHNOLOGY LAB**

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**L T P/D C**

**- - 4 2**

**Objective:**

To Learn the Techniques of Plant Cell, Tissue and Organ Culture and apply them for Phytochemical production and Genetic Transformation

1. Introduction to equipments used in plant tissue culture & Preparation of stock solutions
2. Preparation of media (MS / B5 )
3. Surface sterilization of different explants
4. Inoculation of explants for callus induction
5. Organogenesis
6. Cell suspension culture
7. Somatic Embryogenesis
8. Protoplast isolation from leaf and callus
9. Extraction of Phytochemicals from medicinal plant
10. Qualitative analysis of phytochemicals
11. Quantitative Estimation of Phytochemicals by colorimeter/spectrophotometer
12. Preparation of *Agrobacterium* culture for transformation

**REFERENCES:**

1. Plant Biotechnology: Practical Manual, C. C. Giri & Archana Giri, IK International, 2007.
2. Plant Biotechnology: laboratory manual for plant biotechnology, H. S. Chawla, Oxford IBH publishers
3. A Laboratory Manual of Plant Biotechnology (2nd Ed), S. S.Purohit, Agrobios publishers

**EQUIPMENTS & FACILITIES:**

Autoclave, pH Meter, Laminar air flow chamber, Shaker- incubator, Plant Growth Chamber, Soxhlet Apparatus, Compound Microscope, Tissue Culture Racks, Culture/Incubation Room

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| **. No.** | **COURSE OUTCOMES** | **POs** |
| **1** | **Demonstrate** and **Make-use-of** Equipments & Facilities in Tissue Culture Lab | **b, c, d, l** |
| **2** | **Learn** Techniques of Sterilization and **Establish** Asceptic environment | **b, c, d, l** |
| **3** | **Prepare** Tissue Culture Media and **Modify** it for further use | **b, c, d, l** |
| **4** | **Generate** Callus and **Establish** Suspension Cultures | **b, c, d, l** |
| **5** | **Predict** and **Induce** Indirect and Direct Organogenesis | **b, c, d, l** |
| **6** | **Isolate, Visualize** and **Detect** Protoplasts | **b, c, d, l** |
| **7** | **Extract, Estimate** and **Compare** Phytochemicals | **b, c, d, l** |
| **8** | **Apply** *in vitro* Techniques to genetically transform plant material | **b, c, d, l** |

**III year II Semester**

**(6G679) IMMUNOLOGY LAB**

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**L T P/D C**

**- - 4 2**

1. Red blood cell (RBC) count in blood
2. Total leukocyte (White blood cell) count and Differential leukocyte count in peripheral blood
3. Isolation and viability determination of lymphocyte from peripheral blood
4. Haem-agglutination: Blood grouping / typing
5. Assessment of Antigen-Antibody interaction by Ouchterlony / Double Immuno Diffusion technique
6. Counter Current electrophoresis
7. Enzyme-linked Immunosorbent Assay (ELISA)
8. Immunofluorescence
9. Immunoglobulin precipitation / purification
10. Separation of serum proteins by SDS-Poly Acryl amide Gel
11. Assessment of polyclonal antibodies in serum Electrophoresis
12. Lymphoproliferation Assay

**III Year II Semester B.TECH - BIOTECHNOLOGY**

**(6G680) BIOPROCESS ENGINEERING LABORATORY**

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**L T P/D C**

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**Course Objective**

For gaining hands on experience in conducting various fermentation experiments and to understand kinetics of the biochemical reactions and organisms

**Experiments**

1. Extraction of commercially important enzymes from natural source
2. Quantification of enzyme activity and specific activity
3. Effect of pH, temperature, enzyme and concentration of substrate on enzyme activity
4. Estimation of Michaelis - Menten parameters
5. Immobilization of cells using gel entrapment and calculation of average diameter of bead.
6. Estimation of Monod’s parameters µmax and ks
7. Demonstration ofBatch, Fed-batch reactors.
8. Production and estimation of ethanol from Glucose using S*acharomyces* *cerevisiae* in batch reactor using Taguchi method
9. Production of wine
10. Production and estimation of citric acid by *Aspergillus niger using* Taguchi method
11. Determination of BOD
12. Production and assay of antibiotic

**Course outcomes**

* Ability to demonstrate Extraction of commercially important enzymes from natural source
* Ability to demonstrate the quantification of enzyme activity and specific activity
* Ability to study the ffect of various parameters on enzyme activity, pH, temperature, enzyme and concentration of substrate
* Ability to demonstrate the Estimation of Michaelis - Menten parameters
* Ability to demonstrate the immobilization of cells using gel entrapment and calculation of average diameter of bead.
* Ability to demonstrate the Estimation of Monod’s parameters µmax and ks
* Ability to demonstrate Batch, Fed-batch reactors.
* Ability to Produce and estimation of ethanol from Glucose using S*acharomyces* *cerevisiae* in batch reactor using Taguchi
* Ability to demonstrate the Production of wine
* Ability to demonstrate the Production and estimation of citric acid by *Aspergillus niger*
* Ability to demonstrate the Determination of BOD
* Ability to demonstrate the Production and assay of antibiotic

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**B. Tech. III Year II semester**

**COMPREHENSIVE VIVA VOCE - II**

**CODE: 6G681 L T P/D C**

* **- - 1**

**Pre-Requisites:** None

**Course Objectives:**

Prepare students in basics and advanced relevant courses to revise and face technical interviews for enhancing employability**.**

**Course Outcomes: After completing this course, student shall be able to**

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| 1. Assess the relevant courses they have undergone till the completion of that academic year. |
| 1. Comprehend the concepts in the core subjects and the elective subjects, to make them ready to face technical interviews which improve their employability skills. |

There will be 100 marks in total with 25 marks of internal evaluation and 75 marks of external evaluation.

**Internal:**

Comprehensive Viva Voce is Conducted twice in a semester.

End examination : 75 Marks.

The end examination will be carried out by a committee consisting of an external examiner, head of the department, a senior faculty member and the supervisor.

**III Year II Semester (6G696) TECHNOLOGY LITERATURE REVIEW & SEMINAR - II**

**L T P/D C**

**- - 2 1**

**Pre-Requisites:** All Courses till this semester

**Course Outcomes:**

* Students identify a topic from the current technical topics of their choice in the computer science domain and the allied fields, after surveying in the internet resources, journals and technical magazines in the library.
* Student learnt to arrange the contents of the presentation and scope of the topic, in an effective manner.
* Each student then presents the technical topic they chose in front of the panel and the fellow students, using the oratory skills.
* Students also face the questions posed by the panel and the students and answer them.

There shall be a Technical Paper writing and seminar evaluated for 100 marks in Third Year Second Semester. The evaluation is purely internal and will be conducted as follows:

The faculty members In-charge of seminars must give model presentation and prepare model technical report to create good knowledge among the students before presentation and submission of the technical report.

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| **Sl.No** | **Topic** | **Marks** |
| 1 | Selection of topic and literature survey | 10 marks |
| 2 | Relevance, level of content and report with usual sub topics  (This sub topics -Summary, introduction , historical background , basic theory, detailed description, applications, conclusions and future scope) | 15 marks |
| 3 | Presentation | 20 marks |
| 4 | Discussion | 5 marks |
| 5 | Mid semester Viva ( after first mid test) | 20 marks |
| 6 | Final Viva | 20 marks |
| 7 | Attendance | 5 marks |
| 8 | Class notes | 5 marks |
| **Total Marks** | | 100 marks |

**IV Year I Semester**

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**(6G726) INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY**

**L T P/D C**

**3 1 - 3**

**Course Objectives:**

Understand the concepts and gain knowledge in the area of industrial and environmental biotechnology.

**UNIT I: PRODUCTION OF PRIMARY METABOLITES:** Bioprocess-overview, Organic acids -Citric acid, Lactic acid, Amino acids -Glutamic acid, Phenyl alanine, Alcohols –Ethanol, Strain improvement , Dual or multiple fermentation

**UNIT II: PRODUCTION OF SECONDARY METABOLITES:** Antibiotics-Penicillin, Streptomycin, Erythromycin, Vitamin B12

**UNIT III: ENZYMES AND RECOMBINANT PROTEINS:** Production and applications of Industrial Enzymes **-** Proteases, Amylases, Lipases, Cellulases. Enzymes in food and pharmaceutical industries; Production of recombinant proteins - Insulin, IL2, recombinant vaccines- Hepatitis

**UNIT IV: WASTEWATER TREATMENT:** Characteristics of wastewater, Primary treatment, Secondary and tertiary treatment, Aerobic treatment -Activated sludge process, Trickling filters, Anaerobic treatment -contact digesters

**UNIT V: BIOREMEDIATION:** Concept, Factors and types of bioremediation: *in-situ, ex-situ*, Phytoremediation, Solid and Liquid Phase bioremediation, Biotechnological applications of Hazardous waste management, Detoxification of toxic organics -phenols

**UNIT VI: ECO-FRIENDLY PRODUCTS:** Bioplastics –PHB, Polylactide (PLA) , Biofertilizers – *Rhizobium, Azatobacter, Azospirillum*, Phosphate solubilizing microorganisms, biopesticides – *Trichoderma, Bacillus thuringenesis*, Biofuels (biodiesel , biohydrogen)

**TEXT BOOKS:**

1. Biotechnology, 3rd edition by John E. Smith. Cambridge low price editions.
2. Industrial Microbiology - J. E. Casida
3. Environmental Biotechnology by S. K. Agarwal
4. Biodegradation & Bioremediation (1999), Martin Alexander, Academic press.

**REFERENCES:**

1. Microbiology: - Prescott and Dunn.
2. Microbial biotechnology: Glazer, A.N. and Nikaido, H. 1995 W.H. Freeman &Company, NY
3. Industrial Microbiology: - A. H. Patel.. Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R.,
4. General Microbiology McMillan Publications, 1989.
5. Environmental Biotechnology by S.N. Jogdand Himalaya Publishing
6. Environmental Microbiology 2001. Raina M. Maier, Ian L. Pepper, Academic Press.

**Course Outcomes:**

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| **CO: I** | Ability to gain knowledge in production of primary metabolites |
| **CO:II** | Ability to understand production of secondary metabolites. |
| **CO:III** | Ability to use enzymes and recombinant proteins. |
| **CO:IV** | Ability to characterize and treat waste water |
| **CO:V** | Ability to use remediation techniques to treat solid and liquid wastes |
| **CO:VI** | Ability to gain knowledge on sustainable products |

**IV year I Semester, B. Tech – Biotechnology**

**(6G727) DOWN STREAM PROCESSING**

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**L T P/D C**

**3 1 - 3**

**Course Objective:** This course aims to give insights into various downstream processing operations involved in biotechnology.

**UNIT I:** **INTRODUCTION:** Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high Value products)

**UNIT-II: SOLID-LIQUID SEPARATION-I.** Filtration, Centrifugation(types and equipments) methods. Recent development in product Isolation (for ex. one step purification, reverse micelle extraction)

**UNIT III: SOLID-LIQUID SEPARATION-II:** Cell disruption methods for intracellular products, removal of insoluble, biomass (and particulate debris) separation techniques, flocculation and sedimentation

**UNIT IV: CONCENTRATION OF PRODUCTS I:**

**Membrane-based separations** : micro, ultra filtration, hyper filtration, electrodialysis ,Dialysis and Hemodialysis

**Precipitation methods** (with salts, organic solvents, and polymers), Extractive separations, aqueous two-phase extraction, supercritical fluid extraction.

**UNIT V: CONCENTRATION OF PRODUCTS II:** Chromatographic techniques- Paper, TLC, Adsorption, Ion exchange, Gel filtration, affinity chromatographic separation processes, GC, HPLC.

**UNIT VI: ALTERNATIVE SEPARATIONS METHODS:** Crystallization, Pervaporation.Physical adsorption, Chemisorptions, adsorption isotherms, Single stage operation, fixed bed adsorption, Adsorption wave, Introduction to basics of sustainable bioprocessing: lifecycle analysis and disposable bioreactors

**TEXT BOOKS:**

1. Wankat PC. Rate controlled separations, Elsevier, 1990.
2. Belter PA and Cussler E. Bioseparations, Wiley 1985.

**REFERENCES:**

1. Product Recovery in Bioprocess Technology, BIOTOL.’ Series, VCH, 1990.
2. Asenjo J.M. Separation processes in Biotechnology, 1993, Marcel Dekkere Inc
3. M.R.Ladisch, Bioseparation engineering: Principles, Practice and Economics, Wiley Interscience 2001

**Course Outcomes:**

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| **CO:1** | Ability to solve Problems and requirements of bioproduct purification and Economics of downstream processing in Biotechnology |
| **CO:II** | Ability to understand Physico-chemical basis of bio-separation processes. |
| **CO:III** | Ability to understand Cell disruption methods and separation techniques. |
| **CO:IV** | Ability to understand Membrane-based separations , configuration , Precipitation methods in integrated bioprocessing. |
| **CO:V** | Ability to demonstrate Electrophoresis of proteins and nucleic acids, Chromatographic techniques- Paper, TLC |
| **CO:VI** | Ability to understand Dialysis, Crystallization Pervaporation, super liquid extraction foam based separation |

**IV year I Semester**

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**(6G728) ANIMAL BIOTECHNOLOGY**

**L T P/D C**

**3 1 - 3**

**Course Objective:**

Understand the characteristics of animal cell and understand the cell cycle and know the importance of various cell types and applications of animal cells

**UNIT I: ANIMAL CELL CULTURE AND MEDIA:** Introduction, Media-balanced salt solutions and simple growth medium, Role of serum, Serum and protein free media, cell growth factors, Equipments and materials for animal cell culture technology, Chemical, physical and metabolic functions of different constituents of culture medium – Over View

**UNIT II:** **ESTABLISHED CELL LINES:** Basic techniques, disaggregation of tissue-trypsinization, Primary and established cell lines, cell separation, Cryopreservation, Cell synchronization, cell transformation

**UNIT III: CELL VIABILITY AND TOXICITY:** Measurement of viability and cytotoxicity, Biology and characterization of the cultured cells, measuring parameters of growth, apoptosis and necrosis.

**UNIT IV: APPLICATIONS OF ANIMAL CELL CULTURE:** Applications of Animal cell culture- vaccines, Bio-therapeutics, Monoclonal antibodies, Stem cells –Types and applications, scaling up of animal cell culture.

**Unit V: EXPERIMENTAL & TRANSGENIC ANIMALS:** Concept of Transgenics, Production of transgenic animals - mouse, fish, Poultry, Generation of animal models for biomedical and pharmaceutical studies and limitations of animal models.

**UNIT VI: INDUCED ANIMAL BREEDING:** Introduction, artificial insemination, cloning, in-vitro fertilization and embryo transfer, nuclear transplantation, selective animal breeding.

**Text books:**

1. Culture of Animal Cells, (3rd Edition), F1. Ian Freshney, Wiley-Liss
2. Animal Cell Culture-Practical approach, Ed. John R.W.Masters, Oxford

**References:**

1. Cell Culture Lab Fax. Eds.M.Butler & M.Dawson, Bios Scientific Publications Ltd, Oxford
2. Animal Cell Culture Techniques, Ed. Martin Clynes, Springer
3. Methods in Cell Biology, vol 57, Animal Cell Culture Methods, Ed. Jenni P, Mather and David Barnes, Academic press
4. Cell Growth and Division: A Practical Approach. Ed R.Basega, IRL Press

**Course Outcomes:**

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| --- | --- |
| **CO:1** | Ability to understand basic aseptic techniques and use media for culture of animal cells |
| **CO:II** | Ability to understand Primary and established cell lines |
| **CO:III** | Ability to understand Measurement of viability and cytotoxicity |
| **CO:IV** | Ability to gain knowledge on applications of animal cell culture |
| **CO:V** | Ability to demonstrate the Concept of Transgenics |
| **CO:VI** | Ability to understand induced animal breeding techniques |

**IV year I Semester, B. Tech – Biotechnology**

**(6G729) MASS TRANSFER AND SEPARATIONS**

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**L T P/D C**

3 1 0 3

**Course Objective:** To gain knowledge in fundamentals governing mass transfer and the principles governing a range of separation processes such as absorption, distillation, liquid extraction and oxygen transfer to cells. Students apply the knowledge to the design and evaluation of the separation processes.

**UNIT I: PRINCIPLES OF MASS TRANSFER:** Introduction to Mass Transfer and Diffusion, Molecular diffusion in gases, Molecular diffusion in Liquids, Molecular Diffusion in Biological solutions and gels, Film theory.

**UNIT II: Mass transfer in Bioprocessing-I**: Introduction to Convective Mass Transfer, Types of Mass Transfer coefficients and relation between them. Analogy between momentum, heat and mass transfer; Oxygen uptake in cell cultures, factors affecting oxygen transfer in fermenters, measuring dissolved oxygen concentration, estimating oxygen solubility, mass transfer correlations for oxygen transfer

**UNIT III: Mass transfer in Bioprocessing-II:** Measurement of kLa, measurement of specific oxygen uptake rate, practical aspects of oxygen transfer in large fermenters, alternative methods for oxygenation without sparging, oxygen transfer in shake flasks

**UNIT IV: ABSORPTION**: Definition, Solubilities of gases in liquids, single stage (one component transferring) operation, Material balances, counter current multi stage operation continuous contact equipments.

**UNIT V: DISTILLATION**: Relative volatility, single stage equilibrium distillation, simple distillation, Rayleigh equation and steam distillation operation; continuous distillation, continuous multi stage tray towers, McCabe and Thiele Method, Graphical procedure to calculate number of trays (theoretical plates

**UNIT VI:** **LIQUID-LIQUID EXTRACTION AND DRYING**: Types of equilibrium system, Singe stage extraction, Multi stage cross and counter current operations. **Drying** theory, drying kinetics, mechanism of batch drying, various drying operations, Spray drier, Fluidized Bed drier, Pneumatic drier

**TEXT BOOKS:**

1. Robert E. Treybal, Mass Transfer Operations III Edition, Mc. Graw Hill International**.**
2. Christi J. Geankoplis, Transport process & Unit operations, Ill ed., Prentice Hall India Pvt. Ltd.

3. Pauline M Doran,” Bioprocess Engineering Principles”, Academic Press 2nd edition, 2013.

**REFERENCES:**

1. Judson King: Separation Processes, II Edition, Mc Graw Hill Chemical Engineering series.
2. Philip A. Schweitzer, Handbook of separation Techniques for chemical Engineering, III Edition, Mc. Graw Hill.
3. Philip C. Wankat Rate, Controlled separations, Chapman and Hall, 1985.

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| **Course** **Outcomes** | | **PO** |
| CO-I | To build basic knowledge in diffusion. Diffusion in different phases. Applications of diffusion in gels and biological solutions. | a |
| CO-II | Analyzes convective mass transfer, Interface mass transfer, oxygen uptake by the cells and resistances in it. | a, b |
| CO-III | Understands the mechanism of oxygen transfer in large fermenters and in shake flasks | c |
| CO-IV | Understands the basic mechanism of absorption. Application of absorption in Industries and able to design the absorption units. | c |
| CO-V | Simplifies the mechanism of distillation, its importance in process industry and able to design distillation column. | c, d |
| CO-VI | Determines the importance of liquid-liquid extraction and its application in chemical and biotechnology industry.Understands drying techniques and its applications. | b |

**IV Year I Semester, B. Tech – Biotechnology**

**(6G730) APPLIED VIROLOGY**

**(PROFESSIONAL ELECTIVE-III)**

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**L T P/D C**

**3 1 - 3**

**OBJECTIVE:** To gain knowledge about basic properties of virus its structure, cultivation and characterization of virues. Basic knowledge Plant and viruses their control mechanism

**UNIT I: INTRODUCTION TO VIROLOGY:** Brief outline of Discovery of Viruses; Properties of Viruses. Classification of viruses & nomenclatures.

**Unit II: STRUCTURE OF VIRUSES:** Morphology of Viruses- Structure, Capsid Architecture, Envelopes and peplomers; Genome- Structure and Types, Ultra structure and life cycles of Bacteriophages- M13, Mu, T3, T4 & lambda

**UNIT III: CULTIVATION OF VIRUSES:** General Methods of cultivation of viruses- in Embryonated eggs, cultivation of animal and plant viruses; Isolation and purification of viruses- plant viruses, animal viruses; Criteria of purity, Maintenance and preservation of infectivity

**UNIT IV: GENERAL METHODS OF CHARACTERIZATION OF VIRUSES:** Electron microscopy, X-ray crystallography, sedimentation, analysis; Enumeration viruses- By electron microscopy, plaque assay, acid end point method, Haemagglutinin assay; Detection of viruses- By serological characterization, detection of viral antigen, detection of viral nucleic acid;

**UNIT V:** **PLANT VIRUSES:** Symptoms of diseases caused by plant viruses (Morphological, Physiological and Histological); Ultra structure and life cycles of TMV and CaMV; transmission of plant viruses- Mechanical and biological (vector and non-vector); Basic control measures of plant diseases- vector and chemical control.

**UNIT VI: HUMAN VIRUSES:** Ultra structure and brief account on life cycles of RNA viruses- Polio, Influenza, Measles, Rota virus and HIV; Ultra structure and brief account on life cycles of DNA viruses- Vaccina, HSV, Adeno, SV40 and Hepatitis Virus; Viral vaccines-types and preparation of conventional vaccines.

**TEXT BOOKS**

1. Introduction to Modern Virology, Dimmock N J, Primrose S B, 4th edition, Blackwell Scientific Publications, Oxford.
2. Medical Virology, Morag C, Timbury M, Chrchill Livingstone, London
3. Functionals of Plant Virology, Mathews RE, academic Press, San Diego.

**REFERENCE BOOKS:**

1. Text Book on Principles of Bacteriology, Virology and Immunology, Edward Arnold, London.
2. An introduction to viruses, S B Biswas, Amita Biswas

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| **COURSE OUTCOME (CO)** | | **POs** |
| **CO:1** | To gain knowledge about classification and properties of virus | b, f |
| **CO:II** | Classify and illustrate the different types of Viral Structure | a |
| **CO:III** | To Understand general Methods of cultivation of viruses | d |
| **CO:IV** | To understand general methods of characterization of viruses | b, f |
| **CO:V** | To study various plant viruses and their life cycle | c |
| **CO:VI** | To study various Human viruses and their life cycle | b |

**(6G731) FOOD BIOTECHNOLOGY**

**(PROFESSIONAL ELECTIVE- III)**

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**L T P C**

**3 1 - 3**

**Course Objectives:**

To gain knowledge and understanding about food systems in the production,processing and consumption of food and an appreciation of their impact on society To have a knowledge and understanding about the nature of food and human nutrition and an appreciation of the importance of food to health To spread awareness in the community about the Science of Technology of food processing for use in the household and cottage sector.

**UNIT I**: **INTRODUCTION:** Objectives of Food science and Technology, Chemical, nutritional, and functional properties of carbohydrates (starch, cellulose, sugars, pectin, fibres (changes during processing) manufacture of maltodextrins and corn syrups, Cyclodextrins, lipids (omega-3 and omega-6 fatty acids and their nutraceutical significance) Rancidity.Proteins(Protein efficiency ratioPER).

**UNIT II: FOOD PRESERVATION:** Principles of food preservation: Physical (Blanching, Pasteurization, Freezing), Thermal death time, D-value, Z-value , Irradiated foods –Radappertization, Radicidation, and radurization of foods. Chemical : Benzoic acid and parabens, nitrites and nitrates, phenolics, antioxidants: BHA, BHT and biological methods: Bacteriocin, Nisin )

**UNIT III:FOOD MICROBIOLOGY** AND **FERMENTATIONS:** Probiotics, types of microorganisms associated with food –meats, seafood, Diary products. Factors affecting growth and survival of Microorganisms in foods. Fermented meat -sausages, Fisheries - Fish Sauses, vegetables-Sauerkaraut, Olives, Dairy products -cheese, beverages- wine, beer. Spoilage in Meats, Fish, Food -borne infections – Salmonellosis, shigellosis), Food intoxications – Botulism ,aflatoxins.

**UNIT IV: FOOD ADDITIVES AND ANALYSIS:** Pigments in food, Food Flavours and colours, Water activity measurements and its significance in food quality, Enzymatic methods of food analysis, Analysis of pesticides in foods, Analysis of heavy metals in food, analysis of phytosterols.

**UNIT V: FOOD PROCESSING:** Basic principles, unit operations-size reduction-hammer mill, ball mill, mixing –pan mixers ,masticators, blender. emulsification, centrifugation-tubular bowl centrifuge, disc bowl centrifuge ,Extraction, crystallization-vaccumcrystalizer.

**UNIT VI: QUALITY CONTROL:** Concept of quality: Quality attributes- physical, chemical, nutritional, microbial, and sensory; their measurement and evaluation. International quality systems and standards like HACCP.

**TEXT BOOKS**

1. Roger A., Gordan B., and John T., " Food Biotechnology ", 1989. 3.
2. George J.B., and John T., " Food Microbiology ", CBS Publishers & Distributors, 1987. 4th edition.
3. Frazier and D. C. Westhoff ,Food Microbiology, 4th ed., 1988..

**REFERENCES**

1. George, J. B., “Basic Food Microbiology”, CBS Publishers Distributors, 1987. 4th edition.
2. Lindsay, Willis Biotechnology, Challenges for the flavor and food Industries, Elsevier Applied Science, 1988.

**Course Outcomes**

1. Students shall be able to understand the principles of Food science
2. Students shall be gain knowledge and perform the methods of food preservation.
3. Students shall be able to identify the role of microbes in fermentation
4. Students shall be able to understand the role of food additives and methods to identify food adulterants
5. Students shall be understand the methods in food processing
6. Students shall be able to gain knowledge in the quality control

**IV Year I Semester, (6G732) ENZYME ENGINEERING**

**(PROFESSIONAL ELECTIVE-III)**

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**L T P/D C**

**3 1 - 3**

**Course Objectives:**

The aim of the course is to introduction to the basic properties of the enzymes, their production, isolation, purification, and immobilization. The course will provide theoretical knowledge necessary for an adequate understanding of the biochemical and biotechnological processes, and theoretical knowledge to work with enzymes and their application

**Unit I: Introduction to Enzyme Engineering**

Industrial Enzymes- their source, Isolation, characterization and their purification. Applications of enzymes in Industry, Medicine, Analytical Chemistry, Chemical, Pharmaceutical & Food Sectors. Specific activity, Turnover number. Basis of enzymatic reaction, collision theory and transition state theory

**Unit II: Enzyme Kinetics**

Kinetics of single substrate enzyme catalyzed reaction, equilibrium, steady state assumption - Michaelis-Menten (Briggs- Haldane) equation. Transformation of Michaelis- Menten equation. The Lineweaver Burk, Eadie-Hofstee and Hanes plots. Determination of Vmax, Km, Kcat, Specificity constant (Kcat/Km) and their significance.

**Unit III: Mechanism of Enzyme Catalysis and Inhibition**

Nature and conformation of active site. Functional groups which are essential for catalysis. Hydrolytic, covalent, acid-base, electrostatic and metal ion involved catalysis. Mechanism of enzyme action: Lysozyme, Carboxypeptidase, Chymotrypsin and Ribonuclease. Enzyme inhibition: Reversible inhibition-Competitive, Noncompetitive inhibition, Substrate inhibition, allosteric and irreversible inhibition. Feedback inhibition

**Unit IV: Immobilization of Biocatalysts**

Immobilization of biocatalysts an introduction, Electrostatic Effect, effect of charged and uncharged support, Effect of external and internal mass transfer,

**Unit V: Engineering of Enzymes**

The Goals of Protein Engineering, Classic and Modern Methods to synthesize proteins, Protein Engineering Using PCR, Examples of engineered proteins- insulin and Subtilisin

**Unit VI: Modern concepts in Enzymology**

Modern concepts of evolution of catalysis – catalytic RNA (Ribozymes), Abzymes (catalytic antibodies), Design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

**TEXT BOOKS:**

1. Blanch HW and Clark DS: Biochemical Engineering Marcel Decker - 1987.
2. Enzymes by palmer
3. Blanch HW and Clark DS: Biochemical Enginering, Marcel Decker

**REFERENCES:**

1. Bailey JE, Ollis, DF: Biochemical Engineering Fundamentals
2. Schugerl K., Bellgart KH (Eds): Biorection Engineering, modeling and control: Springer-Verlag, Berlin
3. Wiseman, A: Handbook of Enzyme Biotechnlogy, 3rd Edition, Ellis Horwood Publication
4. Moser, A: Bioprocess technology, kinetics and reactors: Springer Verlag

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| **Unit wise Course Outcomes** | **POs** |
| Students will be able to   1. Define and understand the nomenclature, classification, applications of the enzymes. 2. Understand the kinetics of enzyme reactions including different models 3. Apply enzyme catalysis and Mechanism of enzyme action in different enzyme systems and understand inhibition kinetics. 4. Explain the effect of Temperature and PH dependence of rate constants. 5. Understand Pre-steady–state kinetics of enzymes. 6. Explain kinetics of immobilized enzymes, effect of external and internal mass transfer | a,b  c,e  a,b,c  b,c  b,c  c,f |

**IV year I Semester (6G733) ADVANCED BIOPROCESS CONTROL**

**(Professional Elective - III)**

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**L L T P/D C**

**3 1 - 3**

**Course Objective**: This course aims at providing advanced knowledge about different types of stability criteria to determine system stabilty in bioprocess industries. It also aims to provide an insight into basics of multi loop control systems.

**UNIT-I :** Review of single input single out put (SISO) systems, Routh stability criteria & Qualitative analysis of Bode and Nyquist stability.

**UNIT-II:** Feedback control system with large dead time, dead time compensation, control of systems with inverse response

**UNIT-III :** Multiloop control systems, Cascade control, Selective control systems, Split Range control

**UNIT-IV:** Logic of feed forward control, Problem of designing feed forward control, Feed forward-Feedback control, ratio control

**Unit-V**: Adaptive control, self adaptive control, Inferential control with case study of a distillation column

**Unit VI:** Design questions for MIMO control systems,Degrees of freedom and number of controlled and manipulated variables,Generartion of alternative configurations

**TEXT BOOKS:**

1. Stephanopoulos, “Chemical Process Control -An Introduction to theory & Practices” PHI, 2010

**REFERENCE BOOKS:**

1. Babatunde, O. and Ray W.H., “Process Dynamics, Modeling and Control”., Oxford University Press, 1994.
2. Seborg, D.E., Edgar, T.F and. Mellichamp, D.A, “Process Dynamics and control,” Wiley, 2006.

**Course Outcomes:**

|  |
| --- |
| Ability to understand SISO and stability criteria |
| In this unit student will learn about feedback control systems in detail |
| Ability to understand multi loop control systems with some examples |
| Ability to demonstrate and design equations for feed forward control systems |
| Ability to understand adaptive control and inferential control with distiallation column as case study |
| Ability to design questions for MIMO control systems |

**(IV year I Semester, B. Tech – Biotechnology**

**(6G734) Nanomaterials in Medical Applications**

**(Professional Elective - III)**

**Unit-I: Nanotechnology in pharmaceutical applications:**

overview – developmental prolog - principle of development – neurophysiology – sensory physiology and muscle physiology - trends in nanobiotechnology - protein- and peptide-based compounds for cancer, diabetes, infectious diseases and organ transplant- therapeutic classes- focused pharmaceutical delivery systems.

**Unit-II: Immunoassay techniques:** understanding of antibody-based diagnostic techniques (immunoassay) - micro- and nano-immunosensors- bio-barcode assay- use of magnets, gold, DNA and antibodies- therapies and diagnostics for cancer and central nervous system disorders

**Unit-III: Improved Medical Diagnostics-I:** improved diagnostic products and techniques- i*n vivo* imaging capabilities by enabling the detection of tumors, plaque, genetic defects and other disease states-ability to control

**Unit-IV: Improved Medical Diagnostics-II:** Manipulations on the atomic scale- nanobot medical devices- logic and intelligence embedded into medical devices- stand alone sensing and computing devices.

**Unit-V: Prosthetic and medical implants:** New generation of prosthetic and medical implants- artificial organs and implants- artificial scaffolds or biosynthetic coatings- biocompatibility and reduced rejection ratio- retinal, cochlear, and neural implants, repair of damaged nerve cells, and replacements of damaged skin, tissue, or bone.

**Unit-VI: Methods for diagnosis:** Animation of the PCR-DNA profiling-cantilever sensors - targeted drug delivery-magnetic nanoparticles-cancer cell targeting-stem cell scaffolds - electrochemical impedance spectroscopy (ESI) - tethered lipid membranes

**Reference Books:**

1. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester: 2002.
2. Biosensors and modern biospecific analytical techniques, Wilson & Wilson’s Comprehensive Analytical Chemistry; Ed. L Gorton; Elsevier, Amsterdam, London; 2005.
3. The Immunoassay Handbook; Ed. David Wild; 3rd ed.; Amsterdam: Elsevier; 2005.
4. Electrochemical Methods: Fundamentals and Applications; Allen J Bard and Larry R Faulkner; Wiley, New York, Chichester: 2nd ed.; 2001.
5. Ultrathin Electrochemical Chemo- and Biosensors: Technology and Performance in Springer Series on Chemical Sensors and Biosensors; Volume Two; Ed. Vladimir M. Mirsky; Springer, Berlin; 2004

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | To have basic introductory knowledge about application of nanotechnology in pharmaceuticals |
| **CO:II** | To acquire knowledge about the immunoassay Techniques |
| **CO:III** | To acquire knowledge about novel and improved techniques for detection of tumors, plaque, genetic defects and other disease states-ability to control |
| **CO:IV** | To acquire knowledge about nanobot medical devices- logic and intelligence embedded into medical devices- stand alone sensing and computing devices. |
| **CO:V** | To acquire knowledge about novel and improved techniques Prosthetic and medical implants |
| **CO:VI** | To acquire knowledge about novel and improved methods for diagnosis using PCR and electrochemical impedance spectroscopy |

**IV Year I Semester, B. Tech – Biotechnology**

**(6G735) CANCER BIOLOGY**

**(PROFESSIONAL ELECTIVE- IV)**

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**L T P/D C**

**3 1 2 3**

**OBJECTIVE**

To gain knowledge in biological phenomenon of cancer, molecular mechanism of carcinogenesis, treatment and techniques involved, and to facilitate students to conduct investigations using research based knowledge and methods and find modern biotechnology engineering solutions to combat cancer.

**UNIT I: FUNDAMENTALS OF CANCER BIOLOGY:** Nomenclature of cancer, classification of human cancers, Epidemiology of Human cancer. Various causes of Cancer- carcinogens, genetic susceptibility

**Unit II: MUTATION AND CANCER**: Regulation of cell cycle, modulation of cell cycle in cancer, mutation that cause change in signal molecules, effect on receptor, signal switches, tumor suppressor genes

**UNIT III: PRINCIPLES OF CARCINOGENESIS:** Types of chemical carcinogens, Chemical Carcinogenesis, Targets of Chemical Carcinogenesis. Physical carcinogenesis, mechanism of radiation; Carcinogenesis. Role of viruses in cancer, role of diet in cancer, cancer stem cells

**UNIT IV: ONCOGENES**: Oncogenes / Proto oncogene, identification and detection of Oncogenes, Retroviruses and Oncogenes, Growth Factor and Growth Factor receptors that are Oncogenes.

**UNIT V: PRINCIPLES OF CANCER METASTASIS:** Angiogenesis and its role in metastasis significances of invasion, three-step theory of Invasion, basement Membrane disruption, role of proteinases in tumour cell invasion., heterogeneity of metastatic phenotype, steps in metastatic cascade

**UNIT VI: CANCER DETECTION AND THERAPY**: Various methods used for detection of cancers, Advances in Cancer detection., new molecules for cancer therapy- Different forms of therapies for cancer- chemotherapy, radiation therapy, and immuno therapy their advantages and limitations.

**TEXT BOOKS**

1. L. M. Franks, N. M. Teich. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical Publications, 1991.
2. Robert A Weinberg, The Biology of Cancer, Garland Science, 2010
3. Robin Hesketh, Introduction to Cancer Biology, Cambridge University Press, 2013

**REFERENCE:**

1. Dunmock N.J and Primrose. S.B., Introduction to modern Virology, Blackwell publications.
2. Cancer: Principles and Practice of Oncology, 9th Edition, Vincent T. DeVita, Jr., Theodore S. Lawrence, Steven A. Rosenberg, Lippincott Williams and Wilkins, 2011

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| **UTCOME (CO)** | | **POs** |
| **CO:1** | Classify different types of cancer and assess various causes attributed to cancer | b, f |
| **CO:II** | To determine various types mutations which causes cancer | a |
| **CO:III** | To determine the role of chemical , Physical and Biological carcinogens and demonstrate their cancer causing ability | d |
| **CO:IV** | To understand the role of oncogenes in cancer development | b, f |
| **CO:V** | To have an elaborate understanding about cancer invasion and metastasis | c |
| **CO:VI** | To compare various detection methods and therapies available for cancer | b |

**IV Year I Semester, (6G736) Molecular Markers & Crop Improvement**

**(PROFESSIONAL ELECTIVE- IV)**

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**L T P C**

**3 1 2 3**

**Unit I: Plant Biotechnology for crop improvement:** Conventional plant breeding strategies, Hybridization, Inbred lines, Pure lines, Heterosis. Genetic Engineering of crops for useful agronomic traits for male sterility, food quality, improved crop productivity and molecular farming.

**Unit II: Molecular markers:** Random amplified polymorphic DNA (RAPD), Restriction fragment length polymorphism (RFLP), Amplified fragment length polymorphism (AFLP), Simple sequence repeats (SSR), Inter Simple sequence repeats (ISSR), Single strand conformation polymorphism (SSCP) and Quantitative trait loci (QTLs)

**Unit III: Molecular markers for crop improvement:** Marker assisted selection (MAS), Construction of molecular maps in plants, Map based Cloning**,** Molecular maps and their utility in plant genomics, Advantages and limitations of molecular markers.

**Unit IV:Molecular Biology of Plant Processes:** Discovery / Cloning of Plant Genes: Probe based screening, Genomic and proteomic approaches, Expressed Sequenced Tags, Developmentally regulated genes

**Unit V: Transgenic Crops I:** Secondary metabolites, increase in productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake efficiency, Metabolomics, post harvest technology, strategies for enhancing nutritive value of crops, introduction to male sterility for hybrid seed production

**Unit VI: Transgenic Crops II:** Plants as bioreactors, chloroplast transformation transgenic plants for quality improvement of protein, lipid & carbohydrate content, phytoremediation of contaminated soils, Risks and benefits of release of GM crops. Regulation of research and development of transgenic plants.

**TEXT BOOKS:**

1. Biochemistry & Molecular Biology of Plants (Buchanan, BB, Gruissem, W & Jones, R.L eds.) 2000
2. Molecular Plant Breeding, Yunbi Xu, CABI Publishers, I edition, 2010 (ISBN-13: **978-1845933920)**

**REFERENCES**

1. Principles of Plant Genetics and Breeding,George Acquaah, Blackwell-Wiley Publishers, I Edition, 2006 (ISBN-13: **978-1405136464)**
2. Plant Molecular Breeding- Sheffield Biological Series, H. John Newbury, Blackwell Publishers, 2003 (ISBN-13: **978-0849328138)**

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| **Unit wise Course Outcomes** | **POs** |
| **Students will be able to** |
| 1. Compare the conventional versus modern plant breeding methods | a,b, |
| 1. Understand the types and importance of molecular markers | a,b |
| 1. Describe application of Molecular markers in crop improvement | a,b |
| 1. Understand the molecular biological aspects of plant processes | a,b,c |
| 1. Understand and Explain various strategies for production of transgenic crops | a,b,c,e |
| 1. Understand and differentiate various transgenic crop production platforms, explain the risks associated with them and safety measures to be employed | a,c,e |

**IV year I Semester, B. Tech – Biotechnology**

**(6G737) COMPUTATIONAL MOLECULAR BIOLOGY**

**(PROFESSIONAL ELECTIVE-IV)**

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**L T P/D C**

**3 1 2 3**

**UNIT I: INTRODUCTION TO COMPUTATIONAL MOLECULAR BIOLOGY:** Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics.

**UNIT II**: **SEQUENCE-BASED DATABASE SEARCHES:** BLAST and FASTA algorithms, various versions of basic BLAST and FASTA, Use of these methods for sequence analysis including the on-line use of the tools and interpretation of results.

**UNIT III: GENE PREDICTION:** Prediction of Genes, Promoters, splice sites, regulatory regions, prokaryotic and eukaryotic genomes, Homology based gene prediction. SNPs and applications. EST approach.

**UNIT-IV MICRO ARRAYS:** Basics of Micro array, DNA micro array, understanding of micro array data and correlation of gene expression data to biological processes and computational analysis tools.

**UNIT V: PROTEIN STRUCTURE PREDICTION:** Secondary structure prediction methods, Algorithms of Chou Fasman, GOR methods; concepts in measuring the accuracy of predictions (Q3). Protein homology modeling, Protein threading. Protein ab initio structure prediction.

**UNIT VI: MOLECULAR DOCKING:** Methods of Docking – Flexible and Rigid Docking, Docking algorithms – Genetic algorithm, QSAR overview and its significance in Docking

**TEXT BOOKS:**

1. David W Mount. Bioinformatics- Sequence and genome analysis. CSHL Press.
2. Jonathan Pevsner. Bioinformatics and Functional Genomics. A Jhon Wiely & Sons, Inc., Publication

**REFERENCES:**

1. Moody P C E and A J Wilkinson. Protein Engineering, IRL Press.
2. Creighton T E, Proteins. Freeman W H. Second Edition 1993.
3. Brandon and Tooze – Proteomics

**IV year I Semester, B. Tech – Biotechnology**

**(6G738) BIOPROCESS ECONOMICS & PLANT DESIGN**

**(Professional Elective - IV)**

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**L L T P/D C**

**3 1 2 3**

**Course objective:** This course aims to provide knowledge about basic concepts in Interest, capital investment tax and depreciation and provides an insight into capital, overhead and manufacturing costs estimation. The course is designed to give an understanding of process design development and general design considerations. To give insight about various types of valves, pumps, steam traps, spurges and impellers used in biotech industries

**UNIT-I ECONOMIC EVALUATION**

Capital cost of a project; Interest calculations, nominal and effective interest rates; basic concepts in tax and depreciation; Measures of economic performance, rate of return, payout time; Cash flow diagrams; Cost accounting-balance sheet and profit loss account; Break even and minimum cost analysis.

**UNIT- II BIOPROCESS ECONOMICS**

Bio-Products regulations; Economic analysis of bioprocess; Capital, overhead and manufacturing costs estimation; Case studies of antibiotics (Penicillin and Streptomycin), recombinant products, single cell protein, anaerobic processes and other fine chemicals.

**UNIT- III INTRODUCTION TO PLANT DESIGN**

Process design development: design procedures, design information and flow diagrams, material and energy balances, comparison of different process and design specifications;

**UNIT- IV OPTIMIZATION**

Optimization; General design considerations: Health and safety hazards, Environment protection, plant location and plant layout, plant operation and control

**UNIT- IV BASIC DESIGN PROBLEMS**

Design examples on continuous fermentation, aeration, and agitation; Design calculation of filter for air sterilization; Design of batch and continuous sterilizers; Design calculations for immobilized enzyme kinetics; Practical considerations in designing of Bioreactor/Fermentor construction.

**UNIT- V**

Introduction to different types of valves, pumps, steam traps, spargers and impellers used in fermentation industries; Design exercise on trickle flow fermentor; Problems associated with design equations.

**Text Books:**

1. Plant Design and Economics for Chemical Engineers, 5/e

Max S. Peters, Ronald E. West, (2003) McGraw-Hill Higher,

1. Biochemical Engineering -Humphrey, A. E.; Millis, JSTOR 1966.
2. Biochemical Engineering, by Harvey W. Blanch, Douglas S. Clark CRC; 1st edition (1997).
3. Biochemical Engineering Fundamentals by James; Ollis, David F. Bailey,1977, McGraw-Hill.

**Suggested Reading:**

1. Biochemical Engineering and Biotechnology Handbook by Bernard Atkinson, FerdaMavitunaGrove's Dictionaries; 2 edition (1992).
2. Bioprocess Engineering:Basic Concepts. Michael L. Shuler / FikretKargi, Reihe:Prentice ,(2001) Hall.
3. Plant Design and Economics for Chemical Engineers” by M. Peters and K. Timmerhaus, McGraw-Hill.
4. Bioprocess and Biosystems Engineering Dirk Weuster-Botz, ISSN: 1615-7591 Journal no. 449, Springer.

**Course Outcomes:**

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| --- | --- |
| **CO : I** | Be able to carry out interest calculations and prepare balance sheets for business transactions. |
| **CO : II** | Be able to determine the economic analysis of bioprocesses. |
| **CO : III** | Carry out cost estimations for different industrial productions. |
| **CO : IV** | Develop process design, flow diagrams. |
| **CO : V** | Be able to design filters for air sterilization, batch and continuous sterilizers, valves etc.. |
| **CO : VI** | Able to understand different types of valves, pumps, steam traps, spargers and impellers used in fermentation industries; |

**IV year I Semester, B. Tech – Biotechnology**

**(6G739) NANOTOXICOLOGY (PROFESSIONAL ELECTIVE-IV)**

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**L T P/D C**

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**Unit-I: Introduction:** Concept of Toxicology, dose-response curve, nanotoxicology laboratory models: cells, fish, rodent studies – Ecotoxicologic studies and nanotoxicology testing

**Unit-II: Mechanisms of toxicity:** Mechanism of nanosize particle toxicity - reactive oxygen species, role of oxidative stress - mechanisms and health effects - interactions of nanoparticles with cells and their impact on cells-cytotoxicity, apoptosis and necrosis.

**Unit-III: Fate of nanomaterials in the environment:** Sources, fate and environmental transport of nanomaterials in air, water and soil

**Unit-IV: Human exposure to nanosized materials:** Toxicology of airborne – manufactured nanomaterials in the environment, biological activities of nanomaterials **-** respiratory tract – efficient deposition of inhaled NSPS- cytotoxicity of ultrafine particles

**Unit-V: Translocation of nanosized materials:** Deposition of nsps in the respiratory *-*epithelium translocation – translocation to the circulatory system - neuronal uptake and translocation **-**translocation of nsps in the blood circulation to bone marrow in mice - studies of neuronal translocation of ufps from respiratory tract -exposure via GI tract and skin

**Unit-VI: Risk assessment:** Portals of entry and target tissue – risk assessment – ethical – legal and social implications–development of test protocols for nanomaterials – regulation of engineered nanomaterials in Europe and USA

**Text books**

1. Yuliang Zhao and Hari Singh Nalwa, ‘Nanotoxicology: interactions of nanomaterials with biological systems, American Scientific Publishers, 2007
2. "Nanotoxicology - interactions of nanomaterials with biological systems", ED. Yuliang Zhao and Hari Singh Nalwa, June 2006
3. “Nanoscience and Nanotechnology Environmental and Health impacts” by Vicki H. Grassian Wiley Publishers, 2008.

**Reference books**

1. E. P. Widmaier, H. Raff, K.T. Strang, vander, sherman and luciano, ‘Human physiology: the mechanisms of body. functions’, 9th edition, mcgraw hill, new york, 2004
2. Gunter oberdörster, eva oberdorster and jan oberdorster, *Environmental health* *perspectives*, volume 113 number 7 , july 2005
3. D. Drobne, ‘Nanotoxicology for safe and sustainable nanotechnology’, 58, pp. 471-478, december 2007
4. Monteiro-Riv, ‘Nanotoxicology: characterization, dosing and health effects’, Informa healthcare publishers, 2007

**Course outcome**

1. Outlines the basic concepts of toxicity dose-response curve, nanotoxicology laboratory models
2. Ability to have knowledge about Mechanism of nanosize particle toxicity - reactive oxygen species, role of oxidative stress
3. To have basic understanding about Sources, fate and environmental transport of nanomaterials in air, water and soil
4. Ability to have knowledge basic Toxicology of airborne – manufactured nanomaterials in the environment, biological activities of nanomaterials
5. Ability to knowledge about Translocation of nanosized materials.
6. Explains the different regulation of engineered nanomaterials in Europe and USA

**IV year I Semester, B. Tech – Biotechnology**

**(6G782) DOWN STREAM PROCESSING LABORATORY**

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**LL T P/D C**

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**OBJECTIVE**

To provide hands on practical training to extract different bioproducts and to characterize them for their biotechnological importance, and to enable the student to design and conduct experiment to isolate novel bioproducts which can be exploited in exploring the future biotechnology.

**Experiments:**

1. Sedimentation studies
2. Cell disruption using Homogenizer
3. Cell disruption using enzymatic method
4. Isolation of Chloroplasts and estimation of chlorophyll content using centrifugation
5. Precipitation of proteins using Ammonium sulphate
6. Reverse micellar extraction
7. Adsorption isotherms
8. Affinity chromatography
9. Extraction of lipid from microalgal sample
10. FAME analysis by Gas chromatography in given sample
11. Downstream processing of ethanol using distillation technique
12. Ion exchange chromatography

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | Ability to understand the principle of Sedimentation and calculation of terminal settling velocity |
| **CO:II** | Ability to be able to perform Cell disruption by various mechanical method . |
| **CO:III** | Ability to be able to perform Cell disruption by enzymatic method |
| **CO:IV** | Ability to understand Isolation of cell organelles using downstream processing techniques for ex: chloroplast and estimation of chlorophyll content |
| **CO:V** | Ability to demonstrate the mechanism of precipitation by salts like ammonium sulphate |
| **CO:VI** | Ability to demonstrate reverse micellar extraction |
| **CO:VII** | Abilty to understand the principle of adsorption kinetics and isotherms |
| **CO:VIII** | Ability to demonstrate Affinity Chromatography and to analyze the samples by spectrophotometry. |
| **CO:IX** | Ability to demonstrate extraction of lipid content from sample and quantification of the same |
| **CO:X** | Abilty to understand the operation of gas chromatography for estimating FAME in the lipid sample |
| **CO:XI** | Ability to perform distillation of ethanol from fermented broth and quantitative estimation by potassium dichromate method. |
| **CO:XII** | Ability to demonstrate Ion exchange Chromatography and to analyze the samples by spectrophotometry. |

**IV Year I Semester (6G783) ANIMAL BIOTECHNOLOGY LABORATORY**

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**L T P/D C**

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**Objective:** Understanding the principles of animal cell culture lab and its application.

1. Aseptic culture techniques in Animal cell culture
2. Visualization of Human Buccal epithelial cells in inverted Microscope
3. Media Preparation and Filter sterilization of RPMI 1640/ DMEM
4. Separation of serum from whole Blood
5. Isolation of Hepatocytes from chicken liver cells
6. Determination of cell number using haemocytometer
7. Cell viability Assay by FDA and Trypan blue, Cell Duplication time.
8. Cell Propagation And Passaging
9. Isolation of lymphocytes and establishment of primary cell culture
10. Primary culture technique for chicken embryo fibroblast
11. Evaluation of toxicity using mammalian cells/ *Danio rerio* (Zebra Fish)
12. Cryopreservation Technique

**References**

1. Freshney RI. 2005. Culture of Animal Cells. Wiley Liss.
2. Portner R. 2007. Animal Cell Biotechnology. Humana Press.

**EQUIPMENTS & FACILITIES:**

Phase contrast Microscope, Filtration Unit, CO2 Incubator, Bio safety cabinet

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| **S. No.** | **COURSE OUTCOMES** | **POs** |
| **1** | **Demonstrate** and **Make-use-of** Equipments & Facilities in Cell Culture Lab | **b, c, e, f, I, k** |
| **2** | **Learn** Techniques of Sterilization and **Establish** Aseptic environment | **b, c, e, f, I, k** |
| **3** | **Prepare** Tissue Culture Media and **Modify** it for further use | **b, c, e, f, I, k** |
| **4** | **Generate** monolayer and **Establish** cell lines | **b, c, e, f, I, k** |
| **5** | **Predict** and **Induce**  toxicity to established cell lines | **b, c, e, f, I, k** |
| **6** | **Isolate, Visualize** and **Detect** cell types | **b, c, e, f, I, k** |
| **7** | **Extract, Estimate** and **Compare** cell numbers | **b, c, e, f, I, k** |
| **8** | **Apply** *in vitro* Techniques to animal cell cultures | **b, c, e, f, I, k** |

**IV year I Semester, B. Tech – Biotechnology**

**PROJECT PHASE – I**

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**Code: 6G784 L T P/D C**

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**COURSE OBJECTIVES:**

1. to impart to students a flavor of design, innovation, experimentation and research in the field of Biotechnology.

2.to provide a solid foundation in core Biotechnology disciplines, critical thinking and problem-solving skills.

3.Through the academic program students also develop excellent written and oral communication skills, learn to work as a team and project management.

**COURSE OUTCOME:**

At the end of this course, Students will be able to

1. Identify a topic in advanced areas of Biotechnology.

2. Review literature to identify gaps and define objectives & scope of the work.

3. Generate and implement innovative ideas for social benefit

4. Learn presentation and writ up skills in the process of project report.

The B. Tech. project is a partial requirement for successful completion of the degree. It can be two types: Projects based on implementation of any application oriented problem, which will be more or less experimental in nature, and the others will be based on some innovative/ theoretical work.

This is aimed at the students to identify a project on which they are likely to continue for their project in final year second semester.

The evaluation of internal marks consist of

Day to day progress of the work 20 marks

Mid Semester presentation 20 marks

Report submission 20 marks

Final Presentation and Defense before a departmental

Committee consisting of head, a senior faculty and supervisor 40 marks

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100 marks

There shall be no external evaluation in pre-project seminar.

**IV year I Semester, B. Tech – Biotechnology**

**(6G785) INDUSTRY ORIENTED MINI PROJECT**

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**L T P/D C**

**- - - 2**

**Course Objective :**

To enhance the knowledge on selecting a projcet , learn related tools and enhance programming and communication skills for employabilty.

**Pre-Requisites:** All Courses till this semester

**Course Outcomes: After completing this course, student shall be able to**

* Use the concepts learned in the courses, so far, in conceptualizing, designing and executing the modules of the projects.
* Exhibit the interest in learning the modern tools and technologies through the bridge courses arranged in the college, beyond the curriculum,
* Inculcate an enthusiasm to use the creative ideas to build the innovative projects which are meeting the current needs of the market and society as a whole.
* Improve their communicative skills and team skills largely improve.
* Work as an individual and in a team.

A group project shall be carried out by a group of students consisting of 2 to 3 in number in third year first semester. This work shall be carried out under the guidance of the faculty assigned as internal guide and shall involve design, fabrication, software development or any other significant activity. This can be of interdisciplinary nature also.

There will be 100 marks in total with 25 marks of internal evaluation and 75 marks of external

The **internal evaluation** shall consist of:

Day to day work : 10 marks

Report : 05 marks

Demonstration / presentation : 10 marks

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25 marks

End examination : 75 Marks.

The end examination will be carried out by a committee consisting of an external examiner, head of the department, a senior faculty member and the supervisor.

**IV year I Semester, B. Tech – Biotechnology**

**(6G797) TECHNOLOGY LITERATURE REVIEW & SEMINAR - III**

**L T P/D C**

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**Pre-Requisites:** All Courses till this semester

**Course Outcomes: After completing this course, student shall be able to**

* Identify a topic from the current technologies of their choice in the Biotechnology domain and the allied fields, after surveying in the internet resources, journals and technical magazines in the library.
* Arrange the contents of the presentation and also write the report of the research paper..
* Present the technical topic in front of the panel and the fellow students, using the oratory skills and also submit the report of the research paper.
* Interact through answering the questions and also can add some points to the seminar

There shall be a Technical Paper writing and seminar evaluated for 100 marks in Third Year First Semester. The evaluation is purely internal and will be conducted as follows:

Content : 20 marks

Presentation including PPT : 20 marks

Seminar Notes : 10 marks

Interaction : 10 marks

Report : 25 marks

Attendance : 10 marks

Punctuality : 5 marks

Total 100 marks

**IV year II Semester, B. Tech – Biotechnology**

**6ZC02 MANAGEMENT SCIENCE**

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**L T P/D C**

**3 - - 3**

**Course Objective:** The course is aimed at giving the basics of management, its principles, practices and latest concepts for increasing the performance of engineering graduates in their respective fields.

**UNIT I INTRODUCTION TO MANAGEMENT:**

Management- Definitions, Levels of Management, Functions of management- Planning: types of planning, planning process; Organizing: Organizational Design and Structure, Staffing; Directing; Controlling: Basic control process- Fayol’s principles of Management - Taylor’s principles of scientific management- Maslow’s Motivational theory,.

**UNIT II INTRODUCTION TO OPERATIONS MANAGEMENT:**

Plant Location- need, factors; Plant layout – types , Methods of production, Techniques of Project Management - Network Analysis - Program Evaluation and Review Techniques (PERT), Critical Path Method(CPM) , Crashing of Simple Networks.

**UNIT III MATERIALS MANAGEMENT**:

Objectives of Material management, Inventory control- need for Inventory Control, ABC Analysis, Economic Order Quantity; Just In Time; Introduction to LSCM; Quality Control Techniques– Introduction to SQC, Inspection, ISO standards, Six Sigma.

**UNIT IV**

**(i) Human Resources Management**: Objectives of HRM, Challenges of HRM, HR Planning process HR functions and policies – Job Analysis, Recruitment, Selection, Training and Development, Performance Appraisal**.**

**(ii) Marketing Management**: Concept of Marketing, Functions, Marketing Mix, Product Life Cycle, Marketing Strategies, Channels of Distribution, Differences between products and services.

**UNIT V INTRODUCTION TO ORGANIZATIONAL BEHAVIOR:**

Definition, Nature and Scope of OB, Personality-determinants of Personality – Perception- Attitudes- Attribution theory- Johari Window and Transactional Analysis , Stress Management- factors and remedies

**UNIT VI STRATEGIC MANAGEMENT:**

**I**ntroduction to Strategic Management, Vision, Mission, Goals, Objectives, Environmental Scanning- PESTEL, SWOT Analysis, Competitive Advantage, Concept of Core Competence, PORTER’s five force model, types of strategies, Strategic formulation and Implementation.

**Books Recommended:**

* A R Aryasri: Management Science, Tata Mc Graw Hill

**Referencess:**

* Dr. Y. Satyanarayana: Management control systems in competitive environment,
* Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005
* Kotler Philip & Keller Kevin Lane: Market Management 12/e, PHI, 2005

**Course Out Comes:**

1. Outlines the significance of management, defines the basic concepts and applicability of management principles in changing paradigms.
2. Demonstrates the procedures of the work study method and work measurement, Project management.
3. Infers the need to understand the importance of materials management and quality control techniques.
4. Relates the knowledge of two functional areas of business, human resource management and marketing management.
5. Explains the different dimensions of behavior, personality, perception, attitudes overall to gain insights into organizational behavior.
6. Distinguish some aspects related to strategic planning and strategic implementation to gain competitive advantage over competitors.

**IV Year II Semester, B. Tech – Biotechnology**

**(6G840) CLINICAL TRIALS AND REGULATORY AFFAIRS**

**(PROFESSIONAL ELECTIVE-V)**

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**L T P/D C**

**3 - 3**

**OBJECTIVE**

To gain knowledge in clinical research, ethics and regulatory affairs and its application in the field of biotechnology

**UNIT I:** **INTRODUCTION TO CLINICAL RESEARCH:** Introduction to Drug Discovery and drug Development, Historical Perspectives of clinical Research: Nuremberg Code, Thalidomide study , Nazis Trials, Tuskegee Syphilis Study, The Belmont Report, The declaration of Helsinki, Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines

**UNIT II:** **ETHICS IN CLINICAL RESEARCH:**  Ethics in all aspects of health care, historical cases, negligence, Declaration of Helsinki and informed consent, Ethics committees, constitution and practices up-to-date cases: cloning, human embryos and IVF

**UNIT III: CLINICAL STUDY MANAGEMENT:** Documentation,Types ofAuditing, Audit criteria, Audit process, Responsibilities of stake holders in audit process, Audit follow-up, Audit monitoring and inspection, SOPs

**UNIT IV: REGULATIONS IN CLINICAL RESEARCH :** ICH GCP guidelines , Clinical Research regulations in India – CDSCO guidelines, USFDA regulations to conduct drug studies, Data protection Act and Regulations relating to electronic signatures

**UNIT V:** **INTRODUCTION TO DRUGS AND COSMETIC ACT:**  Aims, objectives, import of drugs, manufacturing of drugs, sale of drugs, labeling and packing of drugs. Patents, Investigational New Drug (IND), New Drug Application (NDA), Abbreviated new Drug Application (ANDA) Submissions

**UNIT VI: REGULATORY AUTHORITIES AND THEIR APPROVAL:** Introduction to FDA, WHO, Schedule Y and its amendments, Hierarchy and working flow of FDA in India, Roles of DCGA and CDSCO in drug control, Clinical trial approval by Drug Controller General of India (DCGI)

**TEXT BOOKS:**

1. Good Clinical Practices, Central Drugs Standard Control Organization, Govt of India
2. Drugs and Cosmetics Act, 1940

**REFERENCES:**

1. International Clinical Trial, Volume 1&2, Dominique P.Brunier and Gerhardt Nahler, Interpharm Press, Colorado
2. Code of Federal Regulations by USFDA-Download
3. ICH-GCP Guidelines-Download

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| **COURSE OUTCOME (CO)** | | **POs** |
| **CO:1** | Demonstrate fair understanding of Origin and Principles of International Conference on Harmonization | d |
| **CO:II** | To able to discuss ethical issues related to clinical research | g h |
| **CO:III** | To demonstrate fair understanding of clinical auditing | i, k |
| **CO:IV** | To able to appraise of various Clinical Research regulations in India and abroad | h |
| **CO:V** | Demonstrate fair knowledge about Indian Drug and cosmetic act | h |
| **CO:VI** | Explain about various regulatory authorities and their procedures for approvals | h |

**IV Year II Semester**

**(6G841) BIOPHARMACEUTICAL TECHNOLOGY**

**(Professional Elective-V)**

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**L T P/D C**

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**OBJECTIVE**

To understand the process of development of biopharmaceutical products such as polypeptide based therapeutic agents, nucleic acid based drugs, neutraceuticals, and antibiotics, and to gain knowledge in designing and developing new drugs using modern engineering and IT tools, softwares and equipment.

**Unit I: Introduction to Pharmaceuticals**- History & Definition of Drugs. Sources of Drugs- Plant, Animals Microbes and Minerals different dosage forms. Routes of drug administration.

**Unit II: Pharmacodynamics**- Definition, Physico-Chemical Principles, Pharmacodynamics- Mechanism of drug action, drug receptors, and Physiological receptors: structural and functional families.

**Unit III: Pharmacokinetics**- Drug absorption, factors that affect the absorption of drugs, Distribution of drugs, Biotransformation of drugs, Bioavailability of drugs.

**Unit IV: Drug manufacturing processes -** Good manufacturing practices, manufacturing facilities, sources of Biopharmaceuticals, Analytical for biopharmaceuticals -Physicochemical and bioanalytical considerations. Quality assurance and control- storage and stability of biotech products

**Unit V: Crude Drugs from natural sources** - Cultivation, Collection, Processing and storage of crude drugs: Factors influencing cultivation of medicinal plants. Adulteration of crude drugs and their detection by microscopic, physical, chemical and biological methods. An introduction to active constituents of drugs: classification and properties.

**Unit VI: Drug Targeting Organ-Specific Strategies:** Basic concepts and novel advances, Brain-specific drug targeting strategies, pulmonary drug delivery, Cell specific drug delivery

**Text books:**

1. Pharmaceutical Biotechnology; Oliver Kayser, Rainer H. Müller, Wiley Publishers, 2005.
2. Drug Discovery and Clinical Applications; Heinrich Klefenz, 2002.
3. Industrial Pharmaceutical Biotechnology, WILEY-VCH Publication, Germany. Daan
4. Pharmaceutical Biotechnology; Tailor and Francis Publications, Newyork. Jay P Rho, Stan G Crommelin, Robert D Sindelar, 2002. Louie, 2003, Hand.

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| **COURSE OUTCOME (CO)** | |
| **CO:1** | Classify different types of Sources of drugs and Route of administration |
| **CO:II** | To understand various aspects of Pharmacodynamics |
| **CO:III** | Ability to understand various aspects of pharmacokinetics |
| **CO:IV** | Ability to understand various aspects of Drug manufacturing process |
| **CO:V** | To have an elaborate understanding about Cultivation, Collection, and storage of crude drugs |
| **CO:VI** | To understand various aspects of Drug targeting and cell specific drug delivery |

**IV year I Semester, B. Tech – Biotechnology**

**(6G842) BIOREMEDIATION AND METAGENOMICS**

**(Open Elective - V)**

**Course Objective**: is to introduce the use of living organisms such as plants and microbes or their systems to the treat contaminants. In addition, the course is expected to develop an efficient, eco-friendly and economical novel alternative treatment technologies.

UNIT I BIOREMEDIATION

Introduction to Bioremediation: Types of Bioremediation, Factors affection Bioremediation Limitations of Bioremediations. Microbes and enzymes for Bioremediation, Microbial Adaptation for Adverse conditions. Metabolic process involved in bioremediation.

UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

UNIT III NUCLEAR WASTE BIOREMEDIATION Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research.

UNIT IV ENVIRONMENTAL GENOMICS Environmental Metagenomics – Introduction; Molecular fingerprinting techniques (RFLP, T-RFLP, ARISA, DGGE, rDNA library, and FISH); Stable isotope probing (SIP); Suppressive subtractive hybridization (SSH); Differential expression analysis (DEA); Microarrays & Metagenome sequencing; Next-generation sequencing approaches to metagenomics

UNIT V. METAGENOMICS IN ENVIRONMENTAL STUDIES Application of Metagenomics to Bioremediation ; Applications of Metagenomics for Industrial Bioproducts; Escherichia coli host engineering for efficient metagenomic enzyme discovery;

UNIT VI METAGENOMICS CASE STUDIES Metagenomic analysis of soil microbial communities; Metagenomic analysis of marine microbial communities; Metagenome of the Microbial Community in Acid Mine Drainage ; Metagenomics and Its Applications to the Study of the Human Microbiome; Bioprospecting Novel Genes and Exploring New Concepts.

REFERENCES

1. Bruce E. Rittmann, Perry L. McCarty, “Environmental Biotechnology: Principles and Applications” McGraw-Hill, 2001.

2. Phillip L. Buckingham , Jeffrey C. Evans,” Hazardous Waste Management” Waveland Pr Inc; Reissue edition 1, 2010.

3. Martin Alexander, “Biodegradation & Bioremediation”, Academic press, 1999.

4. Karrely D., Chakrabarty K., Omen G.S, “Biotechnology and Biodegradation”, Portfolio Pub. Co., 1990. 6. P. Rajendran, P. Guansekaran, “Microbial Bioremediation”, Mjp Publishers, 2011.

5. Diana Marco Universidad Nacional de Cordoba, Argentina, “Metagenomics: Theory, Methods and Applications”, Caister Academic Press,2010 & 2011.

6. Joanna R. Freeland, Heather Kirk, Stephen Petersen, “Molecular Ecology”, Mc Graw Hill, 2nd Edition “2012.

7. Beebee T.J.C., D G. Rowe,” An Introduction to Molecular Ecology”, Mc Graw Hill, 2004.

**IV year II Semester, B. Tech – Biotechnology**

**(6G843) ADVANCED MASS TRANSFER AND SEPERATIONS**

**(Professional Elective - V)**

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**L T P/D C**

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**Course Objective:** The objective of this course is to provide an understanding of the nature of mass transfer mechanisms, models and their applications in solving different engineering problems.

**Unit-I: Distillation:** Fields of application, VLE for miscible liquids, VLLE for immiscible

liquids. Mc.cabe thiele method, optimum reflux ratio, plate efficiencies, principles

of extractive and azeotropic distillation.

**Unit-II: Multicomponent systems:** Equilibrium and simple distillation, Multi component flash

calculation and differential distillation, quantitative relationships.

**Unit-III: Binary multistage separations:** general graphical approach: straight operating lines,

curved operating lines, Processes without discrete stages, general properties of

y-x diagrams.

**Unit-IV: Liquid-liquid operations:** fields of applications of ternary liquid systems.

continuous contact extraction (Packed beds), equipment for liquid-liquid

extraction operation.

**Unit-V: Vapor, gas mixtures:** humidity, relative saturation. Wet-bulb and dry bulb

temperatures, Psychometric charts. Enthalpy of gas-vapor mixtures.

**Unit-VI: Leaching:** fields of application, Preparation of solids for leaching, types of

leaching. Single stage and multi stage leaching calculations. Unsteady state

operation equipment-Percolation tanks, shank system.

**Relevant Problems should be discussed wherever applicable.**

**Text books:**

1. King C.J., Separation processes, Tata McGraw Hill Book company, 2nd Ed., New Delhi, 1983.
2. Treybal R.E., “Mass Transfer operations” 3rd Edition, Mc.Graw Hill, 1980.

**Reference:**

1. Geankoplis C.J., “Transport processes and unit operations”, 4th Edition, PHI, 2006.

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| **Course** **Outcomes** | | **PO** |
| **CO-I** | Understands the importance and industrial applications of distillation and ables to design the distillation columns. | a,e |
| **CO-II** | Studies in detail about the process of distillation in multicomponent systems | a, b |
| **CO-III** | Understands the importance of separations processes, designs effective columns for separation based on x-y diagrams | d |
| **CO-IV** | Studies different equipments used in liquid-liquid operations, working of continuous contact equipments like packed beds. | d |
| **CO-V** | Understands indetail the characteristics of vapor and gas mixtures. | c, d |
| **CO-VI** | Student studies the fields of application of leaching,types of leaching, Percolation and shank systems. | b |

**IV year II Semester, B. Tech – Biotechnology**

**(6G844) NANOELECTRONICS MEMS and NEMS**

**L T P/D C**

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| **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** |
| **X** |  | **X** | **X** |  |  |  |  |  |  |  |

**Unit-I:** Biological building blocks: Sizes of building blocks and Nanostructures, Polypeptide nanowire and protein nanoparticles

**Unit-II:**  Nucleic Acids – DNA Double Nano wire, Genetic code and protein synthesis

**Unit-III:** Biological Nanostructures: Bio-mimicry with examples, Bio compatible Bio sensors, Examples of proteins, vesicles, bilayers, and Multilayer films, application of bio- nanotechnology: bio nano machines, molecular modeling.

**Unit-IV:** Applications to NEMS and Nano devices: Nano bio-sensors and biomedical applications involving drug delivery using implantable drug delivery devices with the emphasis on Biochips and nanoencapsulation, MEMS

**Unit-V:** organic semiconductors, biological neurons and their functions, modeling of neuron cells by VLSI circuits, bio-chemical and quantum mechanical computers: DNA computers, parallel processing, Bit and ‘Q’ bit, Quantum parallelism

**Unit-VI:** Nanoscale processes in the environment, Nano technology for Immune system, clinical imaging, nano robots, Nano Fibres for Tissue Engineering

**Text books:**

1. Bio Nano Technology by Good Sell, Wiley Liss
2. Introduction to Nanotechnology by Charles. P.Poole Jr and Frank J. Owens, Wiley India Pvt Ltd.
3. Nano Technology, A gentle introduction to the next big idea by Mark Ranter and Daniel Ranter, Pearson education
4. Nanotechnology – science, innovation and opportunity by Lynn E Foster, Prentice Hall - Pearson education

**Reference books:**

1. Encyclopedia of Nanotechnology by H.S.Nalwa
2. Encyclopaedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy (Vol I to X), Campus books.

**Course outcome**

1. Outlines the basic concepts of Sizes of building blocks and Nanostructures, Polypeptide nanowire and protein nanoparticles
2. Ability to have knowledge about DNA Double Nano wire, Genetic code and protein synthesis
3. To have basic understanding about Bio-mimicry with examples, Bio compatible Bio sensors,   
   Ability to have knowledge applications to NEMS and Nano devices: Nano bio-sensors and biomedical applications involving drug delivery using implantable drug
4. Ability to knowledge about : DNA computers, parallel processing, Bit and ‘Q’ bit, Quantum parallelism
5. To have a Basic Understanding about Nano technology for Immune system, clinical imaging, nano robots, Nano Fibres for Tissue Engineering

**IV year II Semester, B. Tech – Biotechnology**

**(6G886) PROJECT PHASE - II**

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| **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |  | **x** |  |

**L T P/D C**

**- - 20 12**

**Pre-Requisites:** All Courses till this semester

* Identify vast application areas for medical , plant and environment and Bioprocess Engineering and Bioinformatics.
* They also understand the working principle of Biotechnology and Fermentation technology
* Students understand various methods of and Applications of Biotechnology
* Understand the issues in the cell receptors and signaling
* Understand the issues in the diseases like cancer and tuberculosis

Out of total 200 marks for project work (in the final year second semester), 50 marks shall be for Internal Evaluation and 150 marks for the External Evaluation at the end of the Semester. External Evaluation of the project (viva-voce) shall be conducted by a committee appointed by the Chief Superintendent. The committee consists of an external examiner, HOD, a Senior Faculty Member and Internal Guide.

**The pattern of Internal Evaluation is as follows:**

**Division of marks for internal assessment – 50 marks**

* Progress of Project work and the corresponding interim report   
  as evaluated by internal guides at the end of 5 weeks : 05 Marks
* Seminar at the end of 5 weeks : 05 Marks
* Progress of Project work as evaluated by guides

at the end of 10 weeks : 05 Marks

* Seminar at the end of 10 weeks : 05 Marks
* Evaluation by the Guides ( at the end of 15 weeks) : 10 Marks
* Project Report : 05 Marks
* Final presentation and defense of the project : 15 Marks

If the project is conducted internally the marks will be given by Internal Guide himself.

**Division of Marks for External Evaluation – 150 Marks**

**Pattern of External Evaluation for Project**

1. Final Project Report : 30 Marks
2. Presentation : 20 Marks

Demonstration / Defense of Project :100Marks

**IV year II Semester, B. Tech – Biotechnology**

**(6G887) COMPREHENSIVE VIVA VOCE - III**

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| **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** | **m** |
| **x** |  | **x** |  |  |  | **x** | **x** | **x** | **x** |  |  |  |

**L T P/D C**

**- - - 1**

**Course Objectives:**

1. to assess the candidate’s knowledge in his or her particular field of learning.

2. To test the student’s awareness of the latest developments and relate them to the knowledge acquired during the classroom learning and self learning.

**Course Outcomes**

After completing the subject, students will be able to:

1. Face any type of interviews, viva-voce, and aptitude tests.
2. Perform well in competitive exams and group discussions
3. Apply knowledge in building their career in particular fields.
4. Enhance their communication skills and interactive-ness.

Students are assessed in the courses they have undergone till the completion of that academic year. They are asked to comprehend the concepts in the core subjects and the elective subjects. to make them ready to face technical interviews which improve their employability skills.

There are 50 internal marks. The internal comprehensive viva will be conducted twice in the semester by group of subject teachers awarding 25 marks in each evaluation.

The end examination shall be conducted by a committee consisting of an External examiner, Head of the department and two senior faculty members. It carries marks 75.

**IV year II Semester, B. Tech – Biotechnology**

**(6G898) TECHNICAL LITERATURE REVIEW AND SEMINAR- IV**

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| **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** | **m** |
|  |  |  |  |  | **x** | **x** | **x** |  | **x** |  |  |  |

**L T P/D C**

**- - 2 1**

**Pre-Requisites:** All Courses till this semester

**Course Objective :**

Learn basics of technical paper writing and enhance verbal and writing skills, which is useful for employabilty

**Pre-Requisites:** All Courses till this semester

**Course Outcomes: After completing this course, student shall be able to**

* Identify a topic from the current technologies of their choice in the Biotechnology domain and the allied fields, after surveying in the internet resources, journals and technical magazines in the library.
* Arrange the contents of the presentation and also write the report of the research paper.
* Present the technical topic in front of the panel and the fellow students, using the oratory skills and also submit the report of the research paper.
* Interact through answering the questions and also can add some points to the seminar

There shall be a Technical Paper writing and seminar evaluated for 100 marks in Third Year First Semester. The evaluation is purely internal and will be conducted as follows:

Content : 20 marks

Presentation including PPT : 20 marks

Seminar Notes : 10 marks

Interaction : 10 marks

Report : 25 marks

Attendance : 10 marks

Punctuality : 5 marks

Total 100 marks