SAHRDAYA AUTONOMOUS
COLLEGE OF ENGINEERING & TECHNOLOGY
A CENTRE OF EXCELLENCE IN SCIENCE & TECHNOLOGY | MANAGED BY IRINJALAKUDA DIOCESAN EDUCATION TRUST
Approved by AICTE & Affiliated to APJ Abdul Kalam Technological University | Accredited by:
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# B. Tech

# Curriculum (2024) and Syllabus- Semester I & II

# Biotechnology

## Branch Code: BT

*(SHR/AC/Auto/ Acad. Council /B.Tech/3/Syll./BT)*

*Recommended by BoS on 30/08/2024*

*Approved by Academic Council on 31/08/2024*

**Preface to the Curriculum**

The B.Tech Biotechnology (BT) curriculum is meticulously drafted to cultivate industry-ready professionals endowed with creativity and innovative thinking. This comprehensive curriculum includes induction programs, core and elective courses, practical courses, projects, internships, skill enhancement courses, and extracurricular activities. Designed to total 170 credits, the curriculum ensures a holistic education that prepares students for the dynamic field of Biotechnology. Below is a detailed overview of the curriculum's salient features:

1. **Project-Based Learning Courses:** From the first semester to the fifth semester, one course integrated with Project-Based Learning **(PBL)** empowers students with creativity, engaging them in meaningful projects to learn, explore, and investigate. PBL promotes teamwork and collaboration, essential skills for any professional, by having students work together in teams, each contributing unique skills and perspectives to achieve a common goal.
2. **Skill Enhancement Courses**: These courses are designed to provide students with industry-relevant certifications from reputed organizations, enhancing their employability by certifying their skill sets. They are integral to the academic curriculum and offered from Semester 1 to Semester 5, each carrying one credit.
3. **Foreign Language Courses**: To prepare students for global careers, the curriculum includes options to learn foreign languages, promoting cross-cultural communication skills and international collaboration. These courses are available in the seventh semester.
4. **Program Electives and Micro Specializations**: Students can pursue micro-specializations by completing thematic courses, which allow them to gain in-depth knowledge in specific sub-areas of their discipline. Starting in the fourth semester, this provides an opportunity for focused learning and expertise in emerging fields in alignment with program elective courses.
5. **Industry Elective Courses**: Offered jointly with industry partners, these courses ensure relevance and practical applicability. The academic department and industry partners develop and assess them collaboratively, without end-semester examinations, providing continuous and practical learning experiences.
6. **Startups and Entrepreneurial Skills**: The curriculum encourages students to pursue startups, offering options to engage in product-based or service-based startups during their seventh and eighth semesters. This fosters innovation, creativity, and entrepreneurial skills, preparing students for the dynamic business environment.
7. **Courses Embedded with Practical**: The curriculum includes theory courses embedded with practical and projects, ensuring students apply theoretical knowledge to real-world problems. This hands-on approach enhances learning outcomes and practical skills.
8. **Internships**: The program includes mandatory internships, allowing students to gain industry exposure and practical experience. Students can undertake at least

four to six months of internship in a recognized industry, research organization, or prestigious institution relevant to their field. This bridges the gap between academic learning and industry requirements, enhancing employability.

9. **Community Work, Social Responsibility, and Universal Human Value Courses**: The curriculum integrates opportunities for community work and socially relevant projects promoting civic responsibility and leadership skills. Universal Human Value courses also aim to cultivate a holistic understanding of life, enhancing physical and mental well-being and social and life skills. These courses address various dimensions of life, including individual, family, society, and the environment, promoting a healthy and harmonious lifestyle.
10. **Activity Points**: In addition to academic credits, students must earn activity points through participation in extracurricular activities such as sports, cultural events, community service, and entrepreneurship. This holistic approach ensures the development of leadership, teamwork, and communication skills, preparing students for global challenges.
11. **MOOC Courses:** Students selected for internships can fulfil their credit requirements in the seventh and eighth semesters through MOOC courses, providing flexibility and additional learning opportunities.
12. **Higher Credit Elective:** These courses carry more than the standard credit weight of elective courses. They allow students pursuing honors to reduce the number of required courses by earning additional credits through higher-credit electives. Additional credits earned from higher credit electives can be credited towards the total credit requirement of the honors program, with a maximum of 12 additional credits being applied towards the honors credit requirement.

This curriculum is designed to blend theoretical knowledge with practical experience, foster interdisciplinary learning, and enhance employability through hands-on projects and internships, preparing students for successful careers in Biotechnology.

## General Course Structure

### 1. Credit and Courses:

Credits are a unit of measurement for coursework based on the number of hours of instruction required per week. One hour of classroom lecture (L), 60 minutes long per week and carried out during all weeks of the semester, is considered one instructional unit or one credit. The same goes for a tutorial (T) or a project (R) that is 60 minutes long per week and carried out during all weeks of the semester. In addition, a minimum of 120 minutes per week of laboratory session, practical or fieldwork, training (P) or a combination of these, carried out during all weeks of the semester, is also considered one Instructional Unit or one Credit.

| Classification | Credit assigned |
|---|---|
| 1 Hour Lecture [L] per week | 1 Credit |
| 1 Hour Tutorial [T] per week | 1 Credit |
| 1 Hour Project [R] per week | 1 Credit |
| 1-2 Hours Practical [P] per week | 1 Credit |
| 3-4 Hours Practical [P] per week | 2 Credit |

- *For internship/Start-Up/Main project/Mini project, the credit weightage for equivalent hours is 50% of that for lectures/tutorials*
-

## 2. Course Category and Credits

The B.Tech Program curriculum has 168 academic credits and 2 additional pass/fail credits that can be gained through 100 activity points. The program is expected to accommodate courses from other disciplines so that students have multi-disciplinary exposure. Additionally, the program should provide sufficient opportunities for students to enhance their communication, soft, managerial, and technical skills. Depending on the program, the courses should fall under the engineering, basic science, humanities science, and management categories. The structure of the UG program should essentially have the following categories of courses with the breakup of credits as given:

| Sl. No | Category | Code | Credits |
|---|---|---|---|
| 1 | Humanities and Social Sciences including Management Courses | HMC | 9 |
| 2 | Basic Science Courses | BSC | 20 |
| 3 | Engineering Science Courses | ESC | 26 |
| 4 | Programme (Professional) Core Courses | PCC | 52 |
| 5 | Programme (Professional) Core Courses-Project Based Learning | PBL | 16 |
| 6 | Program Elective Courses | PEC | 18 |
| 7 | Open Elective Courses/Industry Linked Elective | OEC/ILE | 9 |
| 8 | Project Work and Seminar | PS | 12 |
| 9 | UHV and Community Work | PW | 1 |
| 10 | Skill Enhancement Courses | SEC | 5 |
| 11 | Mandatory Student Activities | MSA | 2 |
| | **Total Mandatory Credits** | **170** | |

A 10% to 15 % deviation in credits is permitted under each discipline. While developing the curriculum, the department offering the program should ensure that the students attain the above distribution upon completing their program. Either Minor or Honours can be opted from the optional specialization.

The courses are organized into 1/2/3/4 credit courses based on the content delivery mechanism and desired depth. The delivery methods include Theory-only, Theory with tutorial, Theory with practice, Theory with project, etc. The L-T-P-R-C for each course indicates the number of credits delivered as Lecture (L), Tutorial (T), Practical (P), Project (R) and the total instructional delivery indicated as Credits (C).

$$\mathbf{C = L + T + [P/2] + R}$$

Apart from lectures, tutorials, practical/practice and project hours, the curriculum offers Self-learning hours (S) that indicate the number of hours students are expected to spend for activities that should be completed outside the class defined by the faculty handling courses. The activities aim to support learning and should be initiated by the students themselves without guidance or direction from tutors. For each course, the self-learning hour per week is calculated as:

$$\mathbf{S= (L*1+P*1+[R/2])}$$

Categories of courses included in the curriculum and their L-T-P-R-C components are given in the table below:

| Sl. No. | Lecture- Tutorial- Practical- Project [L-T-P-R] | Credit [C] | Description |
|---|---|---|---|
| 1. | 1-0-2-0 | 2 | Theory course without End Semester Examination [ESE] |
| 2. | 1-0-0-0 | 1 | |
| 3. | 2-0-2-1 | 4 | Theory course embedded with practical and project |
| 4. | 3-1-0-0 | 4 | Theory course embedded with tutorial |
| 5. | 3-0-0-0 | 3 | Theory course |
| 6. | 2-0-0-0 | 2 | |
| 7. | 3-0-2-0 | 4 | Theory course embedded with practical |
| 8. | 3-0-0-1 | 4 | Theory course embedded with project |
| 9. | 0-0-2-0 | 1 | Practical course without ESE |
| 10. | 0-0-3-0 | 2 | Practical course |
| 11. | 0-0-0-3 | 2 | Mini Project |
| 12. | 0-0-3-0 | 2 | Seminar |
| 13. | 0-0-0-8 | 4 | Major Project/Internship/Start-Up |
| 14. | 0-0-0-0 | 1 | MOOC Course |
| Mandatory Courses | | | |
| 15. | 0-0-2-0 | 1 | Skill Enhancement Courses |

| Minor/ Honors Course | | | |
|---|---|---|---|
| 16. | 4-0-0-0 | 4 | Theory course |
| 17. | 0-0-0-4 | 4 | Project only course |

### 3. Course Code

Every course of B. Tech. The program shall take a code from the table given below.

| Course category | Description |
|---|---|
| PCC | Program (Professional) Core Courses |
| PBL | Project Based Learning |
| CLT | Combined Lab Theory |
| PEC | Professional Elective Course |
| OEC | Open Elective Course |
| BSC | Basic Science Course |
| ESC | Engineering Science Course |
| HMC | Humanities, Social Sciences and Management course |
| MOOC | MOOC Course |
| IEL | Industry Elective Course |
| PW | Socially Relevant course |
| PS | Project Work and Seminar |
| SEC | Skill Enhancement Courses |
| HR | Honours |
| MR | Minor |

**Structure of Course Code:** Each course will be identified by a unique Course Code consisting of eight alphanumeric characters, formatted as **24XXYABC**. The code can be interpreted as follows: "24" represents the regulation year, "XX" is the course category code, "Y" indicates the course delivery mode, "A" is the semester number (ranging from 1 to 8, with 0 indicating the course is offered in both odd and even semesters), "B" denotes the version of the course under each category, and "C" signifies the course sequence number.

For example, 24CET303 is a theory course offered by the civil engineering department in the third semester of the 2024 scheme.
24BML408 - laboratory course offered by the biomedical engineering department in the fourth semester of the 2024 scheme
The detailed expansion of the abbreviation of the course code structure is listed in the

table below:

| XX | Y | A | B | C |
|---|---|---|---|---|
| Course category | Course delivery mode | Semester No | Version of the course | Serial No: of course |
| BM-Biomedical Engineering<br>BT-Biotechnology<br>CE – Civil Engineering<br>CS-Computer Science Engineering<br>EC-Electronics and Communication Engineering<br>EE-Electrical and Electronics Engineering<br>MA-Mathematics<br>CY – Chemistry<br>PH-Physics<br>ES-Engineering Science course<br>HU-Humanities and Management Courses<br>SE-Skill Enhancement Courses<br>PW-Social Science and Community work | T-Theory<br>L-Laboratory<br>R-Theory<br>Embedded with Project<br>K-Certification Course<br>E-Elective Course<br>H-Honour<br>M-Minor<br>O-Open Elective<br>I-Industry Elective<br>S-Seminar<br>P-Project<br>N-Internship<br>U-Start Up<br>C – Theory Embedded with practical | 0<br>1<br>2<br>3<br>etc. | 1<br>2<br>3<br>etc. | 1<br>2<br>3<br>4<br>5<br>6<br>etc. |

## 4. Allotted and Cumulative Credits

The allotted and cumulative credits are given in the table below:

| Semester | Allotted Credits | Cumulative Credits |
|---|---|---|
| First | 21 | - |
| Second | 22 | 43 |
| Third | 26 | 69 |
| Fourth | 24 | 93 |
| Fifth | 24 | 117 |
| Sixth | 23 | 140 |

| | | |
|---|---|---|
| Seventh | 17 | 157 |
| Eighth | 11 | 168 |

| FIRST SEMESTER (July-December) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 Days Compulsory Induction Program | | | | | | | | | | | | | |
| **Sl. No** | **Slot** | **Course Code** | **Course Type** | **Course Title (Course Name)** | **Credit Structure** | | | | **Total Marks** | | **Credits** | **Hrs./ Week** |
| | | | | | **L** | **T** | **P** | **R** | **CIA** | **ESE** | | |
| 1 | A | 24MAT121 | BSC | Linear Algebra, Differential Equations & Laplace Transform | 3 | 0 | 0 | 0 | 40 | 60 | 3 | 3 |
| 2 | B | 24CYC132 | BSC-CLT | Chemistry for Bioengineering | 3 | 0 | 2 | 0 | 50 | 50 | 4 | 5 |
| 3 | C | 24EST103 | ESC | Basic Concepts of Biotechnology and Biochemical Engineering | 3 | 0 | 0 | 0 | 40 | 60 | 3 | 3 |
| 4 | D | 24EST144 | ESC | Foundations of Electrical & Electronics Engineering | 4 | 0 | 0 | 0 | 40 | 60 | 4 | 4 |
| 5 | F | 24ESR105 | ESC-PBL | Algorithmic Thinking with Python | 2 | 0 | 2 | 1 | 50 | 50 | 4 | 5 |
| 6 | L | 24ESL106 | ESC | Fundamentals in Biotechnology Lab | 0 | 0 | 2 | 0 | 50 | --- | 1 | 2 |
| 7 | I* | 24HUT007 | HMC | Communicative English | 0 | 0 | 2 | 0 | 100 | —- | 1 | 2 |
| 8 | J* | 24SEK10N | SEC | Skill Enhancement Course 1 | | | | | | | 1 | |
| **Total** | | | | | | | | | | | **21** | **24** |

| SECOND SEMESTER(January-June) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Slot** | **Course Code** | **Course Type** | **Course Title (Course Name)** | **Credit Structure** | | | | **Total Marks** | | **Credits** | **Hrs./ Week** |
| | | | | | **L** | **T** | **P** | **R** | **CIA** | **ESE** | | |
| 1 | A | 24MAT221 | BSC | Infinite series, Multiple Integrals and Vector Calculus | 3 | 0 | 0 | 0 | 40 | 60 | 3 | 3 |
| 2 | B | 24PHC232 | BSC-CLT | Engineering Physics | 3 | 0 | 2 | 0 | 50 | 50 | 4 | 5 |
| 3 | C | 24EST003 | ESC | Engineering Graphics | 3 | 0 | 0 | 0 | 40 | 60 | 3 | 3 |
| 4 | D | 24ESC204 | ESC-CLT | Programming in C | 3 | 0 | 2 | 0 | 50 | 50 | 4 | 5 |
| 5 | E | 24BTR205 | PCC-PBL | Bioprocess Calculations | 2 | 1 | 0 | 1 | 50 | 50 | 4 | 4 |
| 6 | I* | 24HUT006 | HMC | Professional Ethics and sustainable development | 1 | 0 | 2 | 0 | 100 | --- | 2 | 3 |
| 7 | L | 24ESL007 | ESC | Computer Aided Drawing (CAD) & Manufacturing Workshop | 0 | 0 | 2 | 0 | 50 | --- | 1 | 2 |
| 8 | J* | 24SEK10N | SEC | Skill Enhancement Course 2 | | | | | | | 1 | |
| **Total** | | | | | | | | | | | **22** | **25** |

***No Grade Points will be awarded for the MOOC, I and J slot courses.***

***The self-learning (S) hours for each course is calculated based on the formulae,* S= (L*1+P*1+[R/2])**

# SEMESTER-I
# SYLLABUS

| 24MAT121 | LINEAR ALGEBRA, DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 2024 |

**Preamble:**
The course enables the students to understand basic concepts and tools of Linear Algebra, Differential equations and Laplace Transforms. Topics like Ordinary Differential Equations, Multivariable Calculus and Laplace Transform are included. This course helps the learners in modeling and analyzing physical phenomena involving continuous changes of variables or parameters with the help of modern tools and has applications across all engineering domains.

**Prerequisite:** Single variable calculus and matrix theory.

**Course Outcomes:** After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Apply the Gauss elimination method to solve the system of linear equation and to determine whether the matrix is diagonalizable. **[Apply]** |
| **CO 2** | Apply super position principle and method of undetermined coefficients, for solving homogeneous and non-homogeneous linear differential equations with constant coefficients. **[Apply ]** |
| **CO 3** | Apply the concept of partial derivatives to evaluate the extrema of two variable functions.**[Apply ]** |
| **CO 4** | Apply Laplace transform to solve second order ordinary differential equation with constant coefficients. **[Apply]** |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 2 | | | | | | | |
| **CO2** | 3 | 3 | 2 | 3 | | | | | | | | |
| **CO3** | 3 | 3 | 2 | 3 | 2 | | | | | | | |
| **CO4** | 3 | 2 | 2 | 2 | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | √ | √ | √ | √ |
| Understand | √ | √ | √ | √ |
| Apply | √ | √ | √ | √ |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| **Mark Distribution of CIA** | | | | | |
|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Lecture [L]** | | | | |
| | **Attendance** | **Assignment** | **Test-1** | **Test-2** | **Total Marks** |
| 3-0-0-0 | 5 | 10 | 12.5 | 12.5 | 40 |

| **Total Mark distribution** | | | |
|---|---|---|---|
| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
| 100 | 40 | 60 | 2.5 hours |

| **End Semester Examination [ESE]: Pattern** | | | |
|---|---|---|---|
| **PATTERN** | **PART A** | **PART B** | **ESE Marks** |
| PATTERN 1 | 8 Questions (2 Questions from each module), each question carries 3 marks<br><br>Marks: (3x8 =24 marks) | 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of two sub divisions.<br>Each question carries 9 marks.<br>Marks: (9x4 = 36 marks) | 60 |

**SYLLABUS**

**MODULE I: Linear Algebra (9 hours)**

**(Text 2: Relevant topics from section 7.3, 7.4, 7.5, 8.1, 8.4)**
Linear systems of equations, Solution by Gauss elimination, Row echelon form and rank of a matrix, Fundamental theorem for linear systems - homogeneous and non-homogeneous (without proof), Eigen values and Eigen vectors, Diagonalization of matrices.

**MODULE II: Ordinary Differential Equations (9 hours)**

**(Text 2: Relevant topics from section 2.1, 2.2, 2.6, 2.7)**
Homogeneous linear ODEs of second order, Superposition principle, General solution, Homogeneous linear ODEs of second order with constant coefficients (Method to find general solution, solution of linear Initial Value Problem). Non homogeneous ODEs (with constant coefficients)- General solution, Particular solution by the method of undetermined coefficients (Particular solutions for the functions $ke^{ax}$, $kx^n$). Initial value Problem for Non Homogeneous Second order linear ODE (with constant coefficients).

**MODULE III: Multi variable Calculus -Partial derivatives (9 hours)**

**(Text 1: Relevant topics from section 13.2, 13.3, 13.4, 13.5,13.8)**
Limits and continuity, Partial derivatives, Partial derivatives viewed as rate of change and slopes, Second order and higher order partial derivatives, Local Linear

approximations, Chain rule, total derivative, Implicit differentiation, relative maxima and minima.

**MODULE IV: Laplace Transform (9 hours)**

**(Text 2: Relevant topics from section 6.1, 6.2, 6.3, 6.5)**

Laplace Transform, Inverse Laplace Transform, Linearity property, First shifting theorem, Transform of derivatives, Solution of Initial value problems by Laplace transform (Second order linear ODE with constant coefficients with initial conditions at t=0), Unit step function and its transform (without solution of ordinary differential equation involving unit step function), Second shifting theorem, Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions.

**Text books**

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

**Reference books**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition,2010.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012.
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th th Edition, Pearson, Reprint,2002.
5. Louis C Barret, C Ray Wylie, Advanced Engineering Mathematics, Tata McGraw Hill, 6th edition, 2003.

0. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017.

**NPTEL/SWAYAM Courses for reference:**

1. NPTEL :: Advanced Linear Algebra https://archive.nptel.ac.in/courses/111/107/111107164/
2. NPTEL :: Mathematics - Ordinary Differential Equations https://archive.nptel.ac.in/courses/111/108/111108081/
3. NPTEL :: Mathematics - NOC: Laplace Transform https://archive.nptel.ac.in/courses/111/106/111106139/

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours [36 hours] |
|---|---|---|
| | **MODULE 1 [ 9 hours]** | |
| 1.1 | Linear systems of equations | 1 |
| 1.2 | Solution by Gauss elimination | 2 |
| 1.3 | Row echelon form and rank of a matrix | 1 |
| 1.4 | Fundamental theorem for linear systems | 1 |
| 1.5 | Homogeneous and non-homogeneous linear systems (without proof) | 1 |
| 1.6 | Eigen values and Eigen vectors | 1 |
| 1.7 | Diagonalization of matrices | 2 |
| | **MODULE II [ 9 hours]** | |

| | | |
|---|---|---|
| 2.1 | Homogeneous linear ODEs of second order | 1 |
| 2.2 | Superposition principle and General solution | 2 |
| 2.3 | Homogeneous linear ODEs of second order with constant coefficients (Method to find general solution, solution of linear Initial Value Problem) | 1 |
| 2.4 | Non homogenous ODEs (with constant coefficients) | 1 |
| 2.5 | Particular solution by the method of undetermined coefficients (Particular solutions for the functions $ke^{ax}$, $kx^n$). | 2 |
| 2.6 | Initial value Problem for Non Homogeneous Second order linear ODE (with constant coefficients) | 2 |
| **MODULE III [9 hours]** | | |
| 3.1 | Limits and continuity | 1 |
| 3.2 | Partial derivatives | 1 |
| 3.3 | Partial derivatives viewed as rate of change and slopes | 1 |
| 3.4 | Second-order and higher order partial derivatives | 1 |
| 3.5 | Local Linear approximations | 1 |
| 3.6 | Chain rule | 1 |
| 3.7 | Total derivative | 1 |
| 3.8 | Implicit differentiation | 1 |
| 3.9 | Relative maxima and minima | 1 |
| **MODULE IV [ 9 hours]** | | |
| 4.1 | Laplace Transform | 1 |
| 4.2 | Inverse Laplace Transform | 1 |
| 4.3 | Linearity property | 1 |
| 4.4 | First shifting theorem | 1 |
| 4.5 | Transform of derivatives | 1 |
| 4.6 | Solution of Initial value problems by Laplace transform (Second order linear ODE with constant coefficients with initial conditions at t=0) | 1 |
| 4.7 | Unit step function and its transform (without solution of ordinary differential equation involving unit step function) | 1 |
| 4.8 | Second shifting theorem | 1 |
| 4.9 | Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions. | 1 |

**CO Assessment Questions**

| | |
|---|---|
| CO 1 | 1. Find the rank, eigen values and eigen vectors of the given matrix. $\begin{bmatrix} -1 & 2 & 22 \\ 6 & 8 & 26 \\ -8 & 20 & 16 \end{bmatrix}$<br>2. Diagonalize the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 6 & 8 & 6 \\ 8 & 2 & 1 \end{bmatrix}$<br>3. Solve the following linear system of equations using Gauss elimination Method: x + y - z = 9, 8y + 6z = -6, -2x + 4y- 6z= 40. |

| | |
|---|---|
| | Team work:<br>Use a CAS to write a program for Gauss elimination and back substitution (a) that does not include pivoting and (b) that does include pivoting. |
| CO2 | 1. Find a general solution of $y^{II}$-25y=0.Check your answer by substitution.<br>2. Solve the IVP, $y^{II}$+16y=17$e^x$,y(0) =6, $y^{I}$(0)=-2.<br>3. Find a general solution of 4$y^{II}$+32$y^{I}$+63y=0. Show the details of your calculation. |
| CO 3 | 1. Find $f_x$(x,y) and $f_y$(x,y) for f(x,y)=2$x^3y^2$+2y+4x and use those partial derivatives to Compute $f_x$(1,3) and $f_y$(1,3)<br>2. Locate all relative extrema and saddle points of f (x, y) = 3$x^2$ − 2xy + $y^2$ − 8y.<br>**Team work:**<br>Use a graphing tool or software to visualize the function g(x,y)=$x^3$−3x$y^2$+$y^3$ . Identify and classify the extrema. |
| CO 4 | 1. Solve the IVP by the Laplace transform $y^{I}$+2y=0, y (0) =1.5<br>2. Find L(f), if f(t) = t cos4t.<br>3. Sketch the graph of f(t) if F(s)= $\frac{1}{S^3}$ |

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| 24CYC132 | CHEMISTRY FOR BIOENGINEERING | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 | 2024 |

**Preamble:**
Provide students with comprehensive exploration of electrochemistry, corrosion mechanisms, engineering materials, molecular spectroscopy, analytical techniques, and environmental chemistry. Students will gain insights into the fundamental concepts, advanced methodologies, and practical applications essential for addressing contemporary challenges in materials science and environmental sustainability. This course equips learners with the knowledge and skills necessary to analyse, innovate, and implement solutions in bioengineering, ensuring a robust foundation for tackling complex real-world problems.

**Prerequisite:** Basic knowledge in Chemistry and Physics

**Course Outcomes:** After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Employ the fundamental principles of electrochemistry and corrosion, to explore their potential applications across bioengineering sectors. **(Apply)** |
| **CO 2** | Apply knowledge of different engineering materials to select and integrate appropriate materials in various electronic sectors through practical experimentation in the laboratory. **(Apply)** |
| **CO 3** | Interpret various analytical techniques effectively in biomedical and biotechnology domains. **(Apply)** |
| **CO 4** | Understand and apply the principles of environmental chemistry and waste management. **(Apply)** |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | | | | | 2 | | | |
| **CO2** | 3 | 3 | | 2 | | | | | 2 | | | |
| **CO3** | 3 | 3 | | 2 | | | | | 2 | | | |
| **CO4** | 3 | 3 | 3 | 2 | | 2 | 3 | | 2 | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | √ | √ | √ | √ |
| Understand | √ | √ | √ | √ |
| Apply | √ | √ | √ | √ |
| Analyze | | | | |

| | | | | |
|---|---|---|---|---|
| Evaluate | | | | |
| Create | | | | |

**Assessment Pattern for the Lab component**

| **Bloom's Category** | **Continuous Assessment Tools** | |
|---|---|---|
| | **Class work** | **Test1** |
| Remember | √ | √ |
| Understand | √ | √ |
| Apply | √ | √ |
| Analyse | | |
| Evaluate | | |
| Create | | |

**Mark Distribution of CIA**

| **Course Structure [L-T-P-R]** | **Attendance** | **Theory [L- T]** | | | **Practical** | | **Total Marks** |
|---|---|---|---|---|---|---|---|
| | | **Assignment** | **Test-1** | **Test-2** | **Continuous Assessment** | **Lab Exam** | |
| 3-0-2-0 | 5 | 5 | 7.5 | 7.5 | 15 | 10 | 50 |

**Total Mark distribution**

| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
|---|---|---|---|
| 100 | 50 | 50 | 2 hours |

**End Semester Examination [ESE]: Pattern**

| **PATTERN** | **PART A** | **PART B** | **ESE Mark** |
|---|---|---|---|
| PATTERN 2 | 2 Questions from each module.<br>Total of 8 Questions, Answer any 6 questions. Each carrying 3 marks<br>(6x3 =18 marks) | 2 questions will be given from each module, out of which 1 question should be answered.<br>Each question can have a maximum of 3 subdivisions.<br>Each question carries 8 marks. (4x8 = 32 marks) | 50 |

| **SYLLABUS** |
|---|
| **MODULE I: Electrochemistry and Corrosion Science (9 Hours)** |
| **Electrochemical Cell**- Electrode potential- Nernst equation for single electrode and cell (numerical problems), Reference electrodes – SHE & Calomel electrode – construction and working, Electrochemical series – applications, glass electrode & pH measurement, conductivity- measurement. Li-ion battery: construction and working.<br>**Corrosion** –Electrochemical corrosion mechanism (acidic & alkaline medium), Galvanic series, Corrosion control methods - cathodic protection, sacrificial anodic protection and impressed current cathodic protection, electroplating of copper, electroless plating of copper. |
| **MODULE II: Engineering Materials (9 Hours)** |
| **Fuels:** Calorific value – HCV and LCV, experimental determination of calorific value of solid fuels. Octane & Cetane number. Biofuels- biodiesel, green hydrogen<br>**Lubricants:** Classification - solid, semisolid and liquid lubricants. Properties of lubricants – viscosity index, flash point, fire point, cloud point, pour point & aniline point.<br>**Nanomaterials** - Classification based on dimension & materials- Synthesis – Sol gel & chemical reduction -bio-applications of nanomaterials – carbon nanotubes, fullerenes, graphene – structure, properties & application.<br>**Polymers** – Biodegradable polymers- PHBV, PLA -Synthesis, properties and applications, Conducting polymers-classification, Polyaniline & Polypyrrole-synthesis, properties and applications. |
| **MODULE III: Molecular Spectroscopy and Analytical Techniques (9 Hours)** |
| **Molecular Spectroscopy:** Types of spectra- molecular energy levels, beer lambert's law, numerical problems. Electronic spectroscopy – principle, types of electronic transitions –Role of Conjugation in absorption maxima,<br>instrumentation, applications, Vibrational spectroscopy – principle, number of vibrational modes, vibrational modes of $CO_2$ and $H_2O$, applications.<br>**Chromatography-** Chromatography- classification, principle, applications<br>**Electron Microscopic Techniques:** SEM - Principle, instrumentation and applications. |
| **MODULE IV: Environmental Chemistry (9 Hours)** |
| **Water characteristics** – Hardness, types of hardness, temporary and permanent, Disadvantages of hard water, Degree of hardness (Numerical). Water softening methods-ion exchange process-principle, procedure and advantages. Water |

disinfection methods – chlorination, breakpoint chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- definition, significance.

**Waste Management:** Air Pollution- Sources & effects, greenhouse gases, ozone depletion, control methods. Sewage water treatment- primary, secondary and tertiary, flow diagram , trickling filter and the UASB process.

**Text books**

1. Dr. Muhammad Arif M, Smt. Kavitha P Nair, Dr. Annette Fernandez "Engineering Chemistry", Owl Books,2021
2. Engineering Chemistry- B. L. Tembe, Kamaluddin, M. S. Krishnan-2018
3. Instrumental Methods of Analysis- H. H. Willard, L. L. Merritt, CBS Publishers,7th Edition, 2005

**Reference books**

1. Fundamentals of Molecular Spectroscopy C. N. Banwell McGraw-Hill, 4th edn., 2017.
2. Principles of Physical Chemistry B. R. Puri, L. R. Sharma, M. S. Pathania Vishal Publishing Co 47th Edition, 2017.
3. Engineering Chemistry- Jain & Jain, Dhanpath Rai Publishing Company,17th Edition, 2015.
4. Introduction to Spectroscopy Donald L. Pavia Cengage Learning India Pvt. Ltd 2015
5. Polymer Chemistry: An Introduction Raymond B. Seymour, Charles E. Carraher Marcel Dekker Inc 4th Revised Edition, 1996
6. The Chemistry of Nanomaterials: Synthesis, Properties and Applications Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham Wiley-VCH Verlag GmbH & Co. KGaA 2014
7. Organic Electronics Materials and Devices Shuichiro Ogawa Springer Tokyo 2024.
8. Instrumental Methods of Analysis- H. H. Willard, L. L. Merritt, CBS Publishers,7th Edition,2005

**NPTEL/SWAYAM Courses for reference:**

Module - I

1. https://archive.nptel.ac.in/courses/104/106/104106137/ Elementary Electrochemistry
2. https://archive.nptel.ac.in/courses/113/105/113105102/ Electrochemical Energy storage
3. https://archive.nptel.ac.in/courses/113/104/113104082/ Corrosion

Module - II

1. https://archive.nptel.ac.in/courses/113/104/113104102/ Nanomaterials and their properties
2. https://archive.nptel.ac.in/courses/104/105/104105124/ Introduction to Polymer Science
3. https://archive.nptel.ac.in/courses/103/105/103105110/Fuel and combustion

technology

Module III

1. https://nptel.ac.in/courses/104106122/ Fundamentals of spectroscopy

Module IV

1. https://archive.nptel.ac.in/courses/122/106/122106030/Environmental chemistry and analysis

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours [36] |
|---|---|---|
| **MODULE 1: Electrochemistry and Corrosion Science (9 Hours)** | | |
| 1.1 | Electrochemical Cell- Electrode potential, Nernst equation for single electrode and cell (numerical problems), Reference electrodes – SHE & Calomel electrode –construction and working. | 3 |
| 1.2 | Electrochemical series – applications, glass electrode & pH measurement, conductivity- measurement. | 2 |
| 1.3 | Li-ion battery: construction and working. | 1 |
| 1.4 | Corrosion –electrochemical corrosion mechanism (acidic & alkaline medium), Galvanic series | 1 |
| 1.5 | Corrosion control methods - cathodic protection, sacrificial anodic protection and impressed current cathodic protection, electroplating of copper, electroless plating of copper. | 2 |
| **MODULE II: Engineering Materials (9 Hours)** | | |
| 2.1 | Fuels: Calorific value – HCV and LCV, experimental determination of calorific value of solid fuels. Octane & Cetane number. Biofuels-biodiesel, green hydrogen | 2 |
| 2.2 | Lubricants: Classification - solid, semisolid and liquid lubricants. Properties of lubricants – viscosity index, flash point, fire point, cloud point, pour point & aniline point. | 2 |
| 2.3 | Nanomaterials - Classification based on dimension & materials, Synthesis – sol gel & chemical reduction, bio-applications of nanomaterials, carbon nanotubes, fullerenes, graphene– structure, properties & application. | 2 |
| 2.4 | Polymers – PHBV, PLA -Synthesis, properties and applications | 1 |
| 2.5 | Conducting polymers-classification, polyaniline & polypyrrole-synthesis, properties and applications. biomedical application of polymers | 2 |
| **MODULE III: Molecular Spectroscopy and Analytical Techniques (9 Hours)** | | |

| | | |
|---|---|---|
| 3.1 | Molecular spectroscopy-Types of spectra- molecular energy levels, beer lambert's law, numerical problems. | 1 |
| 3.2 | Electronic spectroscopy – principle, types of electronic transitions, role of conjugation in absorption maxima, instrumentation, applications. | 2 |
| 3.3 | Vibrational spectroscopy – principle, number of vibrational modes, vibrational modes of $CO_2$ and $H_2O$, applications. | 2 |
| 3.4 | Chromatography- Chromatography- classification, principle, applications | 2 |
| 3.5 | Electron Microscopic Techniques: SEM - principle, instrumentation and applications. | 2 |
| **MODULE IV: Environmental Chemistry (9 Hours)** | | |
| 4.1 | Water characteristics - Hardness - types of hardness, temporary and permanent, disadvantages of hard water, degree of hardness (numericals). | 2 |
| 4.2 | Water softening methods-ion exchange process-principle, procedure and advantages. | 2 |
| 4.3 | Water disinfection methods – chlorination, break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- definition & significance. | 2 |
| 4.4 | Waste management- Air Pollution- sources & effects, greenhouse gases, ozone depletion, control methods. | 1 |
| 4.5 | Sewage water treatment -primary, secondary and tertiary, flow diagram -trickling filter and the UASB process. | 2 |

**LESSON PLAN FOR LAB COMPONENT**

| No. | Topic | No. of Hours | Experiment (24 hrs.) |
|---|---|---|---|
| 1 | Electrochemistry and Corrosion Science | 4 | Calibration of pH meter and determination of pH of a solution |
| | | | Determination of cell constant and conductance of solutions |
| 2 | Engineering Materials | 6 | 1. Synthesis of polymers<br>a) Urea-formaldehyde resin<br>b) Phenol-formaldehyde resin |
| | | | 2. Determination of flash point of oils and fats by using Pensky-Martens apparatus |

| | | | |
|---|---|---|---|
| | | | Estimation of copper in brass. |
| 3 | Molecular Spectroscopy and Analytical Techniques | 6 | Determination of wavelength of absorption maximum and colorimetric estimation of Fe3+ in solution |
| | | | Determination of molar absorptivity of a compound ($KMnO_4$ or any water- soluble food colorant) |
| 4 | Environmental Chemistry | 8 | 1. Estimation of dissolved oxygen by Winkler's method |
| | | | 2. Estimation of total hardness of water- EDTA method |
| | | | 3. Estimation of chloride content in water |

(Any 2 experiments from each topic are to be completed)

**CO Assessment Questions**

| | |
|---|---|
| CO1 | 1. A zinc electrode is placed in a 1 M $ZnSO_4$ solution at 25°C. Calculate the electrode potential given that $[Zn^{2+}]$ = 1 M and $E°(Zn^{2+}\|Zn)$ = -0.76 V. Discuss how this potential change with temperature and concentration variations.<br>2. Utilizing the electrochemical series, predict the feasibility of a reaction between iron metal and a copper(II) sulphate solution. Provide the relevant half-reactions and explain your reasoning.<br>3. Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged.<br>4. Calibrate the pH meter and determine pH of a given solution. |
| CO 2 | 1. Differentiate between solid, semisolid, and liquid lubricants. Provide examples of each and discuss their typical applications.<br>2. Explain the difference between Higher Calorific Value (HCV) and Lower Calorific Value (LCV). How these values are experimentally determined for solid fuels?<br>3. Compare and contrast the methods used to determine octane number and cetane number, and evaluate their significance in fuel quality assessment.<br>4. Synthesize Urea-formaldehyde resin and find its yield. |
| CO 3 | 1. A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Calculate the concentration of the test solution.<br>2. Outline the principle of DTA. Analyse a DTA graph of $CaC_2O_4.H_2O$ and interpret the observed endothermic and exothermic peaks<br>3. You are given an IR spectrum of an unknown compound. Describe the steps you would take to identify functional groups present in the compound.<br>4. Determine the wavelength of absorption maximum and colorimetric estimation of $Fe^{3+}$ in solution. |

| | |
|---|---|
| CO 4 | 1. Determine the temporary, permanent and total hardness of water solution using EDTA method.<br>2. Explain the ion exchange resins and the process for removal of hardness of water? How exhausted resins are regenerated?<br>3. Sketch the flow diagram of the different steps in sewage treatment. Explain the Each step.<br>4. Calculate the temporary and permanent hardness of a water sample which contains<br>$[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L.<br>5. Estimate the amount of dissolved oxygen present in the given water sample. |

Prepared by
Mrs Mayasree O
Asst.Prof ASH

| 24EST103 | BASIC CONCEPTS OF BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 2024 |

**Preamble:**
This course introduces the fundamental principles and techniques in biotechnology and biochemical engineering. It covers essential topics including molecular biology, genetic engineering, microbial biotechnology, biochemical processes, and bioreactor design. The course aims to provide a comprehensive understanding of the applications and implications of biotechnology in various fields.

**Prerequisite**: Nil

**Course Outcomes**: After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Comprehend different cell types and their importance in biotechnological applications [Understand] |
| **CO 2** | Familiarize with the fundamentals of enzymes and their uses [Apply] |
| **CO 3** | Investigate the applications of bioprocesses in industry. [Apply] |
| **CO 4** | Acquaint the design and maintenance principles of bioreactors. [Apply] |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | | 2 | 2 | | | | | | | | | |
| **CO 2** | | 2 | 2 | | | | | | | | | |
| **CO 3** | 3 | 3 | 2 | | | | | | | | | |
| **CO 4** | 3 | 3 | 3 | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | √ | √ | √ | √ |
| Understand | √ | √ | √ | √ |
| Apply | √ | √ | √ | √ |
| Analyse | √ | √ | √ | √ |
| Evaluate | | | | |
| Create | | | | |

| **Mark Distribution of CIA** | | | | | |
|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Attendance** | **Theory [L- T]** | | | **Total Marks** |
| | | **Assignment** | **Test-1** | **Test-2** | |
| 3-0-0-0 | 5 | 10 | 12.5 | 12.5 | 40 |

| **Total Mark distribution** | | | |
|---|---|---|---|
| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
| 100 | 40 | 60 | 2.5 hours |

| **End Semester Examination [ESE]: Pattern** | | | |
|---|---|---|---|
| **PATTERN** | **PART A** | **PART B** | **ESE Marks** |
| PATTERN 1 | 8 Questions, each question carries 3 marks Marks: (3x8 =24 marks) | 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 subdivisions. Each question carries 9 marks. Marks: (9x4 = 36 marks) | 60 |

**SYLLABUS**

**MODULE I (9 hours)**

**Exploring Biological concepts** – Identify various cell types (e.g., prokaryotic, eukaryotic, animal, plant, microbial) Cycles of life- Mitosis & Meiosis.
**Structure and function of Biomolecules** - carbohydrates (mono-, di-, and polysaccharides), lipids, proteins (amino acids, peptides), and nucleic acids (DNA & RNA).
**Introduction to Biotechnology:** Scope of biotechnology, History and development of biotechnology, Applications of biotechnology in various fields
**Ethical, Legal, and Social Implications:** Ethical issues in biotechnology, Intellectual property rights in biotechnology: an introduction

**MODULE 2 (8 hours)**

**Enzymes:** Classification, Mechanism of Enzyme action (lock & key model and induced fit hypothesis), Steady-state kinetics, Enzyme Inhibition, Regulatory Enzymes, Coenzymes, Vitamins (functions only)
**Application of Enzymes**- Applications of enzymes in industrial, pharmaceutical, and analytical sectors, Enzyme immobilization.

**MODULE 3 (10 hours)**

**Cell growth and Product synthesis** - Nutritional requirements, Growth patterns and kinetics in Batch culture, Conditions/ Factors affecting the cell growth and product synthesis.
Intracellular and extracellular products- Growth-associated and non-growth-associated products.

**Fluid Properties -** Density, Specific weight, Specific volume, Specific gravity, Viscosity, Absolute and gauge pressure. **Unit operations** - distillation, evaporation, absorption, adsorption, extraction and leaching operation. **Unit processes** - saponification, polymerization and hydrogenation.
**Bioprocess-** Basic concepts of Different Upstream and Downstream processes and product recovery

**MODULE 4 (9 hours)**

**Bioreactors** - Basic functions of a bioreactor, parts of a fermenter, and their functions. Role of aeration and mixing in oxygen transfer, mechanism of mixing, impellers- types, and Flow patterns.
**Modes of bioreactor operation** - Batch bioreactor, Continuous bioreactor, Fed-batch bioreactor and applications.
**Introduction to Process Instrumentation and Control:** common methodologies of measurements, Measuring Instruments: Thermocouples, Venturi meters, U-tube manometer. Biosensors- Enzyme and Microbial Biosensors – Basic concepts

**Text books**

1. Bioprocess Engineering-Basic Concepts, M. L. Shuler and F. Kargi, Prentice Hall, 2nd Edition, 2015
2. Principles of Biochemistry, Nelsen, David L., and Michael M. Cox. Lehninger. WH Freeman, Macmillan Learning, 2021
3. Biochemical Engineering Fundamentals, J. E. Bailey and D.F. Ollis, McGraw-Hill Chemical Engineering Series, 2nd Edition, McGraw Hill, 2017
4. Bioprocess Engineering Principles, Pauline M Doran, Academic Press, 1995
5. McCabe, W.L., J.C. Smith and P. Harriot Unit Operations of Chemical Engineering, 6th Edition, Mc Graw Hill, 2001.

**Reference books**

1. Principles of Biomedical Instrumentation, Webb, Andrew G, Cambridge University Press, 2018
2. Principles of Fermentation Technology, P. F. Stanbury, S. J. Hall, and A. Whitaker; 3rd Edition, Elsevier, 2016
3. Biology for Engineers, Johnson, Arthur T, CRC Press, 2018
4. Enzymes: biochemistry, biotechnology, clinical chemistry. Palmer, T., & Bonner, P. L. Elsevier. 2007

**NPTEL/SWAYAM Courses for reference:**

1. NPTEL:: Biotechnology - Cell Biology
2. NPTEL:: Biotechnology - Enzyme Science and Engineering
3. Bioreactor Design and Analysis - Course (nptel.ac.in)
4. NPTEL :: Biotechnology - NOC:Industrial Biotechnology

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours [36 hours] |
|---|---|---|
| | **MODULE 1 [ 9 hours]** | |
| 1.1 | Identify various cell types (e.g., prokaryotic, eukaryotic, animal, plant, microbial) | 1 |

| | | |
|---|---|---|
| 1.2 | Cycles of life- Mitosis & Meiosis. | 2 |
| 1.3 | Structure and function of Biomolecules - carbohydrates (mono-, di-, and polysaccharides), | 1 |
| 1.4 | lipids | 1 |
| 1.5 | Proteins (amino acids, peptides) | 1 |
| 1.6 | Nucleic acids (DNA & RNA) | 1 |
| 1.7 | Introduction to Biotechnology: Scope of biotechnology, History and development of biotechnology, Applications of biotechnology in various fields | 1 |
| 1.8 | Ethical, Legal, and Social Implications: Ethical issues in biotechnology, Intellectual property rights in biotechnology: an introduction | 1 |
| **MODULE II [ 8 hours]** | | |
| 2.1 | Classification, Mechanism of Enzyme action (lock and key model and induced fit hypothesis) | 2 |
| 2.2 | Steady-state kinetics, Enzyme Inhibition, Co-Enzymes | 2 |
| 2.3 | Vitamins (functions only) | 1 |
| 2.4 | Applications of enzymes in industrial, pharmaceutical, and analytical sectors, | 2 |
| 2.5 | Enzyme immobilization | 1 |
| **MODULE III [10 hours]** | | |
| 3.1 | Nutritional requirements, Growth patterns and kinetics in Batch culture, Conditions/ Factors affecting the cell growth and product synthesis. | 3 |
| 3.2 | Intracellular and extracellular products- Growth-associated and non-growth-associated products. | 2 |
| 3.3 | **Fluid Properties -** Density, Specific weight, Specific volume, Specific gravity, Viscosity, Absolute and gauge pressure. | 1 |
| 3.4 | **Unit operations** - distillation, evaporation, absorption, adsorption and extraction operation. **Unit processes** - saponification, polymerization and hydrogenation. | 1 |
| 3.5 | Basic concepts of Different Upstream and Downstream processes and product recovery | 3 |
| **MODULE IV [ 9 hours]** | | |
| 4.1 | Basic functions of a bioreactor, parts of a fermenter, and their functions. | 1 |
| 4.2 | Role of aeration and mixing in oxygen transfer, mechanism of mixing, impellers- types, and Flow patterns. | 2 |
| 4.3 | Batch bioreactor, Disadvantages of batch bioreactor, Continuous bioreactor, advantages of continuous bioreactor, Fed-batch bioreactor, Applications. | 2 |

| | | |
|---|---|---|
| 4.4 | Introduction to process instrumentation and control: common methodologies of measurements, | 2 |
| 4.5 | Measuring Instruments: Thermocouples, Venturi meters, U-tube manometer.<br>Biosensors- Enzyme and Microbial Biosensors – Basic concepts | 2 |
| **CO Assessment Questions** | | |
| CO1 | 1. Explain the structure and function of biomolecules.<br>2. Illustrate cell cycle with appropriate diagrams.<br>3. Summarize the history and development of biotechnology.<br>4. Exemplify the ethical issues in the field of biotechnology with any two case studies. | |
| CO2 | 1. How are enzymes classified according to their function?<br>2. Summarize the applications of enzymes in industrial, pharmaceutical, and analytical sectors.<br>3. Elucidate the lock and key model and induced fit hypothesis with examples.<br>4. Demonstrate the enzyme immobilization. | |
| CO3 | 1. Elucidate the unit operations and unit processes.<br>2. What are the properties of fluids and explain their significance?<br>3. Exemplify the growth patterns and kinetics in batch culture.<br>4. Summarize the basic concepts of different upstream and downstream processes and product recovery. | |
| CO4 | 1. Describe the modes of bioreactor operations.<br>2. Why are biosensors important? Justify your answer with two valid examples.<br>3. Illustrate the working principles of thermocouples, venturimeter and U-tube manometer with neat diagrams.<br>4. Explain the role of aeration and mixing in oxygen transfer mechanism. | |

Prepared by
Dr Ambili Mechoor
Professor, BTE

| 24EST144 | FOUNDATIONS OF ELECTRICAL & ELECTRONICS ENGINEERING | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 0 | 4 | 2024 |

**Preamble:**
This course enables the students to understand the basic concepts of Electrical and Electronics Engineering. This course covers the topics related to analysis of various electrical and magnetic circuits, concepts behind the generation of alternating current, fundamental electronic devices and circuits and an overview of evolution of communication systems.

**Prerequisite:** Nil

**Course Outcomes**: After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Apply the concepts and laws to solve electric circuits theoretically and using simulation tools **[Apply]** |
| **CO 2** | Understand the fundamental concepts and theorems of electromagnetic induction **[Understand]** |
| **CO 3** | Analyze the principles of diodes, transistors, and FETs to make basic electronic circuits **[Analyze]** |
| **CO 4** | Understand communication systems, mobile technologies, and modern electronic applications **[Understand ]** |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | | | 3 | | | | | | | 2 |
| **CO 2** | 2 | | | | | | | | | | | 2 |
| **CO 3** | 3 | 3 | | | | | | | | | | 2 |
| **CO 4** | 2 | | | | | | | | | | | 2 |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | ✔ | ✔ | | ✔ |
| Understand | ✔ | ✔ | | ✔ |
| Apply | ✔ | ✔ | ✔ | ✔ |
| Analyse | ✔ | ✔ | ✔ | ✔ |
| Evaluate | | | ✔ | |
| Create | | | | |

**Mark Distribution of CIA**

| Course Structure [L-T-P-R] | Attendance | Theory [L- T] | | | Total Marks |
|---|---|---|---|---|---|
| | | Assignment | Test-1 | Test-2 | |
| 4-0-0-0 | 5 | 10 | 12.5 | 12.5 | 40 |

**Total Mark distribution**

| Total Marks | CIA (Marks) | ESE (Marks) | ESE Duration |
|---|---|---|---|
| 100 | 40 | 60 | 2.5 hours |

**End Semester Examination [ESE]: Pattern**

| PATTERN | PART A | PART B | ESE Marks |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PATTERN 1 | 8 Questions, each question carries 3 marks<br>Marks: (3x8 =24 marks) | 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions.<br>Each question carries 9 marks.<br>Marks: (9x4 = 36 marks)<br>Time: 3 hours | 60 |

**SYLLABUS**

**MODULE I: Analysis of DC circuits and Fundamentals of Magnetism (10 hours)**

**Elementary concepts of DC electric circuits:** Ideal and non-ideal voltage and current sources; Basic Terminology including voltage, current, power, resistance, emf; Ohm's law and Kirchhoff's laws; Resistances in series and parallel; Capacitors & Inductors: V-I relations and energy stored. Star-delta conversion (resistive networks only-derivation not required)-numerical problems.

**Analysis of DC Electric circuits:** Mesh current method - matrix representation - Solution of network equations - numerical problems and verification through simulation software.

**Electromagnetic Induction**: Faraday's laws, Lenz's law - statically induced and dynamically induced emf – Self-inductance and mutual inductance, coefficient of coupling (numerical problems excluded)

**MODULE II: Analysis of AC circuits (9 hours)**

**Alternating Current fundamentals:** Generation of alternating voltages - Representation of sinusoidal waveforms: frequency, period, average value, RMS value, peak factor and form factor

**Analysis of AC circuits:** Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance; RL, RC and RLC series circuits- power factor, active, reactive and apparent power - numerical problems and verification through simulation software.

**Three phase AC systems:** Generation of three phase voltages, advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents, 3 phase power equation (numerical problems excluded)

**MODULE III: Introduction to Electronic devices (9 hours)**

**Passive and active components in electronics**

Working of PN junction diode, V-I characteristics of PN Junction diode, Zener diode and avalanche breakdown. Basics of Zener voltage regulator, Block diagram of DC power supply, circuit and working of half wave and bridge rectifiers (with and without capacitor filters), Construction and working of BJT, Input output characteristics of CE configuration, Comparison of CE, CB and CC configurations, Simscape Onramp, Circuit Simulation Onramp

**MODULE IV: Modern Electronics and its applications (8 hours)**

**Communication Systems:** General block diagram of a Communication system, Block diagram of Fiber optic Communication system, Concept of AM and FM (No derivation required), Block diagram of AM and FM superheterodyne receiver, Basic concepts of Wired and Wireless communication

**Mobile Communication:** Block diagram of GSM, Comparison of 3G, 4G, 5G and 6G communication technologies

**Applications of modern electronics**: IoT based smart homes, healthcare and agriculture (Case study only)

**Text books**


1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.


**Reference books**


1. Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, "Engineering Circuit Analysis", Tata McGraw-Hill
4. Hughes, "Electrical and Electronic Technology", Pearson Education.
5. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering," Second Edition, McGraw Hill.
6. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.


**NPTEL/SWAYAM Courses for reference:**

1. Prof. Ashok Kumar Pradhan, A Basic Course on Electric and Magnetic Circuits, IIT Kharagpur, [NPTEL], https://nptel.ac.in/courses/108105479 (Relevant sections)
2. Dr. Nagendra Krishnapura, Basic Electrical Circuits, IIT Madras, [NPTEL], https://nptel.ac.in/courses/108106172 (Relevant sections)
3. Mr. Abhijeet Lal & Dr. Onika Parmar, Fundamental of Electronic Engineering Chhattisgarh Swami Vivekanand Technical University (CSVTU) https://onlinecourses.swayam2.ac.in/nou24_ec08/preview
4. Prof. Sudeb Dasgupta, microelectronics: Devices to Circuits, IIT Roorkee, https://onlinecourses.nptel.ac.in/noc24_ee139/preview

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours [36 hours] |
|---|---|---|
| **MODULE 1 [10 hours]** | | |
| 1.1 | Ideal and non-ideal voltage and current sources; Ohm's law and Kirchhoff's laws | 2 |
| 1.2 | Resistances in series and parallel; Current and voltage division rules | 1 |
| 1.3 | Capacitors & Inductors: V-I relations and energy stored | 1 |
| 1.4 | Star-delta conversion (resistive networks only-derivation not required)-numerical problems | 2 |
| 1.5 | Mesh current method - matrix representation - Solution of network equations – numerical problems and verification through simulation software. | 2 |
| 1.6 | Faraday's laws, Lenz's law- statically induced and dynamically induced emf – Self-inductance and mutual inductance, coefficient of coupling - numerical problems. | 2 |
| **MODULE II [9 hours]** | | |
| 2.1 | Generation of alternating voltages - Representation of sinusoidal waveforms: frequency, period, average value, RMS value and form factor - numerical problems | 2 |
| 2.2 | Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance | 2 |
| 2.3 | RL, RC and RLC series circuits- power factor, active, reactive and apparent power - numerical problems and verification through simulation software. | 3 |
| 2.4 | Generation of three phase voltages, advantages of three phase systems, star and delta connections, relation between line and phase voltages, line and phase currents, 3-phase power | 2 |
| **MODULE III [ 9 hours]** | | |
| 3.1 | Working of PN junction diode, V-I characteristics of PN Junction diode | 1 |
| 3.2 | Basics of Zener diode, Zener and avalanche breakdown. Basics of Zener voltage regulator | 2 |
| 3.3 | Block diagram of DC power supply | 1 |
| 3.4 | Circuit and working of half wave, and bridge rectifiers (with and without capacitor filters) | 1 |
| 3.5 | Construction, working and V-I Characteristics of BJT, Input output characteristics of CE configuration | 2 |
| 3.6 | Comparison of CE, CB and CC configurations | 1 |
| 3.7 | Simscape Onramp, Circuit Simulation Onramp | 1 |
| **MODULE IV [ 8 hours]** | | |
| 4.1 | General block diagram of a Communication system, Block diagram of Fiber optic Communication system | 1 |
| 4.2 | Concept of AM and FM (No derivation required), Block diagram FM superheterodyne receiver | 2 |
| 4.3 | Basic concepts of Wired and Wireless communication | 1 |

| | | |
|---|---|---|
| 4.4 | Block diagram of GSM, Comparison of 3G, 4G, 5G and 6G communication technologies | 2 |
| 4.5 | IoT based smart homes | 1 |
| 4.6 | IoT based healthcare and agriculture | 1 |
| **CO Assessment Questions** | | |
| CO1 | 1. Determine the equivalent resistance between terminal X-Y in the network<br>2. Solve for the mesh currents in the given circuit.?<br>3. Explain Kirchhoff's laws with suitable examples.<br>4. Derive the expression for energy stored in an inductor and a capacitor<br>5. Distinguish between statically induced EMF and dynamically induced EMF.<br>6. State and explain Faraday's laws of electromagnetic induction.<br>7. A coil of 200 turns carries a current of 4A. The magnetic flux linkage with the coil is 0.02Wb. Calculate the self-induced emf in the coil.<br>8. A conductor of length 0.5m kept at right angles to a uniform magnetic field of flux density 2Wb/$m^2$ moves with a velocity of 75 m/s at an angle of $60^0$ to the field. Calculate the emf induced in the conductor. | |
| CO2 | 1. A resistor of 10 Ω, an inductor of 0.3 H and a capacitor of 100 μF are connected in series across a 230 V, 50 Hz, single phase ac supply. Determine (a) impedance (b) current (c) power in watts (d) circuit power factor (e) voltage across inductor (f) apparent power. Verify the same through any simulation software.<br>2. Explain the generation process of 3-phase alternating current.<br>3. A sinusoidal voltage of V= 325 sin314t when applied across an L-R series circuit causes a current of I = 14.14 sin (314t – 60°) flowing through the circuit. Calculate (i) Impedance of the circuit (ii) value of L and R (iii) the power consumed.<br>4. Derive the relation between line voltage and phase voltage in 3-phase star connected system | |
| CO3 | 1. Compare the efficiency and ripple factor of half-wave rectifiers and bridge rectifiers. Analyze how the inclusion of a capacitor filter alter the output of each rectifier type?<br>2. Analyze the output characteristics of a BJT and find out the significance of the BJT's operating regions and their impact on the transistor's functionality in different circuit applications.<br>3. Illustrate with the neat diagram the working of a zener voltage regulator.<br>4. Analyze potential barrier formation and current in a forward biased pn junction diode. | |
| CO4 | 1. Compare and contrast between AM and FM?<br>2. Draw and explain the block diagram of FM superheterodyne receiver.<br>3. With the help of a neat block diagram, explain the principle of operation of GSM.<br>4. Compare the different types of communication technologies. | |

Prepared by,
Ms. Drisya K Sasi, Assistant Professor, Department of EEE
Mr. Sebin Davis K, Assistant Professor, Department of EEE
Dr. Vishnu Rajan, Associate Professor, Department of ECE
Ms. Chinchu Jose, Assistant Professor, Department of ECE
Dr. Annet Antony, Assistant Professor, Department of ECE

| 24ESR105 | ALGORITHMIC THINKING WITH PYTHON | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 1 | 4 | 2024 |

**Preamble:** The syllabus is prepared with the view of preparing the engineering graduates to be capable of writing readable Python programs to solve computational problems that they may have to solve in their professional lives. The course content is decided to cover the essential programming fundamentals, which can be taught within the given slots in the curriculum.

**Prerequisite: NIL**

**Course Outcomes**: After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Analyze and develop an algorithm/flowchart for solving computational problems. **[Apply]** |
| **CO 2** | Articulate in design programs with interactive input and output, utilizing arithmetic expression repetitions, and decision-making. **[Understand]** |
| **CO 3** | Utilize modular Python programs using functions and process stored data using List, Tuples, Sets, Dictionaries. **[Apply]** |
| **CO 4** | Understand and implement file operations for reading input and storing output. **[Understand]** |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | | | | | 3 |
| **CO2** | 3 | 3 | 3 | 2 | | | 3 | 3 | | | | 3 |
| **CO3** | 3 | | | | | | | | | | | 3 |
| **CO4** | 3 | | | | | | | | | | | 3 |

**Assessment Pattern for Theory Component**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | √ | √ | | √ |
| Understand | √ | √ | | √ |
| Apply | √ | √ | √ | √ |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

**Assessment Pattern for Practical Component**

| Bloom's Category | Continuous Assessment Tools | |
|---|---|---|
| | Class work | Test |
| Remember | √ | √ |

| | | |
|---|---|---|
| Understand | √ | √ |
| Apply | √ | √ |
| Analyze | | |
| Evaluate | | |
| Create | | |

**Assessment Pattern for Project Component**

| **Bloom's Category** | **Continuous Assessment Tools** | | |
|---|---|---|---|
| | **Evaluation 1** | **Evaluation 2** | **Report** |
| Remember | √ | √ | |
| Understand | √ | √ | |
| Apply | √ | | |
| Analyze | | | |
| Evaluate | | | |
| Create | | | |

**Mark Distribution of CIA**

| | | **Theory [L]** | | | **Practical [P]** | | **Project [R]** | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Attendance** | **Assignment** | **Test-1** | **Test-2** | **Class Work** | **Test** | **Evaluation 1** | **Evaluation-2** | **Report** | |
| 2-0-2-1 | 5 | 5 | 7.5 | 7.5 | 7.5 | 5 | | 7.5 | 5 | 50 |

**Total Marks distribution**

| **Total Marks** | **CIA (Marks)** | **ESE (Mark)** | **ESE Duration** |
|---|---|---|---|
| 100 | 50 | 50 | 2 hrs |

**End Semester Examination [ESE]**

| **PATTERN** | **PART A** | **PART B** |
|---|---|---|
| PATTERN 2 | 2 Questions from each module.<br>Total of 8 Questions,<br>Answer any 6 questions.<br>Each carrying 3 marks<br>(6x3 =18 marks) | 2 questions will be given from each module, out of which 1 question should be answered.<br>Each question can have a maximum of 3 subdivisions.<br>Each question carries 8 marks.<br>(4x8 = 32 marks) |

| **SYLLABUS** |
|---|
| **MODULE I : Fundamentals of Algorithms (5 Hours)** |
| **Problem Solving strategies** — Problem analysis — formal definition of problem — Solution — top- down design — breaking a problem into sub problems- overview of the solution to the sub problems by writing step by step procedure (algorithm) - representation of procedure by flowchart - Implementation of algorithms — use of procedures to achieve modularity.<br><br>**Examples for algorithms and flow charts** - At least 10 problems (starting with non-numerical examples, and numeric problems like factorial, largest among three numbers, largest among N, Fibonacci. |
| **MODULE II: Variable Expression and Statements (6 Hours)** |
| **Introduction to Python-**variables, expressions and statements, evaluation of expressions, precedence, string operations<br>Control statements, Boolean expressions and logical operators, conditional and alternative executions |
| **MODULE III: Functions (6 Hours)** |
| Functions, calling functions, Recursion, composition of functions, mathematical functions, user-defined functions, parameters and arguments. |
| **MODULE IV: List, Dictionary Data Structures (6 Hours)** |
| Strings and lists — string traversal and comparison with examples. List operations with examples tuples and dictionaries — operations and examples ,Introduction to numpy, pandas, matplotlib ,Files and exceptions - text files, directories, Introduction to classes and objects - attributes, instances |
| **Textbooks**<br><br>1. Downey, A. et al., How to think like a Computer Scientist: Learning with Python, John Wiley, 2022<br>2. Reema Thereja., Computer Fundamentals and Programming in C, Oxford, 2023<br>3. Lambert K. A., Fundamentals of Python - First Programs, Cengage Learning India, 2019<br>4. Rajaraman, V., Computer Basics and C Programming, Prentice-Hall India |
| **Reference books**<br><br>1. Barry, P., Head First Python, , O' Reilly Publishers<br>2. Dromy, R. G., How to solve it by Computer, Pearson India<br>3. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India<br>4. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015<br>5. Sprankle , M., Problem Solving & Programming Concepts, Pearson India<br>6. Venit, S. and Drake, E., Prelude to Programming: Concepts & Design, Pearson India |

7. Zelle, J., Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates Inc.

**NPTEL/SWAYAM Courses for reference:**

1. The joy of Computing using Python - https://onlinecourses.nptel.ac.in/noc21_cs32/preview

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours (24) |
|---|---|---|
| | **MODULE I : Fundamentals of Algorithms (5 Hours)** | |
| 1.1 | Problem analysis — formal definition of problem | 1 |
| 1.2 | Solution — top- down design | 1 |
| 1.3 | breaking a problem into sub problems- | 1 |
| 1.4 | overview of the solution to the sub problems by writing step by step procedure (algorithm) | 1 |
| 1.5 | Representation of procedure by flowchart | 1 |
| 1.6 | Examples | 1 |
| | **MODULE II : Variable Expression and Statements [6 Hours]** | |
| 2.1 | variables, expressions | 1 |
| 2.2 | statements, evaluation of expressions | 1 |
| 2.3 | Precedence, string operations | 1 |
| 2.4 | Control statements | 1 |
| 2.5 | Boolean expressions and logical operators | 1 |
| 2.6 | conditional and alternative executions | 1 |
| | **MODULE III : Functions [6 Hours]** | |
| 3.1 | Functions | 1 |
| 3.2 | Calling functions | 1 |
| 3.3 | Recursion | 1 |
| 3.4 | Composition of functions | 1 |
| 3.5 | Mathematical functions | 1 |
| 3.6 | User-defined functions, parameters and arguments. | 1 |
| | **MODULE IV: List, Dictionary Data Structures [6 Hours]** | |
| 4.1 | Strings and lists, string traversal and comparison | 1 |
| 4.2 | List operations with examples | 1 |
| 4.3 | tuples and dictionaries, operations and examples | 1 |
| 4.4 | Files and exceptions - text files, directories | 1 |
| 4.5 | Introduction to numpy, pandas, matplotlib | 1 |
| 4.6 | Introduction to classes and objects - attributes, instances | 1 |

**Project:** Mini projects can be done in the respective engineering domain.

**LESSON PLAN FOR LAB COMPONENT (8 Experiments mandatory)**

| No. | Topic | No. of Hours (12) |
|---|---|---|
| 1 | Simple desktop calculator using Python. Only the five basic arithmetic operators | 1 |
| 2 | Create, concatenate, and print a string and access a sub-string from a given string. | 1 |
| 3 | Familiarize time and date in various formats (Eg. "Thu Jul 11 10:26:23 IST 2024"). | 1 |
| 4 | Program to find the largest of three numbers. | 1 |
| 5 | Convert temperature values back and forth between Celsius (c), and Fahrenheit (f). [Formula: c/5 =f-32/9] | 1 |
| 6 | Program to find the factorial of a number | 1 |
| 7 | Write program to check whether the given number is Armstrong or not | 1 |
| 8 | Write various programs to implement numpy, Pandas and matplotlib | 3 |
| 9 | Write a program to implement file operations | 1 |
| 10 | Write a program to demonstrate OOPs concepts in python | 1 |

**LESSON PLAN FOR PROJECT COMPONENT**

| No. | Topic | No. of Hours (12) |
|---|---|---|
| 1 | Introduction and awareness on various stages of a Mini Hackathon. | 6 |
| 2 | Final Mini Hackathon, Presentation and evaluation. | 6 |

**CO Assessment Questions**

| | |
|---|---|
| CO1 | 1. Draw the flowchart to find out the greatest of three numbers<br>2. Write an algorithm to compute sum of series 1 – x2/2 +x4/4-x6/6+……. n<br>3. Give the algorithm and flowchart for finding the largest and smallest numbers in each list of N numbers<br>4. Simple desktop calculator using Python. Only the five basic arithmetic operators |
| CO2 | 1. Evaluate the expression x ** y ** z. Given x = 2, y = 3, z=2<br>2. Write a python program to display all Armstrong numbers in each range<br>3. Write a python program to count the number of zeros and negative terms in each set of n numbers<br>4. Familiarize time and date in various formats (Eg. "Thu Jul 11 10:26:23 IST 2024"). |

| | |
|---|---|
| CO3 | 1. Why do we need functions? What are the advantages of function<br>2. Write a python program to find the sum of digits of a number<br>3. What do you mean by mutability of data structure? Explain with example why we say that list is mutable while tuples are immutable<br>4. Program to find the factorial of a number |
| CO4 | 1. Write a python program to create a text file and to input a line of text to it. Display the line pf text with all punctuation mark removed.<br>2. Create a class rectangle with attributes length, breadth and method area () to calculate the area of the rectangle. Create two instances of the class and call the method for each instance.<br>3. Write a program to read numbers stored in one file and store the sorted numbers in another after deleting duplicates.<br>4. Write a program to implement file operations |

Prepared by
Dr Sreeraj. R, Professor, CSE Department
Ms Livya George, Assistant Professor, CS Department

| 24ESL106 | FUNDAMENTALS IN BIOTECHNOLOGY LAB | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 | 2024 |

**Preamble:** To offer a comprehensive exploration of the core principles and practical applications in biotechnology and biochemical engineering.

**Prerequisite:** NIL

**Course Outcomes:** After the completion of the course the student will be able to

| | |
|---|---|
| **CO1** | Analyze the laboratory techniques, methodologies and equipment in accordance with current laboratory safety protocols. [Analyze] |
| **CO2** | Apply the principles and application of different analytical techniques in the laboratory [Apply] |
| **CO3** | Evaluate the applications of bioprocess industries [Evaluate] |
| **CO4** | Exemplify the parts and functioning of bioprocess equipment [Apply] |

**CO - PO MAPPING**

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

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | |
|---|---|---|
| | Classwork | Test |
| Remember | | |
| Understand | √ | √ |
| Apply | √ | √ |
| Analyze | √ | |
| Evaluate | √ | |
| Create | √ | |

**Mark Distribution of CIA**

| Course Structure [L-T-P-R] | Attendance | Classwork | Lab Exam | Total Marks |
|---|---|---|---|---|
| 0-0-2-0 | 5 | 25 | 20 | 50 |

**Total Mark distribution**

| Total Marks | CIA (Marks) | ESE (Marks) | ESE Duration |
|---|---|---|---|
| 50 | 50 | 0 | - |

**SYLLABUS- DETAILS OF EXPERIMENTS**

General study on biosafety in Laboratories, Safety precautions, Basic First Aid knowledge and awareness of different types of hazards in laboratories.

Basic concepts of preparing solutions (normality, molarity, molality).

Principles of sterile technique and cell propagation.

Preparation of buffers and determination of pH.

Determination of specific gravity.

Colorimetry - Validation of Beer-Lambert's Law, Absorption Maxima.

| |
|---|
| UV spectra of Nucleic Acids or Protein in spectrophotometer. |
| Estimation of Chemical Oxygen Demand (COD) in a given water Sample. |
| Determination of Biological Oxygen Demand (BOD) of given sample of water. |
| Determination of specific weight and specific volume of a liquid sample. |
| Estimation of Chemical Oxygen Demand (COD) in a given water Sample. |
| Determination of Biological Oxygen Demand (BOD) of given sample of water. |
| Determination of specific weight and specific volume of a liquid sample. |
| Extraction of lipids from natural sources. |
| Immobilization of enzyme (gel entrapment). |
| Demonstration of a bioprocess fermenter. |
| **Text books**<br>1. "Basic Laboratory Methods for Biotechnology" by Lisa A. Seidman, Cynthia J. Moore"<br>2. "Introduction to Chemical Engineering" Badger and Banchero, McGraw Hill.<br>3. Microbiology applications: Laboratory Manual in general Microbiology, McGraw Hill 2004. |
| **CO Assessment Questions** |
| 1. Identify the equipment, tools given to you and demonstrate its proper use.<br>2. Demonstrate the chemical safety precautions as a team<br>3. Articulate the biological safety precautions and sterile practices in the laboratory<br>4. Differentiate the different parameters of solutions and quantify them |
| 1. Identify the instrumentation of spectroscopy instruments, it's functions and principles<br>2. Evaluate the methods used to characterize water and asses the best method to be applied<br>3. Estimate the unknown concentration of a given colored solution<br>4. Elucidate the concentration of nucleic acids, protein sample using absorption spectroscopy principles |
| 1. Implement the principles of bioprocess and deliver products<br>2. Illustrate methods to deliver economically relevant products from natural sources<br>3. Design methods to effectively increase the stability, shelf life of bioproducts<br>4. Compare and contrast the efficiency of products through bioprocess operations and from natural source extraction |
| 1. Identify the different parts of bioprocess fermenter<br>2. Articulate the functions of each part of fermenter<br>3. Assess the external and internal environment of a bioprocess fermenter<br>4. Enumerate all the different conditions that effect the efficiency of a bioprocess operation in a fermenter |

Prepared by
Ms Steny Mary Anto
Asst Prof, BTE

| 24HUT007 | COMMUNICATIVE ENGLISH | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 | 2024 |

**Preamble:** This course aims to enhance the communicative English skills of engineering students. The course will cover the four main language skills: listening, reading, writing, and speaking. Students will engage in various activities, including practical sessions in the language lab, to improve their proficiency in English.

**Prerequisite:** NIL

**Course Outcomes**: After the completion of the course, the student will be able to

| | |
|---|---|
| **CO 1** | Improve Listening Skills in English [Apply] |
| **CO 2** | Enhance Students' Reading Skills in English [Analyze] |
| **CO 3** | Develop Writing Skills in English [Create] |
| **CO 4** | Improve Speaking Skills in English [Evaluate] |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 1 | | | | | | | | 2 | 3 | | |
| **CO 2** | 1 | 2 | | | | | | | | 3 | | |
| **CO 3** | 1 | | 2 | 3 | | | | | 2 | 3 | | |
| **CO 4** | 1 | | | | | | | | 3 | 3 | | |

**Assessment Pattern for Lab Component**

| Bloom's Category | Continuous Assessment Tools | |
|---|---|---|
| | Classwork | Test |
| Remember | | |
| Understand | | |
| Apply | √ | √ |
| Analyze | √ | √ |
| Evaluate | √ | √ |
| Create | √ | √ |

**Mark Distribution of CIA**

| Attendance | Lab [P] | | | | Total Marks |
|---|---|---|---|---|---|
| | Reading Test | Writing Test | Listening Test | Speaking Test | |
| 5 | 25 | 25 | 20 | 25 | **100** |

**Total Marks distribution**

| Total Marks | CIA (Marks) | ESE (Marks) | ESE Duration |
|---|---|---|---|
| 100 | 100 | 0 | - |

**SYLLABUS**

**MODULE I: Introduction and Listening Skills (4 hours)**

Introduction To the Theory of Communication: Types of Communication, Modes of Communication

**Listening Skills**: Listening: Importance And Benefits of Listening Skill, Different Types of Listening, Understanding different accents and dialects, Note-taking strategies, Strategies for Improving Listening

**MODULE II: Reading Skills (4 hours)**

Reading: A Passive Skill – Its Importance, Ten Important Reading Strategies and their Benefits, Skimming and scanning techniques, identifying main ideas and supporting details

**MODULE III: Writing Skills (4 hours)**

Different Styles of Writing, Fundamentals of English Usages, understanding different types of charts, graphs, and diagrams, describing trends and comparing data

Structuring an essay, developing arguments and supporting them with examples, Making Notes and Resumes, Report Writing, Fundamentals of Intonation, Correspondence Writing, Means to Enhance Vocabulary, Content Writing

**MODULE IV: Speaking Skills and Integrated Review (8 hours)**

**Speaking Skills:** The Importance of Speaking as an active skill; Grammar, Vocabulary, and Phonetics: Tools of Communicative English Developing fluency and coherence; Pronunciation and stress; Techniques for Effective Public Speaking; Group Discussion and Interview Skills; Presentation Skills; People Skills.

**Integrated Skills and Review:** Business English, Comprehension, Summary and Paraphrasing, Research Methodology and Documentation

**T Textbooks**


1. Effective Communication Skills/Kul Bhushun Kumar, P S Salaria, Khanna Book Publishing Co (P) Ltd, New Delhi
2. Communication Skills For Engineers & Scientists/ Sangeeta Sharma, Binod Mishra, PHI Learning Pvt Ltd, New Delhi
3. Humanities & Communication Skills/Pearson Education India Pvt Ltd, New Delhi
4. Adler B. Ronald and Russell F. Proctor II. Looking Out, Looking In. Cengage Learning.2017.
5. Dianna L.Vanblerkom. College Study Skills.Wadsworth.2003
6. Aggarwal, R. (2003). Effective Communication Skills. Jaipur: Sublime Publications
7. Davies, F. 1995, Introducing Reading. Penguin Books.
8. Downs, Lisa. Listening Skills Training. USA; ASTD, 2008. Print.


**Reference books**


1. Dawes, L. The Essential Speaking and Listening. Routledge, 2008.
2. Cornbleet, S., and Carter, R. The Language of Speech and Writing. Routledge, 2001.
3. Harvey, I. (1951). The Technique of Persuasion. London: The Falcon Press.
4. Anderson, A. and Lynch, T. (1988) Listening, Oxford: Oxford University, Press.
5. Riggenbach, Heidi. Perspectives on Fluency. University of Michigan Press, 2000.
6. Dianna L.Vanblerkom. College Study Skills.Wadsworth.2003
7. Crystal, D. (2003). English as a Global Language. 2nd edition. Cambridge: Cambridge University Press
8. Anderson, Marilyn, Pramod K. Nayar. Critical Thinking, Academic Writing and Presentation Skills. Dorling Kindersley. India 2010
9. David Crystal Mother-tongue India Talk for Lingua Franca (ABC, Australia), January

2005 http://www.globalenglish.com/blog/2014/06/10/indian-employers-report-business-english-is-essential-totheir-workforce/ by 12/3/14 at 6:15 pm
10. Crystal, David (2003). The Cambridge Encyclopedia of the English Language (2nd Ed.). Cambridge University Press. ISBN 0-521-53033-4.

**NPTEL/SWAYAM Courses for reference:**

1. https://onlinecourses.swayam2.ac.in/cec24_lg08/preview:: Communicative English By Dr. Salia Rex

**LESSON PLAN FOR LAB COMPONENT**

| No. Topic | Topic | No. of Hours (24) |
|---|---|---|
| 1 | Listening practice using audio resources | 4 |
| 2 | Reading comprehension exercises and quizzes | 4 |
| 3 | Writing practice and peer review | 4 |
| 4 | Essay writing/Resume writing/Report writing and feedback sessions | 4 |
| 5 | Speaking practice with peers and recording for self-assessment | 8 |

**CO Assessment Questions**

| | |
|---|---|
| CO1 | Listening Test: You will have to listen to four recordings (conversations and monologues) and then answer the questions asked. The recordings are of native English speakers, and various accents are used. Remember, you can hear each recording only once.<br>• **Recording 1:** You will listen to a dialogue in daily life and context.<br>• **Recording 2:** You will listen to a monologue about everyday life or social context. For instance, a talk on the condition of streets in an area.<br>• **Recording 3:** You will listen to a conversation between more than two people placed in a training or educational context. For instance, a teacher discusses an assignment with students.<br>• **Recording 4:** You will listen to a monologue on any academic subject, such as a college lecture.<br>Answer 6 question types, including:<br>• Multiple choice<br>• Matching<br>• Plan/map/diagram labelling<br>• Note completion<br>• Short answer questions |
| CO 2 | The Reading test is divided into three parts, each featuring a comprehensive passage from contemporary books, journals, magazines, and newspapers. These passages reflect topics relevant to academic and professional environments in English-speaking contexts.<br>Answer 11 question types, including:<br>• Multiple choice<br>• Identifying information<br>• Note completion<br>• Matching headings |

| | |
|---|---|
| | • Matching sentence endings<br>• Summary completion<br>• Sentence completion<br>• Flow-chart completion |
| CO 3 | **Part 1:** You are presented with a graph, table, chart, or diagram and asked to describe, summarize, or explain the information in your own words. You may be asked to describe and explain data, describe the stages of a process, explain how something works, or describe an object or event.<br>**Part 2:** You are asked to write an essay responding to a point of view, argument or problem. |
| CO 4 | **Part 1:** (4–5 minutes) Introduction and interview. The examiner will ask you to introduce yourself and confirm your identity. Then, the examiner will ask you generic questions about family, studies, work, and interests.<br>**Part 2:** (3–4 minutes) Individual long turn. The examiner will give you a task card with a topic written on it, with some points you may cover in your speech. You will have one minute to think and prepare the topic; a paper and pencil will be provided to jot down your notes. Once done ideating, you will have a time of one to two minutes to speak on the subject, followed by some questions on the same by the examiner.<br>**Part 3:** (4–5 minutes) Two-way discussion. The examiner will ask more questions related to the topic provided in Part 2 of the Speaking test. You can use this opportunity to talk about more ideas. |

# SEMESTER-II
# SYLLABUS

| 24MAT221 | INFINITE SERIES, MULTIPLE INTEGRALS AND VECTOR CALCULUS | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 2024 |

**Preamble:**
This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Fourier series and multiple integral. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions and has applications across all engineering domains with the help of modern tools.

**Prerequisite:** Calculus of single and multi-variable functions.

**Course Outcomes:** After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Apply power series and Fourier series representations to express functions, and analyze their domains of convergence.**[Apply]** |
| **CO 2** | Solve double and triple integrals to find areas and volumes of geometrical shapes. **[Apply]** |
| **CO 3** | Evaluate derivatives and integrals of vector valued functions and explore their applications. **[Apply]** |
| **CO 4** | Compute line integrals, surface integral, volume integral and understand their inter relation and application. **[Apply]** |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | | 2 | | | | | | | |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | | | | | | | |
| **CO 3** | 3 | 3 | | | | | | | | | | |
| **CO 4** | 3 | 3 | | | 2 | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | √ | √ | √ | √ |
| Understand | √ | √ | √ | √ |
| Apply | √ | √ | √ | √ |
| Analyses | | | | |
| Evaluate | | | | |
| Create | | | | |

| **Mark Distribution of CIA** | | | | | |
|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Attendance** | **Theory [L]** | | | **Total Marks** |
| | | **Assignment** | **Test-1** | **Test-2** | |
| 3-0-0-0 | 5 | 10 | 12.5 | 12.5 | 40 |

| **Total Mark distribution** | | | |
|---|---|---|---|
| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
| 100 | 40 | 60 | 2.5 hours |

| **End Semester Examination [ESE]: Pattern** | | | |
|---|---|---|---|
| **PATTERN** | **PART A** | **PART B** | **ESE Marks** |
| PATTERN 1 | 8 questions (2 Questions from each Module) , each question carries 3 marks Marks: (3x8 =24 marks) | 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of two sub divisions. Each question carries 9 marks. Marks: (9x4 = 36 marks) | 60 |

**SYLLABUS**

**MODULE I: Series representation of functions (9hours)**

**(Text 1: Relevant topics from section 9.3, 9.8**
**Text 2: Relevant topics from section 11.1,11.2)**

Concept of convergence of an infinite series and region of convergence, Series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence), Taylor series representation (without proof, assuming the possibility of power series expansion in appropriate domains), Maclaurin series representation, Fourier series, Euler formulae, Convergence of Fourier series (Dirichlet's conditions), Fourier series of 2π periodic functions, Fourier series of 2l periodic functions, Half range sine series expansion, Half range cosine series expansion .

**MODULE II: Multivariable Calculus-Integration(9hours)**

**(Text 1: Relevant topics from section 14.1, 14.2, 14.3, 14.5, 14.6)**

Double integrals, Reversing the order of integration in double integrals, Change of coordinates in double integrals (Cartesian to polar), Evaluating areas using Double integrals, finding volumes using double integration, Triple integrals, volume calculated as triple integral, Triple integral in cylindrical and spherical coordinates.

**MODULE III: Calculus of vector functions(9hours)**

**(Text 1: Relevant topics from section 12.1, 12.2, 13.6, 15.1, 15.2, 15.3)**

Vector valued function of single variable - derivative of vector valued function, Concept

of scalar and vector fields, Gradient and its properties, Directional derivative, Divergence and curl, Line integrals of vector fields, Work done as line integral, Conservative vector field, independence of path, Potential function (results without proof).

**MODULE IV: Vector integral theorems(9hours)**

**(Text 1: Relevant topics from section 15.4, 15.5, 15.6, 15.7)**

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals, finding areas using Greens theorem. Surface integrals over surfaces of the form z=g(x,y) Flux integrals over surfaces of the form z= g(x,y), Divergence theorem (without proof), Using Divergence theorem to find flux.

**Text books**

1. H. Anton, I. Biven, S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition, John Wiley & Sons, 2016.

**Reference books**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition,2010.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012.
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson, Reprint,2002.
5. Louis C Barret, C Ray Wylie, Advanced Engineering Mathematics, Tata McGraw Hill, 6th edition, 2003.
6. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017.

**NPTEL/SWAYAM Courses for reference:**

1. Multi Variable Calculus https://nptel.ac.in/courses/111107108 NPTEL ::
2. Taylor's Theorem, Line Integrals,Green's Theorem https://archive.nptel.ac.in/courses/122/104/122104017/

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hrs [36] |
|---|---|---|
| | **MODULE 1 [ 9 hours]** | |
| 1.1 | Concept of convergence of an infinite series and region of convergence | 1 |
| 1.2 | Series representation of exponential, trigonometric, logarithmic functions(without proofs of convergence) | 1 |
| 1.3 | Taylor series representation (without proof, assuming the possibility of power series expansion in appropriate domains) | 1 |
| 1.4 | Maclaurin series representation | 1 |
| 1.5 | Fourier series, Euler formulae | 1 |
| 1.6 | Convergence of Fourier series (Dirichlet's conditions) | 1 |
| 1.7 | Fourier series of 2π periodic functions, Fourier series of 2l periodic functions | 1 |

| | | |
|---|---|---|
| 1.8 | Half range sine series expansion | 1 |
| 1.9 | Half range cosine series expansion | 1 |
| **MODULE II [ 9 hours]** | | |
| 2.1 | Double integrals | 1 |
| 2.2 | Reversing the order of integration in double integrals | 2 |
| 2.3 | Change of coordinates in double integral (Cartesian to polar) | 1 |
| 2.4 | Evaluating areas using double integrals | 1 |
| 2.5 | Finding volumes using double integration | 1 |
| 2.6 | Triple integrals,Volume calculated as triple integral | 1 |
| 2.7 | Triple integral in cylindrical coordinates | 1 |
| 2.8 | Triple integral in spherical coordinates | 1 |
| **MODULE III [9 hours]** | | |
| 3.1 | Vector-valued function of single variable - derivative of vector valued function | 1 |
| 3.2 | Concept of scalar and vector fields | 1 |
| 3.3 | Gradient and its properties | 1 |
| 3.4 | Directional derivative | 1 |
| 3.5 | Divergent and curl | 1 |
| 3.6 | Line integrals of vector fields | 1 |
| 3.7 | Work done as line integral | 1 |
| 3.8 | Conservative vector field | 1 |
| 3.9 | Independence of path, Potential function (results without proof). | 1 |
| **MODULE IV [ 9hours]** | | |
| 4.1 | Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals | 2 |
| 4.2 | Finding areas using Greens theorem | 2 |
| 4.3 | Surface integrals over surfaces of the form z=g(x, y) Flux integrals over surfaces of the form z = g(x, y) | 2 |
| 4.4 | Divergence theorem (without proof) | 2 |
| 4.5 | Flux using Divergence theorem. | 1 |
| **CO Assessment Questions** | | |
| CO1 | 1. Derive power series for sin x, cos x and analyze the domains where these series converge.<br>2. What do you mean by radius of convergence of a power series? How is it determined?<br>3. Find the Fourier series of the function f(x)=$\|x\|$ , which is assumed to have the period 2π. Show the details of your work. Sketch or graph the partial sums up to that including cos 5x and sin 5x.<br>**Teamwork:**<br>Write a MATLAB script to generate the first 10 terms of the Maclaurin series for log(1+x). Discuss the behaviour of the series near the end points of its interval of convergence. | |
| CO2 | 1. Use a triple integral to find the volume of the solid within the cylinder $x^2 + y^2 = 9$ and between the planes z = 1 and x + z = 5. | |

| | |
|---|---|
| | 2. Outline the method for finding the volume of a solid using a double integral. Explain the difference between integrating over a region in the xy-plane versus integrating over a region in the xyz-space. Provide an example of calculating volume using a double integral.<br>3. Use double integration to find the area of the plane region enclosed by the given curve $y = sinx,\ y = cosx\ for\ 0 \leq x \leq \pi/4$.<br>**Teamwork:**<br>Using MATLAB, calculate the area of a circle with a given radius using polar coordinates. |
| CO3 | 1. Describe the parametric curve represented by the equations x = a cost, y = a sin t, z = ct where a and c are positive constants.<br>2. Sketch the graph and a radius vector of r(t) = cost i + sin t j , $0 \leq t \leq 2\pi$.<br>3. Given that $f_x(-5, 1) = -3$ and $f_y(-5, 1) = 2$, find the directional derivative of f at P (−5, 1) in the direction of the vector from P to Q(−4, 3).<br>**Teamwork:**<br>How do you find the tangent and normal vectors to a curve described by a vector valued function? |
| CO4 | 1. Explain the conditions under which Green's Theorem is applicable<br>2. Use Divergence Theorem to find the outward flux of the vector field F(x, y, z) = $x^3\ \hat{\imath} + y^3\ \hat{\jmath} + z^2\ \hat{k}$ across the surface of the region that is enclosed by the circular cylinder $x^2 + y^2 = 9$ and the planes z = 0 and z = 2.<br>3. What is the difference between a scalar surface integral and a vector surface integral?<br>**Teamwork:**<br>Apply Greens theorem to calculate area of an ellipse (major axis-4units, minor axis-3units) in MATLAB. |

Prepared by
Mrs. Rani Thomas
Asst Prof, ASH

| 24PHC232 | ENGINEERING PHYSICS | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 | 2024 |

Preamble: Designed to deepen students' understanding of fundamental physics concepts and their applications in engineering and technology. It aims to build a strong foundation in physics, integrating theoretical principles with practical applications. By exploring interference, diffraction, quantum mechanics, lasers, optical fibres, and acoustics, students will develop the scientific and analytical skills necessary for interdisciplinary research and problem-solving in biotechnology and civil engineering fields.

**Prerequisite:** Basic knowledge in Physics and Mathematics.

**Course Outcomes**: After the completion of the course, the student will be able to

| | |
|---|---|
| **CO 1** | Use the phenomena of interference and diffraction to determine the wavelength of monochromatic light.[Apply] |
| **CO 2** | Apply the knowledge of basic Quantum Mechanics in the behaviour of matter at atomic and subatomic levels.[Apply] |
| **CO 3** | Apply the basic concepts of lasers and optical fibres to get theoretical foundations and practical aspects in engineering fields. [Apply] |
| **CO 4** | Apply the knowledge of waves in non-destructive testing and Acoustics in the design of buildings to provide a safe and healthy environment. [Apply] |
| **CO5** | Apply basic knowledge of principles and theories in physics to conduct experiments. [Apply] |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | | | | | | | | | | 2 |
| **CO 2** | 3 | 3 | | | | | | | | | | 2 |
| **CO 3** | 3 | 3 | | | | | | | | | | 2 |
| **CO 4** | 3 | 3 | | | | | | | | | | 2 |
| **CO 5** | 3 | 3 | | | 2 | | | | 2 | | | 2 |

**Assessment Pattern for Theory Component**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | ✓ | ✓ | ✓ | ✓ |
| Understand | ✓ | ✓ | ✓ | ✓ |
| Apply | ✓ | ✓ | ✓ | ✓ |
| Analyse | | | | |

| | | | | |
|---|---|---|---|---|
| Evaluate | | | | |
| Create | | | | |

**Assessment Pattern for the Lab component**

| **Bloom's Category** | **Continuous Assessment Tools** | |
|---|---|---|
| | **Class work** | **Test1** |
| Remember | ✓ | ✓ |
| Understand | ✓ | ✓ |
| Apply | ✓ | |
| Analyse | | |
| Evaluate | | |
| Create | | |

**Mark Distribution of CIA**

| **Course Structure [L-T-P-R]** | **Attendance** | **Theory [L]** | | | **Practical [P]** | | **Total Marks** |
|---|---|---|---|---|---|---|---|
| | | **Assignment** | **Test-1** | **Test-2** | **Lab work** | **Lab Exam** | |
| 3-0-2-0 | 5 | 5 | 7.5 | 7.5 | 10 | 15 | 50 |

**Total Marks distribution**

| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
|---|---|---|---|
| 100 | 50 | 50 | 2 hours |

**End Semester Examination [ESE]: Pattern**

| **PATTERN** | **PART A** | **PART B** | **ESE Marks** |
|---|---|---|---|
| PATTERN 2 | 2 Questions from each module, 8 questions, each Question carries 3 marks. Answer any 6 Marks: (6x3 =18 marks) | 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 subdivisions. Each question carries 8 marks. Marks: (4x 8 = 32 marks) | 50 |

**SYLLABUS**

| **MODULE I: Interference and Diffraction (9 Hours)** |
|---|
| Introduction to wave optics, Principle of superposition, Constructive and destructive interference, Optical path, Phase difference and path difference, Cosine law- reflected system, Condition for constructive & destructive interference, Colours in thin films, Newton's rings, Measurement of refractive index of transparent liquids & wavelength, Air wedge (qualitative)<br><br>Types of Diffraction, Diffraction through grating- Construction, Grating equation, Dispersive and Resolving Power |
| **MODULE II: Quantum Mechanics (9 Hours)** |
| Introduction to Quantum Mechanics, Wave nature of particle, Uncertainty principle, Applications-Absence of electron inside the nucleus- Natural line broadening, Wave function- properties - physical interpretation, Formulation of time-dependent and time-independent Schrodinger equations, Particle in a one-dimensional box - Derivation of energy eigenvalues and normalised wave function, Quantum Mechanical Tunnelling(Qualitative) |
| **MODULE III: Laser and Fibre Optics (9 Hours)** |
| Properties of Laser, Absorption, Spontaneous emission and stimulated emission, Principle of laser - conditions for sustained lasing – Population inversion, Pumping, Metastable states, Basic components of laser - Active medium, Energy source, Optical resonant cavity, Construction and working of Ruby laser, $CO_2$ Laser, Applications of laser.<br><br>Optic fiber-Principle of propagation of light, Types of fibers-Step index and Graded index fibers, Multimode, Single mode, Acceptance angle, Numerical aperture –Derivation, Applications of optical fibers - Fiber optic communication system (block diagram) |
| **MODULE IV: Waves and Acoustics (9 Hours)** |
| Waves-Transverse and Longitudinal waves, Concept of frequency, time period, wavelength (no derivation), Transverse vibrations in stretched string-Derivation of velocity and frequency Laws of transverse vibration,<br><br>Acoustics-Reverberation and echo, Reverberation time and its significance, Sabine's Formula, Factors affecting acoustics of a building<br><br>Ultrasonics-Piezoelectric oscillator, Ultrasonic diffractometer, SONAR, NDT-Pulse echo method, Medical application-Ultrasound scanning (Qualitative) |
| **Text books**<br>1. M.N. Avadhanulu, P.G. Kshirsagar, TVS Arun Murthy "A Textbook of Engineering Physics", S. Chand &Co., Revised Edition 2019.<br>2. H.K. Malik, A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017. |
| **Reference books**<br>1. G Vijayakumari, "Engineering Physics", Vikas Publications, 8th Edition, 2014<br>2. Gerd Keiser, "Fiber Optic Communications ", Springer, 2021 |

3. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003.
4. D. K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015.
5. Md.N. Khan & S. Panigrahi "Principles of Engineering Physics 1 & 2", Cambridge University Press, 2016.
6. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015.
7. Ajoy Ghatak, "Optics", McGraw Hill Education, Sixth Edition, 2017.
8. Premlet B., "Advanced Engineering Physics", Phasor Books,11th edition ,2021.
9. I Dominic and. A. Nahari, "A Text Book of Engineering Physics", Owl Books Publishers, Revised edition, 2016.
10. H.D Young and R.A Freedman, "University Physics with Modern Physics" 2020, 15th Edition, Pearson, USA.


**NPTEL/SWAYAM Courses for reference:**

Module I- Applied Optics
https://onlinecourses.nptel.ac.in/noc24_ph39/preview

Module II - Quantum Mechanics
https://nptel.ac.in/courses/115101107
Quantum Mechanics and Applications
https://nptel.ac.in/courses/115102023

Module III- Fundamentals and Applications
https://nptel.ac.in/courses/104104085
Introduction to LASER
https://nptel.ac.in/courses/115102124

Module IV-Fundamentals of Acoustics
https://nptel.ac.in/courses/112104212
Architectural Acoustics
https://nptel.ac.in/courses/124105004
Wave Optics
https://nptel.ac.in/courses/115105537

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours [36] |
|---|---|---|
| | **MODULE I: Interference and Diffraction (9 Hours)** | |
| 1.1 | Introduction to wave optics, Principle of superposition, | 1 |
| 1.2 | Constructive and destructive interference, Optical path, Phase difference and path difference | 1 |
| 1.3 | Cosine law- reflected system | 1 |
| 1.4 | Condition for constructive & destructive interference, Colours in thin films | 1 |
| 1.5 | Newton's rings, Measurement of refractive index of transparent liquids & wavelength | 1 |
| 1.6 | Air wedge(qualitative) | 1 |
| 1.7 | Types of Diffraction, Diffraction through grating- Construction | 1 |
| 1.8 | Grating equation | 1 |

| | | |
|---|---|---|
| 1.9 | Dispersive and Resolving Power | 1 |
| **MODULE II: Quantum Mechanics (9 Hours)** | | |
| 2.1 | Introduction to Quantum Mechanics, Wave nature of particles, | 1 |
| 2.2 | Uncertainty principle | 1 |
| 2.3 | Applications-Absence of electron inside the nucleus, Natural line broadening mechanism | 1 |
| 2.4 | Wave function, its properties and physical interpretation, | 1 |
| 2.5 | Formulation of time dependent Schrodinger equations, | 1 |
| 2.6 | Formulation of time independent Schrodinger equations | 1 |
| 2.7 | Particle in a one- dimensional box - Derivation of energy eigenvalues and normalised wave function | 2 |
| 2.8 | Quantum Mechanical Tunnelling(Qualitative) | 1 |
| **MODULE III: Laser and Fibre Optics (9 Hours)** | | |
| 3.1 | Properties of Laser, Absorption, Spontaneous emission and stimulated emission | 1 |
| 3.2 | Principle of laser - conditions for sustained lasing – Population inversion, Pumping, Metastable states | 1 |
| 3.3 | Basic components of laser - Active medium, Energy source, Optical resonant cavity. | 1 |
| 3.4 | Construction and working of Ruby laser | 1 |
| 3.5 | $CO_2$ Laser | 1 |
| 3.6 | Properties of laser, Applications of laser | 1 |
| 3.7 | Optic fibres-Principle of propagation of light, Types of fibres -Step index and Graded index fibre, | 1 |
| 3.8 | Multimode, Single mode, Numerical Aperture - Derivation | 1 |
| 3.9 | Applications of optical fibres - Fibre optic communication system (block diagram) | 1 |
| **MODULE IV: Waves and Acoustics (9 Hours)** | | |
| 4.1 | Waves-Transverse and Longitudinal waves, Concept of frequency, time period, wavelength (no derivation) | 1 |
| 4.2 | Transverse vibrations in stretched string-Derivation of velocity and frequency Laws of transverse vibration, | 1 |
| 4.3 | Acoustics-Reverberation and echo | 1 |
| 4.4 | Reverberation time and its significance | 1 |
| 4.5 | Sabine's Formula, Factors affecting acoustics of a building | 1 |

| | | |
|---|---|---|
| 4.6 | Ultrasonics-Piezoelectric oscillator | 1 |
| 4.7 | Ultrasonic diffractometer | 1 |
| 4.8 | SONAR, NDT-Pulse echo method | 1 |
| 4.9 | Medical application-Ultrasound scanning (Qualitative) | 1 |

**LESSON PLAN FOR LAB COMPONENT**

| No. | Topic | No. of Hours | Experiment |
|---|---|---|---|
| 1 | Interference and Diffraction | 2 | Determination of the diameter of a thin wire using the air wedge method. |
| | | 2 | Determination of wavelength of monochromatic light using grating. |
| | | 2 | Determination of wavelength of monochromatic light using Newton's rings setup. |
| 2 | Quantum Mechanics | 2 | Determine the size of lycopodium powder using a laser. |
| | | 2 | Quantum mechanical tunnelling using simulation. |
| | | 2 | Particle in a 1D box using simulation. |
| 3 | Laser and Fibre Optics | 2 | Determination of wavelength of Laser using diffraction grating. |
| | | 2 | Determination of Numerical aperture and acceptance angle of optic fibre using Laser. |
| 4 | Waves and Acoustics | 2 | Melde's string apparatus-Measurement of frequency in the transverse and longitudinal mode |
| | | 2 | Piezoelectric oscillator using simulation. |
| | | 2 | To determine the frequency and amplitude of waves using CRO |

(Any 2 experiments from each topic to be completed)

**CO Assessment Questions**

| | |
|---|---|
| CO1 | 1. Two Independent sources of light cannot produce interference fringes. Why?<br>2. What is a grating? Derive the grating equation. Explain how we can find the wavelength of monochromatic light using grating. What is the effect of increasing the number of lines on the dispersive power of grating?<br>3. Explain the formation of Newton's rings and show that the radius of the dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? |

| | |
|---|---|
| | 4. With Newton's rings arrangement, $n^{th}$ dark ring formed by light of wavelength $6000A^0$ coincides with the $(n+1)^{th}$ dark ring for the light of wavelength $4500A^0$. If the radius of curvature of the convex surface is 90 cm, Find the diameter of the $n^{th}$ ring for light of wavelength $6000A^0$. |
| CO2 | 1. Give the physical significance of wave function.<br>2. By applying Heisenberg's uncertainty principle prove the absence of electron inside the nucleus.<br>3. An electron is confined to a one-dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV.<br>4. Write down the Schrodinger equation for a particle in a one-dimensional infinite square well potential and also derive the equation for normalised wave function and energy eigenvalues for a particle in 1 D Box. |
| CO3 | 1. Explain the construction and working of a ruby laser with the help of energy level diagrams by applying the concept of stimulated emission.<br>2. Calculate the ratio of spontaneous to stimulated emission by an incandescent bulb at 2000K. Take frequency = $6 \times 10^{14}$ Hz. Boltzmann constant k = $1.38 \times 10^{-23}$ J/K.<br>3. Why should the refractive index of cladding be of lower value in comparison with the refractive index of core in an optic fibre?<br>4. Define numerical aperture and acceptance angle of an optical fibre and derive expression for numerical aperture of a step index fibre with a neat diagram. |
| CO4 | 1. Discuss the propagation of a transverse wave along a stretched string and derive the expression for frequency.<br>2. A uniform steel wire has length 10 m and mass 2 kg. Find the Tension in the string if the speed of transverse wave on the wire is 340m/s.<br>3. Explain the terms absorption coefficient and reverberation time. What is the significance of reverberation time? Discuss the factors on which the Reverberation time depends and write the Sabine's formula.<br>4. Write a note on SONAR. Give any two uses of it. |
| CO5 | 1. Determination of the diameter of a thin wire using the air wedge method.<br>2. Determine experimentally the size of lycopodium powder using a laser.<br>3. By applying the principle of Diffraction determine the wavelength of a laser source using a diffraction grating arrangement.<br>4. Determine experimentally frequency of waves in the transverse and longitudinal mode using Melde's string apparatus. |

Prepared by
Ms. Siji Thomas
Asst.Prof. ASH

| 24EST003 | ENGINEERING GRAPHICS | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 2024 |

**Preamble:**

Practicing Engineers require the ability to translate ideas into tangible designs and interpret existing drawings. "Engineering Graphics" covers fundamental principles such as orthographic projections, dimensioning, sectional views, surface development, isometric projections and conversion of isometric to orthographic projection. This course equips students with essential skills in engineering drawing, preparing them for careers in Engineering.

**Prerequisite:** Nil

**Course Outcomes:** After the completion of the course, the student will be able to

| | |
|---|---|
| **CO1** | Translate the principles of orthographic projections to prepare projections of lines and solids.**[Apply]** |
| **CO2** | Prepare sectional views and develop surfaces of a given solid.**[Apply]** |
| **CO3** | Convert between 2D orthographic views and 3D isometric projections effectively. **[Apply]** |

**CO-PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | | 2 | | |
| **CO2** | 3 | 3 | 2 | | | | | | | 3 | | |
| **CO3** | 3 | 3 | 2 | | | | | | | 3 | | |

**Assessment Pattern for Theory**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test2 | Other tools | |
| Remember | | | ✓ | |
| Understand | | | ✓ | |
| Apply | ✓ | ✓ | ✓ | ✓ |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| Mark Distribution of CIA | | | | | |
|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Attendance** | **Theory[L-T]** | | | |
| | | **Test-1** | **Test-2** | **Class work/ Assignment** | **Total Marks** |
| 3-0-0-0 | 5 | 10 | 10 | 15 | 40 |

| Total Marks distribution | | | |
|---|---|---|---|
| **Total Marks** | **CIA(Marks)** | **ESE(Marks)** | **ESE Duration** |
| 100 | 40 | 60 | 2hrs 30min |

| End Semester Examination [ESE]: Pattern | | | |
|---|---|---|---|
| | **PARTA** | **PARTB** | **ESE Marks** |
| PATTERN 3 | NA | 2 questions will be given from each module, out of which 1 question should be answered,each carrying 15 marks. Marks:(4x15=60marks) | 60 |

**SYLLABUS**

**MODULE I: Introduction to Engineering Drawing and Orthographic Projection of Points and Lines (11 Hours)**

Introduction: Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing. (No questions for the end semester examination)

Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Traces of a line. Inclination of lines with reference planes True length and true inclinations of line inclined to both the reference planes.( Questions limited to Lines in first quadrant , lines in first & second quadrants, lines in first & third quadrants, Lines in third quadrant)

**MODULE II: Orthographic Projections of Solids (10 Hours)**

Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone, Cylinder and tetrahedron. Projection of solids in simple position. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

**MODULE III: Section of solids and Development of Surfaces (10 Hours)**

Sections of Solids: Sections of tetrahedron, Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. (Exclude true shape given problems)

Development of Surfaces: Development of surfaces of the solids and solids cut by different

section planes with axis of the solid perpendicular to HP. (Exclude problems with through holes and shortest distance between two points)

**MODULE IV: Isometric Projection and Multi-view Projection (5 Hours)**

Isometric Projection: Isometric scale- Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Multi view Projection- Conversion of pictorial views to orthographic view(F.V,T.V & S.V)

**Textbooks**

1. P.I. Varghese, Engineering Graphics, Tata McGraw Hill Education
2. Prof. J Benjamin, Engineering Graphics, Pentex Publishers
3. John, K.C. Engineering Graphics, Prentice Hall India Publishers.
4. N.D. Bhatt, Engineering Drawing ,Charotar Publishing House
5. Agrawal, B. And Agrawal, C.M., Engineering Drawing, Tata McGraw Hill Publishers.

**Reference books**

1. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
2. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.

NPTEL/SWAYAM Courses for reference:

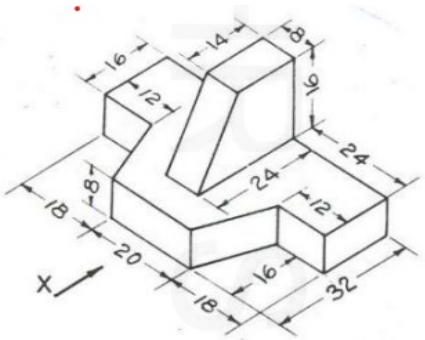
1. Engineering Drawing, Prof P.S. Robi, IIT Guwahati https://nptel.ac.in/courses/112103019
2. Engineering Graphics and Design, Naresh V Datla, Sunil R Kale, IIT Delhi https://archive.nptel.ac.in/courses/112/102/112102304/

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours (36) |
|---|---|---|
| | **MODULE1 (11 Hours)** | |
| 1.1 | Relevance of technical drawing in engineering field. Types of lines and their Uses | 1 |
| 1.2 | Dimensioning, BIS code of practice for technical drawing. | 1 |
| 1.3 | Orthographic Projection Concepts-Projection of points in different quadrants- Problems | 1 |
| 1.4 | Projection of straight lines parallel to both HP and VP- Problems | 1 |
| 1.5 | Projection of straight lines perpendicular to either HP or VP and parallel to other- Problems | 1 |
| 1.6 | Projection of straight lines inclined to either HP or VP and parallel to other- Problems | 1 |
| 1.7 | Trace of a line- Concept | 1 |
| 1.8 | Projection of straight lines inclined to both HP and VP – Line rotation method- Problems | 2 |
| 1.9 | Projection of straight lines inclined to both HP and VP – Plane rotation method- Problems | 2 |
| | **MODULE II (10 Hours)** | |
| 2.1 | Types of Solids | 1 |

| | | |
|---|---|---|
| 2.2 | Projection of solid in simple position- Problems | 1 |
| 2.3 | Projection of solid inclined to any one reference plane. – Problems | 3 |
| 2.4 | Projection of solid inclined to both reference plane. - Problems | 5 |
| **MODULE III (10 Hours)** | | |
| 3.1 | Types of Section planes and True shape of section | 1 |
| 3.2 | Sectional view of solids when section plane is parallel to HP and Perpendicular to VP- Problems | 1 |
| 3.3 | Sectional view of solids when section plane is parallel to VP and Perpendicular to HP- Problems | 1 |
| 3.4 | Sectional view of solids and true shape of section when section plane is inclined to HP and Perpendicular to VP- Problems | 1 |
| 3.5 | Sectional view of solids and true shape of section when section plane is inclined to VP and Perpendicular to HP- Problems | 1 |
| 3.6 | Development of surfaces- concept | 1 |
| 3.7 | Development of surfaces- Prism | 1 |
| 3.8 | Development of surfaces- Pyramid | 1 |
| 3.9 | Development of surfaces- Cone and Cylinder | 1 |
| 3.10 | Development of sectioned solids-Problems | 1 |
| **MODULE IV (5 Hours)** | | |
| 4.1 | Isometric Projection- Isometric Scale- Isometric Drawing | 1 |
| 4.2 | Isometric Projection/drawing of solids- Problems | 1 |
| 4.3 | Isometric Projection/drawing of Combination of solids –Problems | 1 |
| 4.4 | Isometric Projection/drawing of sphere & hemisphere –Problems | 1 |
| 4.5 | Multi-view Projection Concept -Problem | 1 |
| **Total Hours** | | **36** |

**CO Assessment Questions**

| | | |
|---|---|---|
| CO1 | 1 | The distance between end projectors of a line CD is 65mm. End C is 15mm above HP and 40mm in front of VP. Its front view and top view makes an angle of $40^0$ and $45^0$ respectively with XY- line. Draw the projections, find the true length and true inclinations with HP and VP, and locate its traces. The line is in the first quadrant. |
| | 2 | The front view of a line AB measures 70mm and makes an angle of $50^0$ with XY-line. The end A is in the HP and the VT of the line is 30mm above HP. The line is inclined at $40^0$ to the VP. Draw the projections of the line, find its true length and true inclination to HP, and locate its HT. |
| | 3 | One end point of line AB is 12 mm above HP and is 15 mm in front of VP. The other endpoint is 50 mm above HP and is 42 mm in front of VP. Draw the projections of line AB if its elevation measures 70 mm. Find out its true length and the true inclinations with respect to the reference planes. |
| | 4 | A cone of base diameter 40 mm and axis 60 mm long touches the VP on a point of its base circle. The axis is inclined at $30^0$ to VP and the front view of its axis is inclined at $45^0$ to XY line. Draw its projections. |
| | 5 | A square pyramid of base edge 30 mm and height 60 mm is resting on HP on its triangular face such that the square face edge on HP is inclined $30^0$ to VP. |

| | |
|---|---|
| | Draw its projections.<br>6 A pentagonal prism 30 mm base edge and 60 mm height is on HP on one of its base edges so that the axis is inclined at $45^0$ with HP and the base edge on which it rests is inclined at $30^0$ with VP. Draw the projections of the solid. |
| CO2 | 1. A pentagonal pyramid side of base 30 mm, height 65 mm has its base on the ground and one of its base edge is parallel to and nearer to VP. This pyramid is cut by a section plane perpendicular to VP, passing through a point on the axis which is 20 mm below the apex and making an angle of $40^0$ with HP. Draw the front view, sectional top view and true shape of the section.<br>2. A hexagonal prism of base side 35 mm and height 65 mm rests on its base on HP with one of the base edges parallel to VP. It is cut by a section plane inclined towards right at an angle of $30^0$ to HP and perpendicular to VP. The section plane meets the axis of the prism at a height of 45 mm from the base. Draw the front view, sectional top view, and true shape of the section.<br>3. A pentagonal prism of base 30 mm and axis 60 mm long is kept with its base on HP with a base edge perpendicular to VP. It is cut by a plane inclined at $45^0$ to HP, perpendicular to VP and passing through the midpoint of the axis. Draw the development showing the remaining portion of the solid. |
| CO3 | 1. A hemisphere of diameter 60 mm is placed centrally over a square slab of side 50mm and height 40 mm, with its flat surface facing upward. Draw the isometric view of the combination<br>2. A hexagonal pyramid of base edge 25 mm and height 40 mm is surmounted centrally over a cube of 50 mm side. The cube is lying on HP on one of its square faces so that one base edge of the cube and one base edge of the pyramid are parallel to VP. Draw the isometric view of the combination.<br>3. Draw the orthographic projections (front view, top view, and left side view) of the following figure. The front view direction is marked with a long arrow marking as X. Any missing dimension may be suitably assumed. All dimensions are in mm<br>  |

Prepared by
Dr. Nixon K, Principal
Mr. Mathews V J
Asst. Prof, ASH

| 24ESC204 | PROGRAMING IN C | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 2 | 1 | 2 | 0 | 4 | 2024 |

**Preamble:** The syllabus is prepared with the view of preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life. The course content is decided to cover the essential programming fundamentals which can be taught within the given slots in the curriculum.

**Prerequisite: NIL**

**Course Outcomes**: After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Analyze a computational problem and develop an algorithm/flowchart to find its solution. **[Analyze Level]** |
| **CO 2** | Develop readable C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators. **[Understand Level]** |
| **CO 3** | Write readable C programs with arrays, string, structure or union for storing the data to be processed and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem **[Apply Level]** |
| **CO 4** | Write readable C programs which use pointers for array processing and parameter passing and operation in files. **[Apply Level]** |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 2 | | | | | | | | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | | | | | | | | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | | | | | | | 2 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 |

**Assessment Pattern for Theory Component**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test 1 | Test 2 | Other tools | |
| Remember | √ | √ | | √ |
| Understand | √ | √ | | √ |
| Apply | √ | √ | | √ |
| Analyze | √ | √ | | √ |
| Evaluate | | | | |
| Create | | | | |

**Assessment Pattern for Lab Component**

| Bloom's Category | Continuous Assessment Tools | | |
|---|---|---|---|
| | Evaluation 1 | Evaluation 2 | Report |
| Remember | √ | √ | √ |
| Understand | √ | √ | √ |
| Apply | √ | √ | √ |
| Analyze | | | |
| Evaluate | | | |
| Create | | | |

| Mark Distribution of CIA | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Attendance** | **Theory [L- T]** | | | **Practical [P]** | | **Total Marks** |
| | | **Assignment** | **Test-1** | **Test-2** | **Continuous Assessment** | **Lab Exam** | |
| 2-1-2-0 | 5 | 5 | 7.5 | 7.5 | 15 | 10 | 50 |

| Total Marks distribution | | | |
|---|---|---|---|
| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
| 100 | 50 | 50 | 2 hours |

**End Semester Examination [ESE]**

| PATTERN | PART A | PART B | ESE Marks |
|---|---|---|---|
| PATTERN 2 | 2 Questions from each module.<br>Any full 6 Questions, each carrying 3 marks<br>(6x3 =18 marks) | 2 questions will be given from each module, out of which 1 question should be answered.<br>Each question can have a maximum of 3 subdivisions.<br>Each question carries 8 marks. (4x8 = 32 marks) | 50 |

**SYLLABUS**

**MODULE I: Basics of Computer Hardware and Software**

**Processor, Memory, Input& Output devices**

**Application Software & System software:** Compilers, interpreters, High level and low-level languages Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*

**MODULE II: Program Basics**

**Basic structure of C program:** Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf

**Operators and Expressions:** Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence

**Control Flow Statements:** If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. (Simple programs covering control flow)

**MODULE III: Arrays, Strings and Functions**

**Arrays**: Arrays Declaration and Initialization ,1-Dimensional Array, 2-Dimensional Array

**String processing:** In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets) **Introduction to modular programming**: writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters

| |
|---|
| structure, union, Storage Classes, Scope and lifetime of variables, *simple programs using functions* |
| **MODULE IV: Pointers and Files** |
| **Pointers**: Declaring pointers, accessing data though pointers, NULL pointer, array access using pointers, pass by reference effect<br>**File Operations**: open, close, read, write, append, Sequential access and random access to files: In built file handling functions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*), *simple programs covering pointers and files.* |
| **Textbooks**<br>1. Schaum Series, Gottfried B.S.,Tata McGraw Hill,Programming with C, 1996<br>2. E. Balagurusamy, Mcgraw Hill, Programming in ANSI C, 8/e, 2019<br>3. Asok N Kamthane, Pearson, Programming in C, 3/e, 2015<br>4. Anita Goel, Pearson, Computer Fundamentals,2010. |
| **Reference books**<br>1. Anita Goel and Ajay Mittal, Pearson, Computer fundamentals and Programming in C<br>2. Brian W. Kernighan and Dennis M. Ritchie, Pearson, C Programming Language<br>3. Rajaraman V, PHI, Computer Basics and Programming in C<br>4. Yashavant P, Kanetkar, BPB Publications, Let us C |
| **NPTEL/SWAYAM Courses for reference:**<br>1. Introduction to Programming in C - https://archive.nptel.ac.in/courses/106104128/<br>2. Problem solving through programming in C - https://archive.nptel.ac.in/courses/106105171/<br>3. C Programming and Assembly Language - https://archive.nptel.ac.in/courses/106106210/ |

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours (36) |
|---|---|---|
| **Module 1: Basics of Computer Hardware and Software (7 Hours)** | | |
| 1.1 | Basics of Computer Architecture: Processor, Memory, Input& Output devices | 2 |
| 1.2 | Application Software & System software: Compilers, interpreters, High level and low-level languages | 2 |
| 1.3 | Introduction to structured approach to programming, Flow chart | 1 |
| 1.4 | Algorithms, Pseudo code (bubble sort, linear search - algorithms and pseudo code) | 2 |
| **MODULE II: Program Basics (8 Hrs)** | | |
| 2.1 | **Basic structure of C program:** Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf | 2 |
| 2.2 | **Operators and Expressions:** Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, sizeof operator, Assignment operators and Bitwise Operators. Operators Precedence | 2 |
| 2.3 | **Control Flow Statements:** If Statement, Switch Statement, | 4 |

| | | |
|---|---|---|
| | Unconditional Branching using go to statement, While Loop, Do While Loop, For Loop, Break and Continue statements. *(Simple programs covering control flow)* | |
| **MODULE III: Arrays, Strings and Functions (11 Hours)** | | |
| 3.1 | Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array | 2 |
| 3.2 | **String processing:** In built String handling functions (*strlen, strcpy, strcat and strcmp, puts, gets*), *Simple programs covering arrays and strings* | 3 |
| 3.3 | Introduction to modular programming, writing functions, formal parameters, actual parameters | 2 |
| 3.4 | Pass by Value, Recursion, Arrays as Function Parameters | 3 |
| 3.5 | Structure, union, Storage Classes, Scope and lifetime of variables, simple programs using functions | 3 |
| **MODULE IV: Pointers and Files (6 Hrs)** | | |
| 4.1 | **Basics of Pointer**: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect | 3 |
| 4.2 | **File Operations**: open, close, read, write, append | 4 |
| 4.3 | **Sequential access and random access to files:** In built file handling functions (*rewind (), fseek(), ftell(), feof(), fread(), fwrite(), simple programs covering pointers and files.* | 2 |

**LESSON PLAN FOR LAB COMPONENT**

| No. | Topic | No. of Hours (24) | Experiment (8 Programs Mandatory) |
|---|---|---|---|
| 1. | Familiarization of Hardware Components. Familiarization of Linux environment | 2 | 1. Familiarization of Hardware Components of a Computer<br>2. Familiarization of Linux environment – How to do Programming in C with Linux |
| 2. | Familiarization of console I/O and operators in C | 2 | Familiarization of console I/O and operators in C<br>i) Display "Hello World"<br>ii) Read two numbers, add them and display their sum<br>iii) Read the radius of a circle, calculate its area and display it |
| 3. | Basic structure of C program. Operators and Expressions | 2 | 1. Read 3 integer values and find the largest among them.<br>2. Read a Natural Number and check whether the number is prime or not |
| 4. | Arrays & Strings | 4 | Read n integers, store them in an array and find their sum and average Read two strings (each one ending with a $ symbol), store them in arrays and concatenate them without using library functions. |

| | | | |
|---|---|---|---|
| 5. | Structure, Union | 3 | 1. Read two input each representing the distances between two points in the Euclidean space, store these in structure variables and add the two distance values.<br>2. Using structure, read and print data of n employees (Name, Employee Id and Salary) |
| 6. | Simple programs using functions | 3 | Find the factorial of a given Natural Number n using recursive and non-recursive functions |
| 7. | Simple programs using Pointer | 4 | Do the following using pointers<br>i) add two numbers<br>ii) swap two numbers using a user defined function |
| 8. | File Operations | 4 | Create a file and perform the following<br>i) Write data to the file<br>ii) Read the data in each file & display the file content on console<br>iii) append new data and display on console |
| **CO Assessment Questions** | | | |
| 1 | 1. Write short note on processor and memory in a computer.<br>2. What are the differences between compiled and interpreted languages? Give example for each.<br>3. With the help of a flow chart, explain the bubble sort operation. Illustrate with an example<br>Display "Hello World" Program | | |
| 2 | 1. Write a C program to read a Natural Number through keyboard and to display the reverse of the given number. For example, if "3214567" is given as input, the output to be shown is "7654123".<br>2. Is it advisable to use *goto* statements in a C program? Justify your answer.<br>3. With suitable examples, explain various operators in C.<br>4. Read the radius of a circle, calculate its area and display it | | |
| 3 | 1. Write a function in C which takes a 2-Dimensional array storing a matrix of numbers and the order of the matrix (number of rows and columns) as arguments and displays the sum of the elements stored in each row.<br>2. Write a C program to check whether a given matrix is a diagonal matrix.<br>3. Without using any builtin string processing function like *strlen*, *strcat* etc., write a program to concatenate two strings<br>4. Find the factorial of a given Natural Number n using recursive and non-recursive functions | | |
| 4 | 1. With an example, explain the different modes of opening a file.<br>2. Differentiate between sequential files and random-access files?<br>3. Using the prototypes explain the functionality provided by the following | | |

| | |
|---|---|
| | functions.<br>i)(*rewind(), ii)fseek() iii)ftell(), iv) fread(), v) fwrite()*<br>4. With a suitable example, explain the concept of pass by reference.<br>5. Create a file and perform the following i) Write data to the file ii) Read th in each file & display the file content on console iii) append new data and on console |

Prepared By

Ms Minnuja S, Assistant Professor, CSE Department

Ms Anly A, Assistant Professor, CSE Department

| 24BTR205 | BIOPROCESS CALCULATIONS | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 2 | 1 | 0 | 1 | 4 | 2024 |

**Preamble:**

To provide you with a comprehensive understanding of the mathematical principles and computational techniques essential for the analysis and optimization of bioprocesses.

**Prerequisite:** Basic knowledge of the concepts of mathematics, chemistry and chemical engineering principles.

**Course Outcomes**: After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Carry out basic calculations in material balance for various unit operations[Understand] |
| **CO 2** | Solve the unit processes through mass balance approach [Apply] |
| **CO 3** | Analyze the energy requirements of chemical and biochemical processes [Analyze] |
| **CO 4** | Formulate mass and energy requirements in bioprocess based on stoichiometry and elemental balances.[Apply] |

**CO - PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 3 | 3 | 2 | | | | | | | | |
| **CO 2** | 2 | 3 | 3 | 2 | | | | | | | | |
| **CO 3** | 2 | 3 | 3 | 2 | | | | | | | | |
| **CO 4** | 2 | 3 | 3 | 2 | | | | | | | | |

**Assessment Pattern for Theory Component**

| Bloom's Category | Continuous Assessment Tools | | | End Semester Examination |
|---|---|---|---|---|
| | Test1 | Test 2 | Other tools | |
| Remember | √ | √ | √ | √ |
| Understand | √ | √ | √ | √ |
| Apply | √ | √ | √ | √ |
| Analyze | √ | | √ | √ |
| Evaluate | | | | |
| Create | | | | |

**Assessment Pattern for Project Component**

| Bloom's Category | Continuous Assessment Tools | | |
|---|---|---|---|
| | Evaluation 1 | Evaluation 2 | Report |
| Remember | | | |
| Understand | | | |
| Apply | | | |
| Analyze | | | |
| Evaluate | | | |
| Create | √ | √ | √ |

| Mark Distribution of CIA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Structure [L-T-P-R]** | **Attendance** | **Theory [L]** | | | **Project [R]** | | | **Total Marks** |
| | | **Assignment** | **Test-1** | **Test-2** | **Evaluation 1** | **Evaluation-2** | **Report** | |
| 2-1-0-1 | 5 | 5 | 7.5 | 7.5 | 10 | 10 | 5 | **50** |

| Total Marks distribution | | | |
|---|---|---|---|
| **Total Marks** | **CIA (Marks)** | **ESE (Marks)** | **ESE Duration** |
| 100 | 50 | 50 | 2 hrs. |

| End Semester Examination [ESE]: Pattern | | | |
|---|---|---|---|
| **PATTERN** | **PART A** | **PART B** | **ESE Marks** |
| PATTERN 2 | 2 Questions from each module.<br>Any full 6 Questions, each carrying 3 marks<br>(6x3 =18 marks) | 2 questions will be given from each module, out of which 1 question should be answered.<br>Each question can have a maximum of 3 subdivisions.<br>Each question carries 8 marks. (4x8 = 32 marks) | 50 |

**SYLLABUS**

**MODULE I:Units and Conversions: System of Units and Conversion (7 hours)**

Overview of process industry and bioprocess industry. Definition of unit operations and unit processes. Units and Conversions: System of Units and Conversion.

Chemical composition: Methods of expressing compositions of mixtures and solutions- mole percent, mass percent, volume percent, average molecular weight, molarity, molality, normality, ppm, density and specific gravity, and specific gravity scales. (Numerical examples required)

**MODULE II: Fundamentals of material balances (12 hours)**

Fundamentals of material balances: Law of conservation of mass, types of material balance problems - total and component balances, steady and unsteady state processes, batch and continuous processes. Concept of tie element, basis for calculations, independent material balance equations and degrees of freedom, steps for solving material balance.

Material balances without chemical reactions: Material balances for unit operations like evaporation, crystallization, adsorption, extraction, and distillation. Bypass, recycle and

purging

**MODULE III: Material balances with chemical reactions (9 hours)**

Material balances with chemical reactions: Definition of terms like limiting reactant, excess reactant, percentage yield and selectivity, extent of reaction-simple numerical examples. Combustion of solid, liquid and gaseous fuels, heating value of fuels, proximate and ultimate analysis of coal, Orsat analysis. Recycle and purge involving chemical reactions

Fundamentals of energy balances: Law of conservation of energy for non-reactive systems, qualitative study of components of energy balance equations.

**MODULE IV: Stoichiometry of cell growth and product formation (8 hours)**

Stoichiometry of cell growth and product formation: Overall growth stoichiometry-medium formulation and yield factors, elemental material balances for growth, electron balances, product formation stoichiometry, theoretical oxygen demand and maximum possible yield (simple numerical examples).

Thermodynamics of microbial growth and product formation: Heat of reaction with and without oxygen as principal electron acceptor – simple numerical examples

**Textbooks**

1. Stoichiometry and Process Calculations, K.V. Narayanan, B. Lakshmikutty, Prentice Hall of India Learning (P) Ltd, Second edition, 2017
2. Pauline M Doran – Bioprocess Engineering Principles, Second edition, 2013

**Reference books**

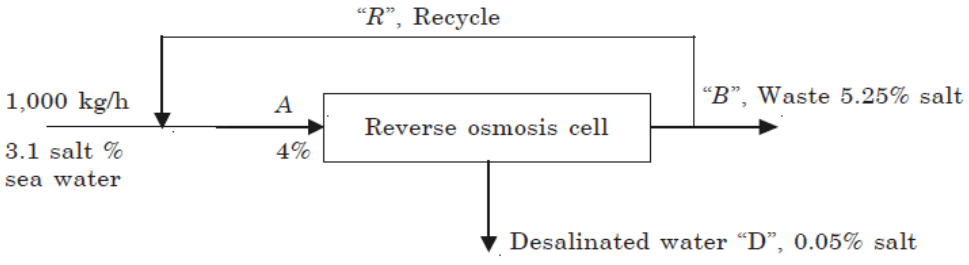
1. V Venkatarmani & N.N.Ananthraman – *Process calculation* – Prentice Hall India.
2. Michael L Shuler & Fikret Kargi – Bioprocess Engg. Basic Concepts – Prentice – Hall, India.
3. David M. Himmelblau, James B. Riggs, Basic Principles and Calculations in Chemical Engineering Prentice Hall of India Learning (P) Ltd, Ninth edition, 2021

**NPTEL/SWAYAM Courses for reference:**

1. Material and Energy balances: https://archive.nptel.ac.in/courses/102/106/102106069/
2. Basic Principles and Calculations in Chemical Engineering: https://archive.nptel.ac.in/courses/103/103/103103165/

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours (36 hours) |
|---|---|---|
| | **MODULE I (7 hours)** | |
| 1.1 | Overview of process industry and bioprocess industry. Definition of unit operations and unit processes. | 2 |
| 1.2 | Units and Conversions: System of Units and Conversion. | 1 |
| 1.3 | Chemical composition: Methods of expressing compositions of mixtures and solutions- mole percent, mass percent, volume percent, average molecular weight | 2 |

| | | |
|---|---|---|
| 1.4 | molarity, molality, normality, ppm | 1 |
| 1.5 | density and specific gravity, and specific gravity scales | 1 |
| **MODULE II (12 hours)** | | |
| 2.1 | Fundamentals of material balances: Law of conservation of mass, types of material balance problems - total and component balances, steady and unsteady state processes, batch and continuous processes. | 2 |
| 2.2 | Concept of tie element, basis for calculations, independent material balance equations and degrees of freedom, steps for solving material balance. | 2 |
| 2.3 | Material balances without chemical reactions: Material balances for unit operations like evaporation | 2 |
| 2.4 | Crystallization and adsorption | 2 |
| 2.5 | Extraction and Distillation | 2 |
| 2.8 | Bypass, recycle and purging | 2 |
| **MODULE III (9 hours)** | | |
| 3.1 | Material balances with chemical reactions: Definition of terms like limiting reactant, excess reactant, percentage yield and selectivity, extent of reaction-simple numerical examples. | 2 |
| 3.2 | Combustion of solid, liquid and gaseous fuels, heating value of fuels, proximate and ultimate analysis of coal, | 2 |
| 3.3 | Orsa analysis | 2 |
| 3.4 | Recycle and purge involving chemical reactions | 2 |
| 3.5 | Fundamentals of energy balances: Law of conservation of energy for non-reactive systems, qualitative study of components of energy balance equations. | 1 |
| **MODULE IV (8 hours)** | | |
| 4.1 | Stoichiometry of cell growth and product formation: Overall growth stoichiometry- medium formulation and yield factors | 2 |
| 4.2 | Elemental material balances for growth, electron balances | 2 |
| 4.3 | product formation stoichiometry | 1 |
| 4.4 | theoretical oxygen demand and maximum possible yield). | 1 |
| 4.5 | Thermodynamics of microbial growth and product formation: Heat of reaction with and without oxygen as principal electron acceptor | 2 |
| | **PROJECT** | |
| Description: To immerse students in the application of bioprocess calculations theory through a series of project-based assignments. Students will gain practical experience in analyzing bioprocess data, designing experiments, modeling bioreactor kinetics, and optimizing process conditions. Emphasis will be placed on integrating mathematical principles with real-world biotechnological applications. | | |
| **LESSON PLAN FOR PROJECT COMPONENT** | | |
| **No. Topic** | **Topic** | **No. of Hours (13)** |
| **1** | Preliminary Design of the Project | 2 |

| | | |
|---|---|---|
| **2** | Zeroth presentation (4th week) | 2 |
| **3** | Project work - First Phase | 2 |
| **4** | Interim Presentation | 2 |
| **5** | Project work - Final Phase & Report writing (discussions in class during project hours) | 2 |
| **6** | Final Evaluation, Presentation and Exhibition (11th and 12th weeks) | 3 |
| **CO Assessment Questions** | | |
| CO1 | 1. The pressure reading from a barometer is 742 mm Hg. Express this reading in kilopascals, kPa.<br>2. An aqueous solution contains 40% of Na2CO3 by weight. Express the composition in mole percent?<br>3. Calculate the weight of NaCl that should be placed in a 1 litre volumetric flask to prepare a solution of 1.8 molality. Density of this solution is 1.06 g/cc.<br>4. A gas contains methane: 45% and carbon dioxide: 45% and rest nitrogen. Calculate the average molecular weight? | |
| CO2 | 1. A weak acid containing 12.5% H2SO4 and the rest water is fortified by adding 500 kg of concentrated acid containing 80% H2SO4. Determine the amount of the solution obtained if it contains 18.5% H2SO4.<br>2. An aqueous solution of ethanol containing 20% by weight ethanol is to be separated into a distillate product containing 97% by weight ethanol and bottom product containing 2% by weight ethanol. Apply the principle of material balance to determine the amount of distillate and bottom products obtained from 100kg of feed<br>3. A solution containing 10% NaCl, 3% KCl and water is fed to the process shown in Figure 8.13 at the rate of 18,400 kg/h. The compositions of the streams are as follows: Evaporator product P—NaCl: 16.8%, KCl : 21.6% and water. Recycle product R—NaCl: 18.9% and water. Calculate the flow rates in kg/h and compute the composition of feed to the evaporator (F).<br>4. Sea water is desalinated by reverse osmosis using the scheme shown in Figure 8.10D stream has 500 ppm salt = 0.05%. Find (a) rate of B, (b) rate of D, (c) recycle R<br>  | |

| | |
|---|---|
| CO3 | 1. Coal contains 85% carbon and 15 % ash. The cinder formed as a result of combustion of coal contains 80% ash and 20% carbon. Determine the weight of cinder formed by the combustion of 100 kg of coal.<br>2. Fresh orange juice contains 12% (by mass) solids and rest water. 90% of the fresh juice is sent to an evaporator to remove water and the product subsequently mixed with the remaining 10% of fresh juice. The resultant product contains 40% solids. Illustrate the process with a neat sketch and determine the following:<br>i) suitable basis for the problem<br>ii) material balance around the evaporator and mixing point<br>iii) water removed in kg from 1kg fresh juice.<br>3. Determine the flue gas analysis and the air–fuel ratio by weight when a medium viscosity of fuel–oil with 84.9% C, 11.4% H2, 3.2% S, 0.4% O2 and 0.1% ash is burnt with 20% excess air. Assume complete combustion.<br>4. A coal containing 87.5% total carbon and 7% unoxidized hydrogen is burnt in air (a) If 40% excess air is used than that of theoretically needed, calculate the kg of air used per kg of coal burned. (b) Calculate the composition by weight of gases leaving the furnace assuming complete combustion. |
| CO4 | 1. The aerobic degradation of Benzoic acid by mixed culture can be represented by the following reaction: $C_6H_5COOH$ + a $O_2$ + b $NH_3$ —----- $cC_5H_7O_2N$ +d $H_2O$+e $CO_2$. Find the stoichiometric coefficients where RQ value is 0.9.<br>2. Explain how degrees of reduction useful in finding stoichiometric coefficients.<br>3. Determine the amount of $(NH_4)_2SO_4$ to be supplied in a fermentation medium where the final cell concentration is 30 g/l in a $10^3$ l culture volume. Assume that the cells are 12% nitrogen by weight and $(NH_4)_2SO_4$ is the only nitrogen source.<br>4. Biological denitrification of nitrate-containing waste waters can be described by the following overall reaction.<br>$NO_3^{-1} + a\,CH_3OH + H^+ \longrightarrow b\,C_5H_7NO_2 + c\,N_2 + d\,CO_2 + e\,H_2O$<br>**a.** Determine *a, b, c, d,* and *e,* if $Y_{X/S}$ = 0.5 g *X*/g N.<br>**b.** Determine the degree of reduction of bacteria and methanol. |

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| 24HUT006 | PROFESSIONAL ETHICS AND SUSTAINABLE DEVELOPMENT | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 1 | 0 | 2 | 0 | 2 | 2024 |

**Preamble:**
Engineering Ethics enables students to explore the ethical principles and responsibilities of engineers in their professional practice, using real-world case studies. Sustainable Development transform our world, recognize interdependence, enhance quality of life, enhance human responsibilities, eliminate pollution, conserve natural resources and uplift human-nature coexistence. Relevant case studies impart students, effective ways to practically apply their skills and their understanding of learned facts to a real-world situation. The presentation of case studies will provide an opportunity to read, understand and prepare technical report about sustainable, professional and socially responsible projects.

**Prerequisite:** NIL

Course Outcomes: After the completion of the course, the student will be able to

| | |
|---|---|
| **CO1** | Understand key ethical principles and moral development theories that shape the ethical behavior of a professional. |
| **CO2** | Analyze the role and responsibility as engineers through real world case studies to solve moral and ethical problems. |
| **CO3** | Appreciate the relevance and necessity of sustainable development and recognize good practices and opportunities for an integrated approach to sustainable development |
| **CO4** | Understand case studies about sustainable and socially responsible projects which impart students an effective way to realize real-world situations |

**CO – PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | 1 | | | 3 | 2 | 3 | 2 | | | 3 |
| CO2 | | | 1 | | | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| CO3 | | | 1 | | | 3 | 3 | 2 | 2 | | | 3 |
| CO4 | | | 1 | | | 3 | 3 | 2 | 2 | 3 | 2 | 3 |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | | | Case studies |
|---|---|---|---|---|
| | Test 1 | Test 2 | Assignment | |
| Remember | ✓ | ✓ | | |

| | | | | |
|---|---|---|---|---|
| Understand | ✓ | ✓ | ✓ | ✓ |
| Apply | ✓ | ✓ | ✓ | ✓ |
| Analyze | | | | ✓ |

**Mark Distribution of CIA**

| Course Structure [L-T-P-R] | Attendance | Theory [L] | | | Practical [P] | Total Marks |
|---|---|---|---|---|---|---|
| | | Assignment | Test-1 | Test-2 | Case Study | |
| 1-0-2-0 | 5 | 5 | 20 | 20 | 50 | 100 |

**SYLLABUS**

**MODULE 1**

Introduction to Professional Ethics-Morals, Values and Ethics, Personal and Professional ethics
Key ethical Principles-Honesty, integrity, respect, responsibility
Moral Development Theories (Kohlberg's theory, Gilligan's theory)
Case studies on professional responsibility (Hyatt Regency Walkway Collapse, Ethical consideration in the design and deployment of autonomous vehicle)

**MODULE 2**

Engineering as Experimentation – Engineers as responsible Experimenters-Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors
Codes of Ethics- Plagiarism-Professional Rights-Employee right- IPR Discrimination.
Ethical challenges posed by emerging technologies
Case Studies on emerging technologies (Artificial Intelligence)

**MODULE 3**

Introduction to Sustainable Development- Concept of Sustainability- pillars of sustainability- social- economic -environmental sustainability.
MDG - SDG- Nexus between Technology and sustainable development.
Case studies on SDGs. Case studies on Nexus between Technology and Sustainable development.

**MODULE 4**

Pathways for sustainable development - Social aspects - poverty- hunger - health - education- gender equality. Economic aspects- society- consumers - industries. Environmental aspects - renewable energy- zero waste - Carbon emission- conservation of ecosystem- global environmental issues

Case studies on Sustainable habitat, Sustainable Industry

**Textbooks**

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2014.
2. Our Common Journey: A Transition Toward Sustainability. National Academy Press.
3. Sustainable Development., Susan Baker, Taylor and Francis
4. Elliott, Jennifer. 2012. An Introduction to Sustainable Development. 4th Ed. Routledge, London
5. Rogers, Peter P., Kazi F. Jalal, and John A. Boyd. "An introduction to sustainable
6. development." (2012).

**Reference books**

1. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
2. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics-Concepts and cases, Wadsworth Thompson Learning, United states,2005.
3. Guidelines for Professional Conduct for Civil Engineers ASCE, 2008
4. UN Millennium Project (2005) Investing in Development: A Practical Plan to Achieve the Millennium Development Goals, Overview.
5. World Bank (2006) Enhancing Agricultural Innovation: How to Go beyond the Strengthening of Research Systems, World Bank: Agriculture and Rural Development
6. World Commission on Environment and Development (1987) Our Common Future, Oxford, OUP.

**NPTEL Course**

1. Ethics in Engineering Practice
   https://nptel.ac.in/noc/individual_course.php?id=noc18-mg25
2. Non-Conventional Energy Sources
   https://nptel.ac.in/noc/individual_course.php?id=noc18-ge14
3. Education for Sustainable Development
   https://onlinecourses.nptel.ac.in/noc22_hs61/preview

| No. | COURSE CONTENTS AND LECTURE SCHEDULE | No. of Hours (36 hours) |
|---|---|---|
| | **MODULE 1 (4 Hours)** | |
| 1.1 | Introduction to Professional Ethics-Morals, Values and Ethics | 1 |
| 1.2 | Personal and Professional ethics | 1 |

| | | |
|---|---|---|
| 1.3 | Key ethical principles-Honesty, integrity, respect, responsibility. Moral Development Theories (Kohlberg's theory, Gilligan's theory) | 1 |
| 1.4 | Case studies on professional responsibility (Hyatt Regency Walkway Collapse, Ethical consideration in the design and deployment of autonomous vehicle) | 1 |
| **MODULE 2 (4 Hours)** | | |
| 2.1 | Engineering as Experimentation – Engineers as responsible Experimenters-Engineers as Managers | 1 |
| 2.2 | Consulting Engineers, Engineers as Expert witnesses and advisors | 1 |
| 2.3 | Codes of Ethics- Plagiarism-Professional Rights-Employee right- IPR Discrimination. | 1 |
| 2.4 | Ethical challenges posed by emerging technologies. Case Studies on emerging technologies (Artificial Intelligence | 1 |
| **MODULE 3 (4 Hours)** | | |
| 3.1 | Introduction to Sustainable Development- Concept of Sustainability- pillars of sustainability- social- economic -environmental sustainability | 1 |
| 3.2 | MDG - SDG- Nexus between Technology and sustainable development | 1 |
| 3.3 | Case studies on SDGs | 1 |
| 3.4 | Case studies on Nexus between Technology and Sustainable development | 1 |
| **MODULE 4 (4 Hours)** | | |
| 4.1 | Pathways for sustainable development, social aspects - poverty- hunger - health -education- gender equality | 1 |
| 4.2 | Economic aspects- society- consumers - industries | 1 |
| 4.3 | Environmental aspects - renewable energy- zero waste - Carbon emission- conservation of ecosystem- global environmental issues | 1 |
| 4.4 | Case studies on Sustainable habitat, Sustainable Industry | 1 |
| **LESSON PLAN FOR CASE STUDIES** | | |
| **No.** | **Topic** | **No. of Hours (20)** |

| | | |
|---|---|---|
| 1 | Do Case studies of emerging trends in technology, sustainable, socially and professionally responsible projects | 5 |
| 2 | Selection of a case study for presentation and prepare a technical report | 15 |
| **No.** | **Case Study Assessment** | **Marks** |
| 1 | Selection of case study - Relevance of topic to the Course | 10 |
| 2 | Preparation of case study | 15 |
| 3 | Submission of Technical Report on case study | 25 |
| **CO Assessment Questions** | | |
| CO1 | 1. Define integrity and point out ethical values.<br>2. Discuss in detail about moral development theories<br>3. Investigate the responsibilities of a professional with case studies | |
| CO2 | 1. Illustrate the role of engineers as experimenters.<br>2. Exemplify the engineers as managers.<br>3. Investigate the ethics in emerging technologies with case studies | |
| CO3 | 1. Explain the necessity for Sustainable Development.<br>2. Enumerate SDG. Describe the challenges and barriers to sustainable development<br>3. Give any three examples for Nexus between Technology and Sustainable development. | |
| CO4 | 1. Describe Sustainable practices for achieving Economic sustainability<br>2. Enumerate global environmental issues<br>3. Investigate the Sustainable practices for sustainable habitat with case studies | |



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Ms. Uma E S, Asst. Prof., CSE

| 24ESL007 | COMPUTER AIDED DRAWING (CAD) & MANUFACTURING WORKSHOP | L | T | P | R | C | Year of Introduction |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 | 2024 |

**Preamble:**
The course is designed to empower students to explore the full potential of computer-aided design, additive manufacturing, and other manufacturing techniques. Students will foster a team working environment to enhance the necessary skills for planning, preparing and executing an engineering project. In addition the students will be introduced to various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

**Prerequisite: NIL**

**Course Outcomes:** After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Identify mechanical operations in accordance with manufacturing of products. [Understand] |
| **CO 2** | Application of advanced metrology instruments used in general workshop. Accomplish model making using modern manufacturing method.[Apply] |
| **CO 3** | Execute 2D and 3D drawing using CAD software.[Apply] |
| **CO 4** | Critically assess the advantages and limitations of 3D printing compared to traditional manufacturing methods. [Understand] |

**CO-PO MAPPING**

| CO | PO 1 | PO2 | PO 3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO1 0 | PO1 1 | PO1 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | 2 | | | |
| CO2 | | | | | 3 | | | | 2 | | | |
| CO3 | | | | | 2 | | | | | 3 | | |
| CO4 | | | | | 3 | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tools | |
|---|---|---|
| | Classwork | Test1 |
| Remember | √ | √ |
| Understand | √ | √ |
| Apply | √ | √ |
| Analyze | √ | |
| Evaluate | √ | |
| Create | | |

**Mark Distribution of CIA**

| Course Structure [L-T-P-R] | Attendance | Classwork | Lab Exam | Total Marks |
|---|---|---|---|---|
| 0-0-2-0 | 5 | 35 | 10 | 50 |

**Total Mark distribution**

| Total Marks | CIA(Marks) | ESE(Marks) | ESE Duration |
|---|---|---|---|
| 50 | 50 | 0 | - |

**SYLLABUS-DETAILS OF EXPERIMENTS**

**SECTION – 1 (Manufacturing Lab Experiments)**
***Minimum 5 experiments are mandatory***

General study of manufacturing process – Foundry – Sheet metal – Fitting – Welding – Metrology – Modern manufacturing method – Power tools.

**SECTION – 2 (CAD Lab Experiments)**
***Minimum 5 experiments are mandatory***

Introduction to Computer Aided Drawing (CAD) – 2D Drafting – 3D Modeling

**Textbooks**

1. Mechanical Workshop Practice, K C John PHI Learning Edition 2, 2010
2. Engineering Materials, S C Rangwala Charotar Publishing House Pvt Limited Edition 43, 2019
3. Engineering Graphics Essentials with AutoCAD 202x Instruction Kirstie Plantenberg ,SDC Publication 2023

**Reference Books**

1. Elements of Workshop Technology Vol-1-Manufacturing Processes S K Hajra Choudhury A K Hajra Choudhury Nirjhar Roy MPP Media Promoters and Publishers2008
2. AutoCAD 3D Modeling: Exercise Workbook Steve Heather Industrial Press Inc.,U.S

**LIST OF EXPERIMENTS**

**Manufacturing - 12Hrs**
***(Minimum 5 experiments are mandatory)***

| No. | Experiments |
|---|---|
| 1 | General-Introduction to workshop practice – safety precautions – Basic first aid knowledge – Study of workshop tools |
| 2 | Welding- Understanding arc welding process and components – Experiment on horizontal bead formation. |
| 3 | Metrology- Common measuring instruments used in workshop, experiments to measure using instruments like Vernier Caliper, micrometer, Vernier Height Gauge (Ordinary & Digital). |
| 4 | Modern manufacturing method-3D printing |
| 5 | Power Tools-Demonstration of the following power tools – Portable DC inverter welding set, portable power planer, Portable jig saw machine, Portable circular saw, Portable Drilling machine, Angle grinder. |
| 6 | Foundry- Understanding of foundry tools – Experiment on Bench moulding. |
| 7 | Fitting- Understanding the tools used for fitting and knowledge of at least one model |
| 8 | Sheet Metal: Understanding sheet metal working tools and knowledge of at least one model. |

| | |
|---|---|
| **CAD LAB - 12Hrs**<br>***(Minimum 5 experiments are mandatory)*** | |
| 1 | Computer Aided Drawing (CAD): Introduction, Role of CAD in design and development of new products, Advantages of CAD.<br>2D Drawing Exercise I: Introduction to common drafting tools and annotations. |
| 2 | 2D Drawing Exercise II: Introduction to common modification tools. |
| 3 | 2D Drawing Exercise III: 2D drafting and property changing. |
| 4 | 2D Drawing Exercise IV: 2D drafting using different drafting methods. |
| 5 | 2D Drawing Exercise V: Drafting orthographic projection and isometric view. |
| 6 | 3D Drawing: Introduction to different 3D modeling tools. |
| 7 | 3D Drawing Exercise I: Introduction to solid editing. |
| 8 | 3D Drawing Exercise II: Introduction to different modify tools. |
| **CO Assessment Questions** | |
| CO1 | 1. Identify the tools given to you and demonstrate their proper use.<br>2. Choose a suitable manufacturing process to make the given model. |
| CO2 | 1. Identify the given measuring instrument and demonstrate its proper use.<br>2. Take the 3D printout of the given drawing. |
| CO3 | 1. Prepare 2D drawings using CAD software.<br>2. Prepare 3D drawings using CAD software. |
| CO4 | 1. Find the advantages of 3D printing compared to traditional manufacturing processes.<br>2. Find the limitations of 3D printing compared to traditional manufacturing processes. |

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