



Learn Beyond

**KPR Institute of  
Engineering and  
Technology**

(Autonomous, Affiliated to Anna University)

# **CURRICULUM AND SYLLABI REGULATIONS – 2025 (REVISED)**

Department of  
Biomedical Engineering



## I. Vision and Mission of the Institute

### Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of industry, society, the nation and the world at large

### Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning processes through scholarly activities
- Enriching research and innovation activities in collaboration with industry and institutes of repute
- Ensuring the academic processes to uphold culture, ethics and social responsibilities

## II. Vision and Mission of the Department

### Vision

To be a centre of excellence for dissemination of knowledge, research and development in biomedical engineering to serve

### Mission

The mission of the department is to

- Impart value-based education in biomedical engineering using modern equipment and tools
- Build an integrated team of biomedical engineers to foster technologies through research, development and innovation
- Provide healthcare industries with solutions imbibed through lifelong learning with ethics and moral values

## III. Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) of the BIOMEDICAL ENGINEERING (BM) represent major accomplishments that the graduates are expected to achieve after three to five years of graduation.

**PEO1:** Apply the knowledge gained from biomedical engineering to help solve the technological problems in industries.

**PEO2:** Design and develop healthcare products and processes through continuous skill upgradation and research.

**PEO3:** Demonstrate professional and ethical standards of behavior and commit to lifelong learning to meet the needs of society.

## IV. Program Outcomes (POs)

Graduates of the BIOMEDICAL ENGINEERING will be able to

- PO1:** Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems
- PO2:** Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4)
- PO3:** Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5)
- PO4:** Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions (WK8)
- PO5:** Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems (WK2 and WK6)



- PO6:** The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment (WK1, WK5, and WK7)
- PO7:** Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws (WK9)
- PO8:** Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/ multi-disciplinary teams
- PO9:** Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10:** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments
- PO11:** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8)

#### Knowledge and Attitude Profile (WK)

- WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
- WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
- WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
- WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
- WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area
- WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
- WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development
- WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
- WK9:** Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

#### V. Program Specific Outcomes (PSOs)

Graduates of the BIOMEDICAL ENGINEERING will be able to

- PSO1:** Design and evaluate medical solutions using biosensors, biomaterials, biomechanics, and diagnostic and therapeutic equipment for the healthcare industries.
- PSO2:** Identify, analyze, solve and develop algorithms for addressing healthcare problems using the software skills acquired through bio-signal and image processing advancements.

#### VI. PEO / PO Mapping

Following three levels of correlation should be used:

1: Low

2: Medium

3: High



| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| PEO 1      | 3   | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 1   | 2    | 2    | 3    | 3    |
| PEO 2      | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 2   | 2    | 2    | 3    | 3    |
| PEO 3      | 1   | 1   | 1   | 1   | 1   | 2   | 2   | 3   | 3   | 3    | 2    | 1    | 1    |

## VII. Mapping of Course Outcomes (COs) with Program Outcomes (POs)

| Sem | Course Title                                     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|-----|--------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| I   | Professional Communication - I                   | -   | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -    | ✓    | -    | -    |
|     | Multivariable Calculus and Applications          | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Engineering Physics                              | ✓   | ✓   | ✓   | -   | ✓   | -   | -   | ✓   | ✓   | -    | -    | ✓    | -    |
|     | C Programming                                    | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Electrical Circuits and Electronic Devices       | ✓   | ✓   | ✓   | -   | ✓   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Makerspace                                       | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | ✓    | -    |
|     | C Programming Laboratory                         | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Induction Program                                |     |     |     |     |     |     |     |     |     |      |      |      |      |
|     | Universal Human Values                           | -   | -   | -   | -   | -   | ✓   | ✓   | ✓   | -   | -    | ✓    | -    | -    |
|     | தமிழர் மரபு / Heritage of Tamils                 | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -   | ✓    | -    | -    | -    |
|     | Environmental Governance and Sustainability      | ✓   | ✓   | -   | -   | -   | ✓   | ✓   | -   | ✓   | -    | ✓    | -    | -    |
|     | Professional Skill Development - I               | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
| II  | Professional Communication - II                  | -   | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -    | ✓    | -    | -    |
|     | Linear Algebra and Complex Variables             | ✓   | ✓   | -   | -   | ✓   | -   | -   | -   | ✓   | -    | ✓    | -    | ✓    |
|     | Medical Physics                                  | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Engineering Chemistry                            | ✓   | ✓   | ✓   | -   | ✓   | -   | -   | ✓   | ✓   | -    | ✓    | ✓    | -    |
|     | Python Programming                               | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Analog Electronics for Biomedical Applications   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | ✓   | ✓    | ✓    | ✓    | -    |
|     | Engineering Graphics                             | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Python Programming Laboratory                    | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Design Thinking                                  | ✓   | ✓   | ✓   | -   | -   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
|     | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -   | ✓    | -    | -    | -    |
|     | Professional Skill Development - II              | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
| III | Probability and Statistics                       | ✓   | ✓   | -   | -   | ✓   | -   | -   | -   | -   | -    | -    | -    | ✓    |
|     | Human Anatomy and Physiology                     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Biomedical Sensors and Instrumentation           | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | -    | ✓    | -    |



| Sem | Course Title                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|-----|---------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|     | Digital System Design                             | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -    | ✓    | -    | -    |
|     | Data Structures and Algorithms                    | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | -    | -    | ✓    |
|     | Biomaterials                                      | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | ✓   | -    | ✓    | ✓    | -    |
|     | Human Anatomy and Physiology Laboratory           | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Biomedical Sensors and Instrumentation Laboratory | ✓   | ✓   | ✓   | ✓   | ✓   | -   | ✓   | ✓   | ✓   | -    | -    | ✓    | -    |
|     | Digital System Design Laboratory                  | ✓   | ✓   | ✓   | ✓   | -   | -   | ✓   | ✓   | ✓   | -    | ✓    | ✓    | -    |
|     | Essence of Indian Traditional Knowledge           | -   | ✓   | -   | ✓   | -   | -   | ✓   | -   | -   | -    | -    | -    | -    |
|     | Professional Skill Development - III              | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
| IV  | Stochastic Processes in Engineering Systems       | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | ✓    |
|     | Integrated Biosciences                            | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Hospital Administration                           | ✓   | ✓   | ✓   | ✓   | -   | ✓   | ✓   | -   | -   | ✓    | ✓    | ✓    | -    |
|     | Object Oriented Programming Using Java            | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Biophysical Signals and Systems                   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | -    | -    | ✓    |
|     | Integrated Biosciences Laboratory                 | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | ✓   | ✓   | -    | ✓    | ✓    | -    |
|     | Object Oriented Programming Using Java Laboratory | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | -    | ✓    |
|     | Indian Constitution                               | -   | -   | -   | -   | -   | ✓   | ✓   | ✓   | -   | -    | -    | -    | -    |
|     | Professional Skill Development - IV               | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |

  
 HOD, BIOMEDICAL ENGINEERING  
 APR INSTITUTE OF ENGINEERING  
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 SUR COIMBATORE-641 407

**BIOMEDICAL ENGINEERING**  
**Regulations 2025**  
**For the students admitted from 2025 onwards**  
**CHOICE BASED CREDIT SYSTEM**  
**CURRICULUM FOR I - VIII SEMESTERS**

**SEMESTER I**

| No                                                                             | Course Code | Title                                       | Category | Type          | L        | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|---------------------------------------------|----------|---------------|----------|---|---|---|----|
| 1                                                                              | U25REN101   | Professional Communication - I              | HSMC     | TwL           | 2        | - | 2 | - | 3  |
| 2                                                                              | U25RMA101   | Multivariable Calculus and Applications     | BSC      | T             | 3        | 1 | - | - | 4  |
| 3                                                                              | U25RPH01    | Engineering Physics                         | BSC      | TwL           | 2        | - | 2 | - | 3  |
| 4                                                                              | U25RCSG01   | C Programming                               | ESC      | T             | 3        | - | - | - | 3  |
| 5                                                                              | U25RBM101   | Electrical Circuits and Electronic Devices  | PCC      | TwL           | 3        | - | 2 | - | 4  |
| 6                                                                              | U25RGE01    | Makerspace                                  | ESC      | L             | -        | - | 4 | - | 2  |
| 7                                                                              | U25RCSG03   | C Programming Laboratory                    | ESC      | L             | -        | - | 2 | - | 1  |
| Total                                                                          |             |                                             |          |               |          |   |   |   | 20 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                             |          |               |          |   |   |   |    |
| 8                                                                              | U25RMNC01   | Induction Program                           | MNC      | MNC           | 3 Weeks  |   |   | - |    |
| 9                                                                              | U25RMCC01   | Universal Human Values                      | MCC      | MCC           | 3        | - | - | - | 3  |
| 10                                                                             | U25RMCC02   | தமிழர் மரபு / Heritage of Tamils            | MCC      | Tamil Courses | 1        | - | - | - | 1  |
| 11                                                                             | U25RMCC04   | Environmental Governance and Sustainability | MCC      | MCC           | 2        | - | - | - | 2  |
| 12                                                                             | U25RMCC06   | Professional Skill Development - I          | MCC      | MCC           | 15 Hours |   |   | 1 |    |
| Total                                                                          |             |                                             |          |               |          |   |   |   | 7  |

**SEMESTER II**

| No                                                                                    | Course Code | Title                                            | Category | Type          | L | T | P | J | C         |
|---------------------------------------------------------------------------------------|-------------|--------------------------------------------------|----------|---------------|---|---|---|---|-----------|
| 1                                                                                     | U25REN201   | Professional Communication - II                  | HSMC     | TwL           | 2 | - | 2 | - | 3         |
| 2                                                                                     | U25RMA202   | Linear Algebra and Complex Variables             | BSC      | TwL           | 3 | - | 2 | - | 4         |
| 3                                                                                     | U25RPH05    | Medical Physics                                  | BSC      | T             | 2 | - | - | - | 2         |
| 4                                                                                     | U25RCY01    | Engineering Chemistry                            | BSC      | TwL           | 2 | - | 2 | - | 3         |
| 5                                                                                     | U25RCSG04   | Python Programming                               | ESC      | T             | 3 | - | - | - | 3         |
| 6                                                                                     | U25RBM201   | Analog Electronics for Biomedical Applications   | PCC      | TwL           | 1 | - | 2 | - | 2         |
| 7                                                                                     | U25RMEG01   | Engineering Graphics                             | ESC      | L             | - | - | 4 | - | 2         |
| 8                                                                                     | U25RCSG06   | Python Programming Laboratory                    | ESC      | L             | - | - | 2 | - | 1         |
| <b>Total</b>                                                                          |             |                                                  |          |               |   |   |   |   | <b>20</b> |
| <b>MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC)</b> |             |                                                  |          |               |   |   |   |   |           |
| 9                                                                                     | U25RMCC03   | Design Thinking                                  | MCC      | MCC           | 1 | - | 2 | - | 2         |
| 10                                                                                    | U25RMCC05   | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology | MCC      | Tamil Courses | 1 | - | - | - | 1         |





| No    | Course Code | Title                               | Category | Type | L        | T | P | J | C |
|-------|-------------|-------------------------------------|----------|------|----------|---|---|---|---|
| 11    | U25RMCC07   | Professional Skill Development - II | MCC      | MCC  | 15 Hours |   |   |   | 1 |
| Total |             |                                     |          |      |          |   |   |   | 4 |

**SEMESTER III**

| No                                                                             | Course Code | Title                                             | Category | Type | L        | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|---------------------------------------------------|----------|------|----------|---|---|---|----|
| 1                                                                              | U25MA302    | Probability and Statistics                        | BSC      | TwL  | 2        | - | 2 | - | 3  |
| 2                                                                              | U25BM301    | Human Anatomy and Physiology                      | PCC      | T    | 3        | - | - | - | 3  |
| 3                                                                              | U25BM302    | Biomedical Sensors and Instrumentation            | PCC      | T    | 3        | - | - | - | 3  |
| 4                                                                              | U25ECG02    | Digital System Design                             | PCC      | T    | 3        | - | - | - | 3  |
| 5                                                                              | U25ADG02    | Data Structures and Algorithms                    | PCC      | TwL  | 3        | - | 2 | - | 4  |
| 6                                                                              | U25BM303    | Biomaterials                                      | PCC      | TwP  | 2        | - | - | 2 | 3  |
| 7                                                                              | U25BM304    | Human Anatomy and Physiology Laboratory           | PCC      | L    | -        | - | 2 | - | 1  |
| 8                                                                              | U25BM305    | Biomedical Sensors and Instrumentation Laboratory | PCC      | L    | -        | - | 4 | - | 2  |
| 9                                                                              | U25ECG03    | Digital System Design Laboratory                  | PCC      | L    | -        | - | 2 | - | 1  |
| Total                                                                          |             |                                                   |          |      |          |   |   |   | 23 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                                   |          |      |          |   |   |   |    |
| 10                                                                             | U25MNC02    | Essence of Indian Traditional Knowledge           | MNC      | MNC  | 1        | - | - | - | -  |
| 11                                                                             | U25RMCC08   | Professional Skill Development - III              | MCC      | MCC  | 15 Hours |   |   |   | 1  |
| Total                                                                          |             |                                                   |          |      |          |   |   |   | 1  |

**SEMESTER IV**

| No                                                                             | Course Code | Title                                             | Category | Type | L        | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|---------------------------------------------------|----------|------|----------|---|---|---|----|
| 1                                                                              | U25MA402    | Stochastic Processes in Engineering Systems       | BSC      | T    | 3        | - | - | - | 3  |
| 2                                                                              | U25BM405    | Integrated Biosciences                            | PCC      | T    | 3        | - | - | - | 3  |
| 3                                                                              | U25BM402    | Hospital Administration                           | PCC      | T    | 3        | - | - | - | 3  |
| 4                                                                              | U25CSG11    | Object Oriented Programming Using Java            | PCC      | T    | 3        | - | - | - | 3  |
| 5                                                                              | U25BM403    | Biophysical Signals and Systems                   | PCC      | TwL  | 2        | - | 2 | - | 3  |
| 6                                                                              | U25BM406    | Integrated Biosciences Laboratory                 | PCC      | L    | -        | - | 4 | - | 2  |
| 7                                                                              | U25CSG13    | Object Oriented Programming Using Java Laboratory | PCC      | L    | -        | - | 2 | - | 1  |
| 8                                                                              | -           | Open Elective I                                   | OEC      | T    | 1        | - | 4 | - | 3  |
|                                                                                |             |                                                   |          |      | 3        | - | - | - |    |
|                                                                                |             |                                                   |          |      | 2        | - | 2 | - |    |
| Total                                                                          |             |                                                   |          |      |          |   |   |   | 21 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                                   |          |      |          |   |   |   |    |
| 9                                                                              | U25MNC03    | Indian Constitution                               | MNC      | MNC  | 1        | - | - | - | -  |
| 10                                                                             | U25RMCC09   | Professional Skill Development - IV               | MCC      | MCC  | 15 Hours |   |   |   | 1  |
| Total                                                                          |             |                                                   |          |      |          |   |   |   | 1  |

T - Theory, L - Laboratory, TwL - Theory with Laboratory, TwP - Theory with Project

## SEMESTER I



| U25REN101 | Professional Communication - I<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: HSMC |   |   |   |   |
|-----------|------------------------------------------------------------------------------------------------------|----------------|---|---|---|---|
|           |                                                                                                      | L              | T | P | J | C |
|           |                                                                                                      | 2              | 0 | 2 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To develop professional communication skills for academic, technical and workplace environments
- To enhance the listening skills and facilitate effective pronunciation
- To enable students to communicate confidently in individual and team-based situations

## COURSE OUTCOMES:

|                                                                                                   |            |
|---------------------------------------------------------------------------------------------------|------------|
| CO 1: Use appropriate vocabulary and grammatical structures in professional communication         | Understand |
| CO 2: Communicate confidently in academic, social and workplace situations                        | Apply      |
| CO 3: Develop reading and writing skills for technical and professional purposes                  | Apply      |
| CO 4: Infer and present information using appropriate communication strategies                    | Analyze    |
| CO 5: Demonstrate effective listening, presentation, and teamwork skills in professional contexts | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: FOUNDATIONS OF PROFESSIONAL COMMUNICATION

6 + 6

Verbal, Non-verbal and Digital Communication - Word chain - Professional Etiquette - Self-Introduction and Elevator Pitch - Growth Mindset and Workplace Communication - Cross-cultural Communication - Professional Terminology - AI-assisted Communication Tools

## UNIT II: PROFESSIONAL READING AND WRITING

6 + 6

Reading Technical Articles - Error correction - Manuals and SOPs - Infographics and Data - Email Etiquette - Email Writing - AI-assisted Writing Tools - Ethical Use of AI - Verbal Analogy

## UNIT III: LISTENING AND INTERPERSONAL COMMUNICATION

6 + 6

Listening Barriers - Note-taking Techniques - Listening for Problem Solving - Team Communication - Conflict Resolution - Workplace Discussions - Idioms and Phrases



**UNIT IV: DIGITAL COMMUNICATION AND PRESENTATION SKILLS**

6 + 6

Storytelling Techniques - Discourse markers, linkers and cohesive devices - Data Presentation - Presentation Anxiety Management - Digital Presentation Platforms - Branding - Commonly Confused Words

**UNIT V: EMPLOYABILITY AND PROFESSIONALISM**

6 + 6

Prefixes, Suffixes and Root Words - LinkedIn Profile - Interview Skills - Group Discussion Strategies - Art of Persuasion - Entrepreneurial Communication - AI in Future Workplace

**LIST OF EXPERIMENTS**

1. Self-Introduction
2. Group Presentation
3. Listening to TED Talks
4. Listening to Documentaries
5. Digital Profiling

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Ashraf Rizvi, Effective Technical Communication, 3rd Edition, McGraw-Hill Education, 2023
2. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice, 4th Edition, Oxford University Press, 2022
3. Sanjay Kumar & Pushp Lata, Communication Skills, 3rd Edition, Oxford University Press, New Delhi, 2018

**REFERENCES:**

1. Stephen E. Lucas, The Art of Public Speaking, 14th Edition, McGraw Hill Education, New York, 2023
2. Dale Carnegie, The Quick and Easy Way to Effective Speaking, Updated Edition, Simon & Schuster, New York, 2019
3. Matt Abrahams, Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot, Simon & Schuster, New York, 2024



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## SEMESTER I

| U25RMA101 | Multivariable Calculus and Applications<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: BSC |   |   |   |   |
|-----------|---------------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                               | L             | T | P | J | C |
|           |                                                                                                               | 3             | 1 | 0 | 0 | 4 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To provide a comprehensive knowledge of multivariable calculus, including, partial derivatives integral calculus, and vector calculus
- For constructing more convenient for students to apply their calculus knowledge to their various fields of study
- To develop skills in solving first and second order linear differential equations for engineering applications

## COURSE OUTCOMES:

- CO 1:** Explain the concepts of multivariable differential calculus, estimate the extreme values and Taylor's Understand formula of two variable functions
- CO 2:** Apply integral calculus to evaluate double integrals over various regions and compute area and volume using double integration Apply
- CO 3:** Apply vector calculus to compute directional derivative, divergence, curl, Green's, Stokes' and Gauss divergence theorems Apply
- CO 4:** Solve first order ordinary differential equations, model physical phenomena, determine appropriate methods for solving them, and interpret the results Apply
- CO 5:** Formulate second-order differential equations, solve the equations, and interpret the solutions for physical models Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 2       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 3       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 4       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 5       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |

## SYLLABUS:

## UNIT I: DIFFERENTIAL CALCULUS

9 + 3

Functions of two variables – Partial derivatives – Total derivatives – Taylor's formula for functions of two variables – Extreme Values

## UNIT II: INTEGRAL CALCULUS

9 + 3

UNIT II Double integrals – Over rectangles – Over general regions – Fubini's theorem (statement only), Area and Volume by double integration – Reversing the order of integration

  
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**UNIT III: VECTOR CALCULUS****9 + 3**

Differentiation in vector field – Gradient of a scalar field – Directional derivative – Divergence of a vector field – Curl of a vector field – Integration in vector field – Line integrals – Work– circulation and flux – Path independence – Conservative fields – Green's – Gauss divergence and Stoke's theorems

**UNIT IV: FIRST ORDER LINEAR ORDINARY DIFFERENTIAL EQUATIONS****9 + 3**

Basic concepts of ordinary differential equations – Separable and exact differential equations – Integrating factors and first-order linear differential equations – Mathematical modelling of real-world problems

**UNIT V: SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS****9 + 3**

Homogeneous linear equations of second order – linearity principle – second order homogeneous equations with constant coefficients – Euler–Cauchy equation – Non-homogeneous linear second order-solution by variation of parameters

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** 15 Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Thomas G. B. and Finney R. L., "Calculus and Analytic Geometry", Pearson Education, New Delhi, 2012
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt Ltd, New Delhi, 2012

**REFERENCES:**

1. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2013
2. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2010
3. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017



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## SEMESTER I &amp; II

| U25RPH01 | Engineering Physics<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: BSC |   |   |   |   |
|----------|-------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                           | L             | T | P | J | C |
|          |                                                                                           | 2             | 0 | 2 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the fundamental mechanical and thermal properties of solids and fluids for real-world engineering applications
- To explore advanced concepts in ultrasonic waves and their applications in imaging, testing, and sensing technologies
- To gain insights into semiconductor physics and photonics for their role in modern electronic and optical systems

## COURSE OUTCOMES:

|       |                                                                                                                             |       |
|-------|-----------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Apply the stress-strain behavior concepts in engineering materials and structures                                           | Apply |
| CO 2: | Apply principles of heat transfer and fluid mechanics to evaluate thermal systems and engineering applications              | Apply |
| CO 3: | Demonstrate the operation of ultrasonic wave generation and detection techniques for industrial and biomedical applications | Apply |
| CO 4: | Analyze the electrical properties and carrier transport mechanisms in semiconductors and semiconductor devices              | Apply |
| CO 5: | Demonstrate the principles of lasers and optical fibers in communication, sensing, and biomedical applications              | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | 1    | -    |
| CO 2       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | 1    | -    |
| CO 3       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | 1    | -    |
| CO 4       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | 1    | -    |
| CO 5       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | 1    | -    |

## SYLLABUS:

## UNIT I: MECHANICAL PROPERTIES OF SOLIDS

6 + 6

Modulus of Elasticity – Stress-strain diagram – Poisson's ratio – Elastic and plastic deformation – Stress-strain behaviour in metals, polymers and ceramics – Bending Moment – Cantilever – Applications (GIRDERS, MEMS)

## UNIT II: FUNDAMENTALS OF HEAT TRANSFER AND FLUIDS

6 + 6

Heat transfer – Thermal expansion – Heat conductivity – Lee's Disc method – Surface tension – Viscosity – Coefficient of viscosity using Poiseuille's flow experiment – Solar water heater – Microwave oven – Heat exchangers – Radiators – Cooling towers



**UNIT III: ULTRASONICS AND ITS APPLICATIONS**

6 + 6

Properties of Ultrasonic waves – Production of ultrasonic waves – Piezoelectric Oscillator – Magnetostriction Oscillator – Velocity measurement of Ultrasonic waves – SONAR – Non-Destructive Testing – Ultrasound imaging – Ultrasonic scanning methods

**UNIT IV: SEMICONDUCTOR PHYSICS**

6 + 6

Properties – Direct and Indirect bandgap-semiconductor – Intrinsic and extrinsic Semiconductors – Carrier concentration in n-type semiconductor – P-type semiconductor – Carrier Transport in Semiconductor – Hall effect – Ohmic contacts – Schottky diode

**UNIT V: PHOTONICS**

6 + 6

Interaction of Radiation with Matter – Laser Characteristics – Population Inversion – CO<sub>2</sub> laser – Semiconductor Diode Laser – Laser applications – Total Internal Reflection – Structure and working principle of Optical fibre – Fiber optic Endoscopy – Fiber optic sensors

**LIST OF EXPERIMENTS**

1. Determine the moduli of elasticity of the given beams and evaluate them for different structural applications. (High/Medium/Low modulus)
2. Evaluate the shear moduli of the different materials and rank them for suitable applications with reference to their strength
3. Select the most effective thermal insulation material from mica, cardboard, and glass for optimal heat protection
4. Determine the Viscosity of Liquids Using Poiseuille's Method and Identify the Fastest-Flowing Liquid
5. Measure the speed of ultrasound in liquids and calculate their compressibility for different hydraulic purposes
6. Categorize the specified semiconducting materials according to their energy bandgap values
7. Determine a semiconducting material's Hall coefficient and identify its type
8. Determination of wavelength of given laser and the particle size of the given samples using diffraction method
9. Use an optical fiber to measure its light-gathering capacity and calculate the propagation angle
10. Calculate the surface tension of different liquids and examine how surfactants affect it
11. Determination of wavelength of various spectral lines by using spectrometer and grating
12. Determination of velocity of light passing through glass medium using spectrometer

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 60 Periods

**TEXTBOOKS:**

1. M.N. Avadhanulu, P.G. Kshirsagar, and T.V.S. Arun Murthy, "A Textbook of Engineering Physics", 11th edition, S. Chand Publishing, New Delhi, 2022
2. R.K. Gaur and S.L. Gupta, "Engineering Physics", 8th edition, Dhanpat Rai Publications, New Delhi, 2017

**REFERENCES:**

1. Harald Ibach and Hans Luth, "Solid State Physics: An Introduction", 4th edition, Springer Publications, 2020
2. Charles Kittel, revised by David Pines (Editor) "Introduction to Solid State Physics", 9th edition, Wiley & Sons, US, 2020
3. H.K. Malik and A.K. Singh "Engineering Physics" Publisher: McGraw Hill Education India, 2022
4. [https://onlinecourses.nptel.ac.in/noc20\\_cy17/preview](https://onlinecourses.nptel.ac.in/noc20_cy17/preview)

## SEMESTER I

| U25RCSG01 | C Programming<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: ESC |   |   |   |   |
|-----------|-------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                     | L             | T | P | J | C |
|           |                                                                                     | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To enable students to understand the fundamentals of problem-solving and C programming, including algorithms, flowcharts, pseudocode, and the structure of a C program
- To develop programming skills using input/output operations, control structures, arrays, strings, functions, pointers, and dynamic memory allocation
- To introduce user-defined data types such as structures and unions for handling complex data effectively
- To familiarize students with file handling concepts and develop C-based solutions for real-world applications

## COURSE OUTCOMES:

- CO 1:** Explain fundamental programming concepts, problem-solving techniques, and the basic structure of C programs **Understand**
- CO 2:** Develop C programs using input/output functions, operators, decision-making, and iterative control structures **Apply**
- CO 3:** Implement arrays and string handling concepts to solve data processing and real-world applications **Apply**
- CO 4:** Develop modular and efficient programs using functions, recursion, pointers, and dynamic memory allocation techniques **Apply**
- CO 5:** Apply user-defined data types and file handling operations to manage and process data effectively **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 5       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | 2    | -    | 1    |

## SYLLABUS:

## UNIT I: PROBLEM SOLVING APPROACHES AND C PROGRAMMING BASICS

10

Problem Solving Techniques: Problem Statement and Analysis – Problem Modelling – Identifying Input and Output Requirements – Algorithms – Flowcharts – Pseudocode for Solving Basic Scientific and Business Problems. Introduction to C: Characteristics of C – Structure of a C Program – Compiling and Executing C Program – Pre-processor Directives – Tokens – Character Set – Keywords – Identifiers – Constants – Variables – Operators – Data Types – Typecasting – Input/Output Statements in C





**UNIT II: DECISION CONTROL AND LOOPING STATEMENTS****8**

Conditional Statements: if Statement – if-else Statement – Nested if Statements – else-if Ladder – switch Statement. Looping Statements: while Loop – do-while Loop – for Loop – Nested Loops. Jump Statements: break Statement – continue Statement – goto Statement

**UNIT III: ARRAYS AND STRINGS****9**

Arrays: Declaration and Initialization – Accessing and Manipulating Array Elements – One-Dimensional Arrays – Two-Dimensional Arrays – Applications of Arrays. Strings: Declaration and Initialization of Strings – String Handling Functions – String Arrays

**UNIT IV: FUNCTIONS AND POINTERS****9**

Functions: Definition – Function Call – Function Prototype – Return Statement – Types of Functions – Recursive Functions – Command Line Arguments. Pointers: Declaration and Initialization – Pointer Arithmetic – Passing Arguments by Value and by Reference – Pointer to Pointer – Pointers and Arrays. Dynamic Memory Allocation: malloc(), calloc(), realloc(), free()

**UNIT V: USER-DEFINED DATA TYPES AND FILE MANAGEMENT****9**

Structures: Declaration and Initialization – Accessing Structure Members – Arrays of Structures – Nested Structures – Pointer to Structures. Unions – Storage Classes. Files: File Access Methods – File Modes – File Operations – File Pointers – Binary File Operations

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Computer Fundamentals and Programming in C", 3rd Edition, Oxford University Press, 2023
2. Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", 2nd Edition, Pearson, 2015

**REFERENCES:**

1. Paolo Ferragina and Fabrizio Luccio, "Computational Thinking First Algorithms", Then Code", 1st Edition, Springer International Publishing, 2018
2. Paul Deitel and Harvey Deitel, "C How to Program", 7th Edition, Pearson Publication
3. Juneja, B. L and Anita Seth, "Programming in C", 1st Edition, Cengage Learning India Pvt. Ltd., 2011
4. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 1st Edition, Oxford University Press, 2009



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## SEMESTER I

| U25RBM101 | Electrical Circuits and Electronic Devices | Category: PCC |   |   |   |   |
|-----------|--------------------------------------------|---------------|---|---|---|---|
|           |                                            | L             | T | P | J | C |
|           |                                            | 3             | 0 | 2 | 0 | 4 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To summarize the foundational understanding of electrical circuits and the principles of circuit analysis techniques
- To familiarize the operation and applications of semiconductor devices including diodes, transistors

## COURSE OUTCOMES:

|       |                                                                                                                                             |           |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CO 1: | Make use of electrical laws and circuit theorems to analyze circuits involving active and passive elements                                  | Apply     |
| CO 2: | Experiment with the working principles and characteristics of various semiconductor diodes                                                  | Apply     |
| CO 3: | Construct and analyze rectifiers, clippers, clampers, voltage regulators, voltage multipliers and logic circuits using semiconductor diodes | Apply     |
| CO 4: | Apply the characteristics of transistors to analyze and design basic electronic switching and logic gate circuits                           | Apply     |
| CO 5: | Utilize the theoretical knowledge to analyze, simulate and evaluate the characteristics of electronic components and circuits               | Precision |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 2       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 3       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 4       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 5       | 3   | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | 1    | 2    | -    |

## SYLLABUS:

## UNIT I: ELECTRICAL CIRCUITS AND ANALYSIS

9 + 6

Active and Passive Elements: Current and Voltage Sources, Resistors, Inductors and Capacitors – Circuits: Resistors in series and parallel circuits, Passive Filters – Analysis: Kirchhoff's Laws, Superposition, Thevenin, Norton, Maximum Power Transfer and Reciprocity Theorems

## UNIT II: SEMICONDUCTOR DIODES

9 + 6

Ideal and Practical Diodes: Equivalent Circuit, Diode resistance, Datasheet, Transition and Diffusion capacitance – Structure, Working principle and Characteristics: PN junction diode, Zener diode, Light emitting diode, Photodiode



**UNIT III: APPLICATIONS OF SEMICONDUCTOR DIODES****9 + 6**

Rectifier, Clipper and Clamper circuits, Voltage Multiplier, Polarity Detector, Logic Circuits: AND, OR Gates – Voltage regulator – Seven segment Displays – Solar Cell

**UNIT IV: CURRENT CONTROLLED TRANSISTORS****9 + 6**

Bipolar Junction Transistor: Construction, Operation and Types – Characteristics: Common base configuration, Common emitter configuration, Common collector configuration – Applications: Switching circuits, Amplifiers, Logic Gates and Voltage Level Indicators

**UNIT V: VOLTAGE CONTROLLED TRANSISTORS****9 + 6**

Construction, Operation, Types and Characteristics: MOSFET – Applications: Relay Driver – CMOS Operation and Applications: Inverter, NAND and NOR Gates

**LIST OF EXPERIMENTS**

1. Verification of Kirchhoff's Current and Voltage Laws
2. V-I Characteristics of a PN Junction Diode
3. Design and Testing of Voltage Regulator using Zener Diode
4. Input and Output Characteristics of BJT
5. Drain and Transfer Characteristics of a MOSFET

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 75 Periods

**TEXTBOOKS:**

1. William H. Hayt, Jack Kemmerly, Jamie Phillips and Steven M. Durbin, "Engineering Circuit Analysis", 10th Edition, McGraw-Hill Education, 2024
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2015

**REFERENCES:**

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 7th Edition, McGraw-Hill Education, 2022
2. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008



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## SEMESTER I &amp; II

| U25RGE01 | Makerspace<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: ESC |   |   |   |   |
|----------|----------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                  | L             | T | P | J | C |
|          |                                                                                  | 0             | 0 | 4 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- Apply fundamental fabrication, electrical, electronics, programming, and digital manufacturing techniques for engineering applications
- Develop practical skills in prototyping, automation, robotics, and emerging technologies through experiential learning activities
- Design and construct interdisciplinary engineering prototypes by integrating concepts from multiple engineering domains

## COURSE OUTCOMES:

|       |                                                                                                              |        |
|-------|--------------------------------------------------------------------------------------------------------------|--------|
| CO 1: | Fabricate simple components using basic mechanical engineering tools and additive manufacturing              | Apply  |
| CO 2: | Carry out electrical wiring installations applying safety measures in domestic applications                  | Apply  |
| CO 3: | Interface electronic devices to develop functional engineering solutions                                     | Apply  |
| CO 4: | Illustrate the role of automation and artificial intelligence in engineering applications                    | Apply  |
| CO 5: | Develop interdisciplinary engineering prototype addressing specific problems through teamwork and innovation | Create |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | -   | 3   | -   | -   | 3   | 2   | -    | 2    | 1    | -    |
| CO 2       | 3   | 2   | -   | -   | 3   | -   | -   | 3   | 2   | -    | 2    | 1    | -    |
| CO 3       | 3   | 2   | -   | -   | 3   | -   | -   | 3   | 2   | -    | 2    | 1    | -    |
| CO 4       | 2   | -   | -   | -   | 3   | -   | -   | -   | -   | -    | 2    | 1    | -    |
| CO 5       | 3   | 3   | 2   | 1   | 3   | 2   | 2   | 3   | 3   | 2    | 2    | 1    | -    |

## LIST OF EXPERIMENTS

## MODULE 1: FABRICATION AND MAKING SKILLS (10 Hours)

1. Welding procedure, selection & safety Measures - Hands-on session for preparing base material and joining of steel materials using arc welding
2. Study on basic pipe connections with different joining components.
3. Demo on laser cutting of acrylic boards and wire arc welding

## MODULE 2: DIGITAL DESIGN AND RAPID PROTOTYPING (10 Hours)

4. 3D Modelling of simple components using software's
5. Fabrication of simple components / parts using 3D printers
6. Demonstration of assembly modelling of components

## MODULE 3: AUTOMATION AND ROBOTICS (8 Hours)



**B.E. - BM - R2025 - CBCS**

7. Demonstration on mechatronics components/systems
8. Demonstration on basic robotics system
9. Demonstration on automobiles, performance measures
10. Demonstration on programmable logic control circuit

**MODULE 4: ELECTRICAL PRACTICES (10 Hours)**

11. Study on basic electrical installation tools, equipment and safety measures
12. Basic electrical wiring and connections such as soldering, fuses, earthing, miniature circuit breakers and switch wiring
13. Hands-on session of electrical connections for lightings, fans, calling bells etc
14. Hands-on session of electrical connections for motors and uninterruptible power supply

**MODULE 5: ELECTRONICS AND EMBEDDED SYSTEMS (8 Hours)**

15. Electronic components, equipment and safety measures
16. Interfacing of sensors and actuator with microcontrollers (Arduino)
17. Integration of electronic circuits with IoT system
18. Interfacing of components with printed circuit board

**MODULE 6: ARTIFICIAL INTELLIGENCE (4 Hours)**

19. Demonstration on artificial intelligence technologies
20. Demonstration on AR/VR technologies

**MODULE 7: INTERDISCIPLINARY PROTOTYPE CHALLENGE (10 Hours)**

21. Students work in teams to develop and demonstrate an interdisciplinary product/prototype for the problem identified

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 60 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes and Systems", 7th Edition, Wiley, 2020
2. Simon Monk, "Programming Arduino: Getting Started with Sketches", 3rd Edition, McGraw-Hill Education, 2022
3. Richard H. Barnett, "Introduction to Mechatronics and Measurement Systems", 6th Edition, McGraw-Hill Education, 2023
4. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016

**REFERENCES:**

1. Arduino Documentation – <https://www.arduino.cc>
2. Tinkercad Learning Portal – <https://www.tinkercad.com>
3. FreeCAD Documentation – <https://www.freecad.org>
4. Ultimaker Cura Resources – <https://ultimaker.com/software/ultimaker-cura>
5. ESP32 Documentation – <https://docs.espressif.com>

  
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## SEMESTER I

| U25RCSG03 | C Programming Laboratory<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: ESC |   |   |   |   |
|-----------|------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                | L             | T | P | J | C |
|           |                                                                                                | 0             | 0 | 2 | 0 | 1 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To provide hands-on experience in problem solving and structured programming using the C programming language
- To develop programming skills using control structures, arrays, strings, functions, pointers, and dynamic memory management techniques
- To enable students to design and implement applications using user-defined data types and file handling concepts for real-world problems

## COURSE OUTCOMES:

|       |                                                                                                                           |       |
|-------|---------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Demonstrate problem-solving techniques, algorithms, flowcharts, and basic C programming constructs in program development | Apply |
| CO 2: | Develop C programs using input/output operations, decision-making statements, and iterative constructs                    | Apply |
| CO 3: | Demonstrate the use of arrays and strings for data processing and manipulation                                            | Apply |
| CO 4: | Develop modular applications using functions, recursion, pointers, and dynamic memory management techniques               | Apply |
| CO 5: | Develop applications using structures, unions, storage classes, and file handling operations for data management          | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 2       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 3       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 4       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 5       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |

## LIST OF EXPERIMENTS

1. Design and implementation of algorithms, flowcharts, and pseudo code for basic problem-solving applications
2. Development of C programs demonstrating data types, operators, and formatted input/output operations
3. Implementation of decision-making applications using conditional statements and switch-case constructs
4. Development of iterative applications using looping and loop control statements
5. Design and implementation of console-based applications for real-world mathematical and logical problem solving
6. Implementation of one-dimensional array operations for searching, sorting, and statistical analysis
7. Development of matrix manipulation applications using two-dimensional arrays
8. Design and implementation of string processing applications using standard string handling functions
9. Development of modular applications using user-defined functions and recursive techniques



10. Implementation of applications demonstrating parameter passing mechanisms using call by value and call by reference
11. Development of applications using pointers, pointer arithmetic, and array-pointer relationships
12. Implementation of dynamic memory management applications using malloc(), calloc(), realloc(), and free()
13. Design and implementation of applications using structures, nested structures, unions, and storage classes
14. Development of file processing applications using text and binary file operations in C
15. Implementation of command-line and console-based applications integrating functions, pointers, structures, and file management concepts for real-world use cases

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 30 Periods

**REFERENCES:**

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson Education, 2015
2. Reema Thareja, "Computer Fundamentals and Programming in C", 3rd Edition, Oxford University Press, 2023
3. Yashavant Kanetkar, "Let Us C", 17th Edition, BPB Publications, 2023
4. Byron Gottfried, "Programming with C", 4th Edition, Schaum's Outline Series, McGraw Hill Education



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## SEMESTER I



| U25RMNC01 | <b>Induction Program</b><br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | <b>Category: MNC</b> |   |   |   |   |
|-----------|------------------------------------------------------------------------------------------------|----------------------|---|---|---|---|
|           |                                                                                                | L                    | T | P | J | C |
|           |                                                                                                | 3 Weeks              |   |   |   |   |
|           |                                                                                                |                      |   |   |   | 0 |

**GUIDELINES:**

Students come with diverse thoughts, backgrounds and preparations. It is important to assist them adjust in the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Keeping the above thought in mind AICTE proposes a 3-week induction program for the UG students entering the institution before the commencement of normal classes which will start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, set a healthy daily routine, create bonding in the batch as well as between faculty, develop awareness, sensitivity and understanding of the self, society at large, and nature. The following are the activities under the induction program in which the student should be fully and actively engaged throughout the entire duration of the program.

**Physical Activity:** To inculcate team spirit, competitiveness, group cohesion and bonding as well as physical & mental health, physical activities like team sports, yoga, physical exercises should be conducted daily during early morning & evening. Activities like gardening may also be encouraged.

**Creative Arts:** Every student should choose one skill related to arts /visual arts/ performing arts like painting, sculpture, pottery, music, dance etc. to develop a sense of aesthetics and also to enhance creativity. The student should pursue it daily for the duration of the program.

**Universal Human Values:** Universal Human Values module will help the student to explore oneself and experience the joy of learning, stand up to peer pressure, take decisions with courage, create awareness about the relationship with colleagues and supporting staff in the hostel and department, etc.

**Literary:** Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

**Proficiency Modules:** To establish the command over skills like English, a computer familiarity etc. these modules can be taught earlier so that when norm

**CONTACT PERIODS:**

Lecture: - Periods

Tutorial: - Periods

Practical: - Periods

Project: - Periods

Total: 0 Periods


  
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## SEMESTER I

| U25RMCC01 | Universal Human Values<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|----------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                              | L             | T | P | J | C |
|           |                                                                                              | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the significance of universal human values and their role in complementing technical, intellectual, and professional skills for holistic development.
- To apply a holistic perspective in addressing personal, societal, professional, and environmental challenges through ethical and value-based approaches.
- To demonstrate responsible citizenship, professional ethics, mutual respect, and sustainable practices that contribute positively to society, industry, and the environment.

## COURSE OUTCOMES:

- CO 1:** Explain the significance of Universal Human Values and self-exploration in developing a holistic Understand perspective, enabling students to harmonize technical competence with ethical responsibility and value-based living.
- CO 2:** Differentiate the needs of the Self and the Body, and apply self-exploration to develop healthy habits, Understand value-based decision-making, and holistic well-being.
- CO 3:** Explain the concepts of natural acceptance, competence, and respect, and apply them to foster Understand harmonious relationships, resolve social conflicts, promote value education for children, and develop holistic perspectives for societal development.
- CO 4:** Demonstrate an understanding of the interconnectedness of existence and integrate holistic perspectives Apply into academic, professional, and societal contexts.
- CO 5:** Apply human values and professional knowledge to promote sustainable development, family harmony, Apply societal well-being, and responsible participation in nature.

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | 3   | 3   | -   | -   | -    | 3    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | 3   | 3   | 3   | -   | -    | 3    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | 3   | 3   | -   | -   | -    | 3    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | 3   | 3   | -   | -   | -    | 3    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | 3   | 3   | 3   | -   | -    | 3    | -    | -    |

## SYLLABUS:

  
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**UNIT I: INTRODUCTION TO VALUE EDUCATION**

9

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) – Understanding Value Education – Self-exploration as the Process for Value Education – Continuous Happiness and Prosperity – the Basic Human Aspirations – Happiness and Prosperity: Current Scenario – Method to Fulfil the Basic Human Aspirations. Self-Exploration Activity Topics: Sharing about Oneself – Exploring Human Consciousness

**UNIT II: HARMONY IN THE HUMAN BEING**

9

Understanding Human being as the Co-existence of the Self and the Body – Distinguishing between the Needs of the Self and the Body – The Body as an Instrument of the Self – Understanding Harmony in the Self – Harmony of the Self with the Body – Programme to ensure self-regulation and Health. Self-Exploration Activity Topics: Exploring the difference of Needs of Self and Body – Exploring Sources of Imagination in the Self – Exploring Harmony of Self with the Body

**UNIT III: HARMONY IN THE FAMILY AND SOCIETY**

9

Harmony in the Family – the Basic Unit of Human Interaction – 'Trust': the Foundational Value in Relationship – 'Respect': as the Right Evaluation – Other Feelings, Justice in Human-to-Human Relationship – Understanding Harmony in the Society – Vision for the Universal Human Order. Self-Exploration Activity Topics: Exploring the Feeling of Trust – Exploring the Feeling of Respect – Exploring Systems to fulfil Human Goal

**UNIT IV: HARMONY IN THE NATURE/EXISTENCE**

9

Understanding Harmony in the Nature – Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders – Realizing Existence as Co-existence at All Levels – The Holistic Perception of Harmony in Existence. Self-Exploration Activity Topics: Exploring the Four Orders of Nature – Exploring Co-existence in Existence

**UNIT V: HARMONY ON PROFESSIONAL ETHICS : HOLISTIC UNDERSTANDING**

9

Natural Acceptance of Human Values – Definitiveness of (Ethical) Human Conduct – A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order – Competence in Professional Ethics – Holistic Technologies, Production Systems and Management Models: Typical Case Studies – Strategies for Transition towards Value-based Life and Profession. Self-Exploration Activity Topics: Exploring Natural Acceptance – Exploring Ethical Human Conduct – Exploring Humanistic Models in Education – Exploring Steps of Transition towards Universal Human Order

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. R R Gaur, R. Asthana, G P Bagaria, "A Foundation course in Human Values and Professional Ethics", 3rd Edition, Excel Books, New Delhi, 2024. ISBN 978-93-87034- 47-1
2. Prof. K. V. Subba Raju, "Success Secrets for Engineering Students", Smart Student Publications, 3rd Edition, 2013.
3. R R Gaur, R Asthana, G P Bagaria, "Teachers Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

**REFERENCES:**



1. Ivan Illich, "Energy & Equity", The Trinity Press, Worcester, and HarperCollins, USA, 1974.
2. E. F. Schumacher, "Small is Beautiful: a study of economics as if people mattered.", Blond & Briggs, Britain, 1973.
3. A Nagraj, "Jeevan Vidya ek Parichay", Divya Path Sansthan, Amarkantak, 1998.



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## SEMESTER I

| U25RMCC02 | தமிழர் மரபு / Heritage of Tamils<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|--------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                        | L             | T | P | J | C |
|           |                                                                                                        | 1             | 0 | 0 | 0 | 1 |

QP PATTERN: A

## COURSE OBJECTIVES:

- Learn the extensive literature of classical Tamil
- Review the fine arts heritage of Tamil culture
- Realize the contribution of Tamils in Indian freedom struggle

## COURSE OUTCOMES:

|       |                                                                                                            |            |
|-------|------------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Understand the extensive literature of Tamil and its classical nature                                      | Understand |
| CO 2: | Understand the heritage of sculpture, painting and musical instruments of ancient people                   | Understand |
| CO 3: | Review on folk and martial arts of Tamil people                                                            | Understand |
| CO 4: | Realization of Thina concepts, trade and victory of Chozha dynasty                                         | Understand |
| CO 5: | Understand the contribution of Tamils in Indian freedom struggle, Self-esteem movement and siddha medicine | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| 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    | -    | -    | -    |

## SYLLABUS:

## UNIT I: LANGUAGE AND LITERATURE

3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan

## UNIT II: HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

3

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils

## UNIT III: FOLK AND MARTIAL ARTS

3

Tattooing, basket weaving, Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils



**UNIT IV: THINAI CONCEPT OF TAMILS**

3

Flora and Fauna of Tamils & Aham: and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas

**UNIT V: CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**

3

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 15 Periods

**TEXTBOOKS:**

1. Jayanthi Ravikrishna K, Heritage of Tamils, Sri Krishna publications, First Edition, 2023
2. S. Priyadharshini, Heritage of Tamils, V. K. Publications

**REFERENCES:**

1. தமிழக வரலாறும் மக்களும் பண்பாடும் - கே. கே. பிள்ளை, உலகத் தமிழாராய்ச்சி நிறுவனம் (International Institute of Tamil Studies), C.P.T கேம்பஸ், சென்னை.
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம், விகடன் பிரசுரம், அண்ணொ சொல, .சன்னை, திசம்பர் 2016
3. கீழடி - 0வ0க நதிக்க0ரயில் சங்ககொல நகர நொகரிகம், .தொல்லியல் துறை .வளையீடு, தமிழ்நொடு அரசு, .சன்னை, ஆறொம் பதிப்பு 2020
4. Social Life of Tamils, Dr. K. K. Pillay, A joint publication of TNTB & ESC and RMRL (in print) University of Madras, Chennai, Second Edition 1975
5. The Contributions of the Tamils to Indian Culture, Dr.M.Valarmathi, International Institute of Tamil Studies, C.I.T Campus, Tharamani, Chennai, First Edition 1995

  
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## SEMESTER I &amp; II

| U25RMCC04 | Environmental Governance and Sustainability<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|-------------------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                                   | L             | T | P | J | C |
|           |                                                                                                                   | 2             | 0 | 0 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To provide basic concepts of ecosystem, biodiversity, atmospheric and hydrological processes
- To inculcate knowledge on the lithosphere, waste management practices, environmental laws and disaster management strategies
- To apply the principles of sustainable living and green technologies in alignment with the UN Sustainable Development Goals

## COURSE OUTCOMES:

- CO 1:** Explain the role of biodiversity conservation and wildlife protection in addressing environmental issues Understand
- CO 2:** Apply pollution control methods, environmental laws, and water management practices for environmental protection Apply
- CO 3:** Implement sustainable waste management practices for efficient resource utilization Apply
- CO 4:** Explain the role of disaster management, governance, and IT tools in environmental and health sustainability Understand
- CO 5:** Employ sustainable practices and national environmental initiatives for sustainable development Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 2       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 3       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 4       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 5       | 3   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: ENVIRONMENT AND BIODIVERSITY

6

Scope of Environmental Science – Ecology – Ecosystem – Classification, structure, productivity – Energy flow and nutrient cycles – Nitrogen cycle – Ecological succession – Biodiversity – Types and values of biodiversity – Biodiversity at Global, National and Local Levels – Bio-geographical Classification of India – India as a Mega-diversity Nation – Red Data Book – Hotspots of Indian Biodiversity – Endangered and endemic species – Conservation of biodiversity

Self - Learning & Case Studies – Species conservation projects in India – Species Reintroduction – National Biodiversity Action Plan 2015 – Role of International Union for Conservation of Nature (IUCN)



**UNIT II: ATMOSPHERE AND HYDROSPEHERE**

6

Atmosphere – Structure and composition – Earth's Albedo – Carbon cycle and oxygen cycle – Air Quality Standards – Air Pollution – Sources, effects and control measures – Indian Environmental Laws – Air Act 1981. Hydrosphere – Hydrosphere – Hydrological Cycle, Water Quality Parameters, Water Pollution – Sources, effects, and control measures - Water conservation – Rainwater harvesting, Dams, and watershed Management – Wastewater treatment, Ocean acidification, Blue economy, Water Act, 1974 and Environment Protection Act, 1986

Self - Learning & Case Studies – Clean Development Mechanism (CDM) – Greenhouse Gas Protocol – ISO 14064 – Jal Shakti Abhiyan – Implementation of CNG in NCT of Delhi – Taj Trapezium Case – Narmada River – Sardar Sarovar Project

**UNIT III: LITHOSPHERE AND SOLID WASTE MANAGEMENT**

6

Lithosphere – Structure of the lithosphere – Continental drift – Forest resources – Deforestation – Causes and effects – Agriculture – Effects of modern agriculture – Soil Pollution – Causes, effects and control measures. Solid Waste Management – Solid Waste – Sources, classification, and effects , Waste reduction strategies – Circular Economy and 5R Principles, Solid waste treatment, Disposal techniques, Refuse-Derived Fuel and Waste-to-Energy technologies, Biomedical, E-Waste and Hazardous waste management, Resource recovery – Environmental Standards and Waste Management Regulations (ISO 14001 and Waste Rules)

Self - Learning & Case Studies – Solid Waste Management rules, 2024 – Plastic Waste Management Rules (PWMR) – Degradation of Soil in Rajasthan – Indore's Waste Management System

**UNIT IV: GLOBAL ISSUES, HUMAN WELFARE AND ROLE OF TECHNOLOGY**

6

EIA- Concepts, stages – Land clearing projects – Environmental and social Impacts, Resettlement and Rehabilitation – Concepts and challenges – Disaster management – Floods, Landslides, Disaster management cycle and mitigation – Environmental Governance, Global Governance and Fundamental Human Rights – Importance. Human Population – Population growth, explosion and its challenges – Trends and variation among nations – Role of IT – Remote sensing, GIS and Google earth engine – Disease tracking and prediction using big data and AI (e.g., COVID-19 apps)

Self - Learning & Case Studies – Mission Amrit Sarovar – Beti Bachao Beti Padhao mission – Kerala Flood (2018) – Sterlite Copper Plant Case – Thoothukudi

**UNIT V: SUSTAINABLE DEVELOPMENT AND GREEN PRACTICES**

6

Sustainable Development – Concept, significance of sustainability – UN Sustainable Development Goals (UN SDGs) – Sustainability assessment – Carbon footprint, accounting, Carbon Neutrality – Net Zero Emissions – Carrying Capacity of the Earth – Carbon Sequestration and Carbon Capture – Blue Carbon and Green Carbon. Green Practices – Sustainable Agriculture – Green Energy – Biofuels, Green Hydrogen, Solar, wind and biomass Energy – Sustainable Transport – Electric Vehicles (EVs)

Self - Learning & Case Studies – National Solar Mission, Green India Mission – Ambikapur, Chhattisgarh – Zero Waste Model – Delhi Metro – Energy Efficiency and Sustainable Transport

**CONTACT PERIODS:**

Lecture: 30 Periods

Tutorial: - Periods

Practical: - Periods

Project: - Periods

Total: 30 Periods

**TEXTBOOKS:**

1. E. Bharucha, "Environmental Studies for Undergraduate Courses", 2nd edition, Hyderabad, University Press (India) Pvt. Ltd, 2005
2. R. Rajagopalan, "Environmental Studies: From Crisis to Cure", 3rd edition, New Delhi, Oxford University Press, 2016
3. R. R. Hiremath, "Sustainable Development", 1st edition, New Delhi, Himalaya Publishing House, 2008

**REFERENCES:**

1. Anubha Kaushik and C.P. Kaushik, "Environmental Studies" 6th edition, New Age International Publishers, New Delhi, 2018
2. Benny Joseph, "Environmental Studies", 3rd edition, New Delhi, McGraw Hill Education, 2017
3. M. Anji Reddy, "Textbook of Environmental Science and Technology", 3rd edition, BS Publications, 2019
4. R. B. Singh, "Disaster Management", 1st edition, New Delhi, Rawat Publications, 2006
5. .V. Desai, "Environment and Sustainable Development" 1st edition, Mumbai, Himalaya Publishing House, 2009



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## SEMESTER I

|           |                                                                                                          |               |   |   |   |   |
|-----------|----------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
| U25RMCC06 | Professional Skill Development - I<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|           |                                                                                                          | L             | T | P | J | C |
|           |                                                                                                          | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities **Apply**
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation **Apply**
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | 1   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 3   | 2   | 2   | 1   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | 3   | 2   | 2   | 1   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

  
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## SEMESTER II

| U25REN201 | Professional Communication - II<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: HSMC |   |   |   |   |
|-----------|-------------------------------------------------------------------------------------------------------|----------------|---|---|---|---|
|           |                                                                                                       | L              | T | P | J | C |
|           |                                                                                                       | 2              | 0 | 2 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To strengthen advanced communication and interpersonal skills required for academic and professional success
- To integrate AI-enabled communication tools for content creation, presentations and professional documentation
- To prepare students for modern workplace communication in global and digital environments

## COURSE OUTCOMES:

|       |                                                                                                      |            |
|-------|------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Apply advanced verbal, written and digital communication strategies in professional contexts         | Apply      |
| CO 2: | Analyze technical information and produce effective workplace documents                              | Analyze    |
| CO 3: | Demonstrate negotiation, leadership and collaborative communication skills                           | Understand |
| CO 4: | Deliver impactful technical presentations and communicate innovative ideas effectively               | Apply      |
| CO 5: | Utilize AI-assisted communication tools ethically for professional growth and workplace productivity | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: TECHNICAL WRITING AND DOCUMENTATION

6 + 6

Technical Reports - Proposal Writing - Meeting Agenda and Minutes - Technical Instructions and Process Description - AI-assisted Technical Documentation - Technical Vocabulary

## UNIT II: COGNITIVE PROFESSIONALISM

6 + 6

Critical Thinking Strategies - Problem-solving Communication - Case Study - Brainstorming Techniques - Collaborative Decision Making - One-word Substitutions

## UNIT III: CAREER PLANNING

6 + 6

Self-Assessment Techniques - SWOT Analysis - Goal Setting - AI-assisted Documentation - Digital Content Writing - Collocations



**UNIT IV: CORPORATE COMMUNICATION AND NETWORKING**

6 + 6

Public Speaking - Welcome Address - Vote of Thanks - Anchoring and Event Hosting - Audience Engagement - Cloze tests - Discourse markers - linkers and cohesive devices

**UNIT V: CRITICAL THINKING AND COLLABORATIVE PROBLEM SOLVING**

6 + 6

Problem-solving Techniques - Mind Mapping - Negotiation Skills - Book Review / Film Review - Podcast and Media Analysis - Critical Reading - Group Discussion

**LIST OF EXPERIMENTS**

1. Public Speaking
2. Group Discussion
3. Case Study
4. Blog Writing
5. Mind Mapping

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Ashraf Rizvi, Effective Technical Communication, 3rd Edition, McGraw Hill Education, 2023
2. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice, 4th Edition, Oxford University Press, 2023
3. Sanjay Kumar & Pushp Lata, Communication Skills, 3rd Edition, Oxford University Press, New Delhi, 2018

**REFERENCES:**

1. Stephen E. Lucas, The Art of Public Speaking, 14th Edition, McGraw Hill Education, New York, 2023
2. Dale Carnegie, The Quick and Easy Way to Effective Speaking, Updated Edition, Simon & Schuster, New York, 2019
3. Matt Abrahams, Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot, Simon & Schuster, New York, 2024



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## SEMESTER II

| U25RMA202 | Linear Algebra and Complex Variables<br>(Common to BM, EC, EV) | Category: BSC |   |   |   |   |
|-----------|----------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                | L             | T | P | J | C |
|           |                                                                | 3             | 0 | 2 | 0 | 4 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To introduce the concepts of linear algebra and complex analysis relevant to engineering systems
- To impart in-depth theoretical concepts of matrix methods and complex techniques in solving engineering problems
- To develop analytical skills for modeling and analyzing engineering systems using linear algebra and complex variables

## COURSE OUTCOMES:

|       |                                                                                                                   |       |
|-------|-------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Apply matrix operations and eigenvalue analysis to engineering systems                                            | Apply |
| CO 2: | Apply the vector spaces and linear transformations in engineering contexts                                        | Apply |
| CO 3: | Apply Gaussian elimination, Gauss–Jordan elimination and LU decomposition methods in solving systems of equations | Apply |
| CO 4: | Utilize complex variables and analytic functions in solving engineering problems                                  | Apply |
| CO 5: | Apply complex integration and residue techniques in mathematical analysis                                         | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | -    | 1    |
| CO 2       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | -    | 1    |
| CO 3       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | -    | 1    |
| CO 4       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | -    | 1    |
| CO 5       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | -    | 1    |

## SYLLABUS:

## UNIT I: SYSTEMS OF LINEAR EQUATIONS

9 + 6

Systems of linear equations – Gaussian elimination method – Gauss–Jordan elimination method – LU decomposition method – Consistency of linear systems and rank of a matrix

## UNIT II: VECTOR SPACES

9 + 6

Definition and examples of vector spaces – Subspaces – Linear independence – Basis and dimension of vector spaces – Linear transformations and matrix representation

## UNIT III: EIGENVALUES AND EIGENVECTORS

9 + 6

Eigenvalues and eigenvectors – Characteristic equation – Diagonalization of matrices – Cayley–Hamilton theorem – Applications of eigenvalues and eigenvectors





**UNIT IV: COMPLEX VARIABLES AND FUNCTIONS****9 + 6**

Complex numbers – Functions of a complex variable – Analytic functions – Cauchy–Riemann equations – Bilinear Transformation – Conformal mapping– Harmonic functions

**UNIT V: COMPLEX INTEGRATION****9 + 6**

Complex integration – Cauchy's Integral theorem – Cauchy's Integral formula – Singular points – Classification of Singularities (Removable, Pole, Essential) – Laurent's series expansion – Residues and Cauchy's-Residue theorem

**LIST OF EXPERIMENTS**

1. Systems of Linear Equations – Solve systems of linear equations using Gauss–Jordan method – Implement LU decomposition method
2. Vector Space Computations – Determine linear independence and basis of vectors – Compute dimension and rank of matrices
3. Eigenvalue Analysis – Compute eigenvalues and eigenvectors of matrices – Perform diagonalization of matrix
4. Complex Variables and Functions – Verify Cauchy–Riemann equations for analytic functions – Bi-linear transformation for complex functions
5. Complex Integration – Expand functions using Laurent series – Compute residue integrals for complex functions

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 75 Periods

**TEXTBOOKS:**

1. Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt Ltd, New Delhi, 2018

**REFERENCES:**

1. David C. Lay, Linear Algebra and Its Applications, 5th Edition, Pearson Education, 2015
2. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Wellesley Cambridge Press, 2016
3. Dennis G. Zill and Patrick D. Shanahan, A First Course in Complex Analysis with Applications, 3rd Edition, Jones & Bartlett Learning, 2011
4. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 9th Edition, McGraw-Hill Education, 2013



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## SEMESTER II

| U25RPH05 | Medical Physics | Category: BSC |    |   |   |   |
|----------|-----------------|---------------|----|---|---|---|
|          |                 | L             | T* | P | J | C |
|          |                 | 2             | 0  | 0 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To acquire the basics of atomic physics and non-ionizing radiation
- To inculcate the principles behind senses and radioactive nuclides
- To gain the knowledge of interaction of radiation and its effects in human body

## COURSE OUTCOMES:

- CO 1:** Explain the physical principles involved in human sensory systems including cutaneous sensation, gustation, olfaction, audition, vision, and psychophysics **Understand**
- CO 2:** Describe the concepts of atomic physics, Zeeman and Stark effects, and the biological effects of non-ionizing electromagnetic radiation **Understand**
- CO 3:** Apply the principles of radioactive decay, radionuclide production, and radiation interaction with matter in medical and diagnostic applications **Apply**
- CO 4:** Analyze the interaction of charged particles, X-rays, and neutrons with matter and evaluate their clinical significance in radiation dosimetry **Apply**
- CO 5:** Apply radiation quantities, radiation protection principles, and prevention measures to minimize radiation hazards in medical exposure **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 2       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 3       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 4       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 5       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |

## SYLLABUS:

## UNIT I: PHYSICS OF THE SENSES

6

Cutaneous sensation – The chemical senses: Gustation, Taste equation, Olfaction – Audition – Doppler effect – Vision – Psychophysics (Introduction)

## UNIT II: ATOMIC PHYSICS AND NON-IONIZING RADIATION

6

Atomic Physics: Absorption and Emission of light – Zeeman effect – Anomalous Zeeman effect – Stark effect – Non-ionizing electromagnetic radiation: Low frequency effects and High frequency effects



**UNIT III: PRINCIPLES OF RADIOACTIVE NUCLIDES**

6

Radioactive Decay – Isomeric Transition – Sources of Radioisotopes: Natural and artificial radioactivity – Radionuclide – Cyclotron and reactor produced Radionuclide – Medical applications

**UNIT IV: INTERACTION OF RADIATION WITH MATTER**

6

Interaction of charged particles with matter – Specific ionization – Linear energy transfer range, Bremsstrahlung, Annihilation – Interaction of X-ray with matter – Interaction of neutron with matter and their clinical significance (Radiation Dosimetry)

**UNIT V: RADIATION QUANTITIES AND RADIATION EFFECTS**

6

Radiation Quantities: Inverse square law – KERMA and absorbed dose – Stopping power – Bragg 's curve – Concept of LD50  
Radiation Effects and Prevention Measures: Stochastic and Non-stochastic effects – Principles of radiation protection in diagnostic medical exposure – Individual prevention measures

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 30 Periods

**TEXTBOOKS:**

1. Brown B. H., Smallwood R. H., Barber D., Lawford P. V and Hose D. R., "Medical Physics and Biomedical Engineering", 1st edition, CRC Press, 2017
2. Rachel A. Powsner, Edward R. Powsner, "Essentials of Nuclear Medicine Physics and Instrumentation", 4th edition, Wiley-Blackwell, West Sussex, 2022

**REFERENCES:**

1. Muhammad Maqbool "An Introduction to Medical Physics" 2017 edition, Springer, 2018
2. Woodcock J. P., "Ultrasonics Medical Physics Handbook – 1", Adam Hilger Ltd, Bristol, 2002
3. Attix F H, "Introduction to Radiological Physics and Radiation dosimetry", Viley – VCH, Verlag, 2004
4. Meredith W. J. and Massey J. B., "Fundamental Physics of Radiology", Varghese Publishing house, 1992
5. <https://nptel.ac.in/courses/115103101>



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## SEMESTER I &amp; II

| U25RCY01 | Engineering Chemistry<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: BSC |   |   |   |   |
|----------|---------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                             | L             | T | P | J | C |
|          |                                                                                             | 2             | 0 | 2 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To introduce the fundamentals, properties, industrial applications of polymeric materials and advanced energy storage devices
- To impart knowledge about corrosion prevention, surface treatment methods and nanomaterials
- To provide a basic understanding of semiconductor materials, microelectronics, quantum, computational chemistry and their applications

## COURSE OUTCOMES:

|       |                                                                                                                           |       |
|-------|---------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Apply the concepts of polymer materials and their properties in solving industrial and technological challenges           | Apply |
| CO 2: | Interpret the performance of batteries, solar cells, and supercapacitors for their effective energy storage applications  | Apply |
| CO 3: | Utilize suitable corrosion prevention methods, surface treatment techniques and nanomaterials for industrial requirements | Apply |
| CO 4: | Apply suitable semiconductor materials, microfabrication processes and display technologies for specific applications     | Apply |
| CO 5: | Utilize quantum chemistry principles and AI-assisted techniques to model, visualize, and predict material properties      | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 2       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 3       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 4       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 5       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |

## SYLLABUS:

## UNIT I: POLYMERIC MATERIALS

6 + 6

Polymers – Introduction – Compounding – Compression, Injection – Smart Polymers – Temperature responsive (PNIPAM), pH responsive (PAA), Light responsive (Azobenzene), 3D Printable (PLA), flexible and wearable polymers (PDMS – E-skin, RFID) – Conductive Polymers (PEDOT) – Synthesis, working and applications – Biopolymers – Classification, PEG, Alginate Hydrogel – Synthesis and applications



**UNIT II: ENERGY CONVERSION AND STORAGE****6 + 6**

Batteries – Classification,  $\text{LiFePO}_4$  – Construction, working and applications – Fuel Cells – Proton Exchange Membrane (PEM), Solid Oxide Fuel Cells (SOFC) – Green Hydrogen – Classification, production method, electrolysis – Organic photovoltaics – P3HT and PCBM – Working and applications – Solar Cells – Dye-Sensitized Solar Cells (DSSC), Supercapacitors – Electrostatic Double Layer – Working and application

**UNIT III: CORROSION AND NANO SCIENCE****6 + 6**

Types of corrosion – Factors influencing corrosion – Cathodic protection, Coatings – Galvanization, Epoxy, Polyurethane, Enamel, Superhydrophobic coatings – Process and applications. Surface treatments – Carburizing, Nitriding, Cyaniding – Process and applications. Nanomaterials – Introduction, 0D (Quantum dots), 1D (nanowire, nanorods and carbon nanotubes) 2D nanomaterials ( $\text{MoS}_2$ ), Size effects and quantum confinement, Synthesis – Laser ablation and Chemical Vapour Deposition (CVD), Various applications of nanomaterials

**UNIT IV: SEMICONDUCTOR AND DISPLAY TECHNOLOGY****6 + 6**

Semiconductors – Perfluoropentacene, GaN – Characteristics and applications, Neuromorphic Materials – Phase-Change Memory and Memristors – Working and applications – Liquid Crystal Displays, OLED, QLED – Working and applications – Wafer Manufacturing – Purification – Czochralski and Float Zone methods – Photolithography and microfabrication

**UNIT V: QUANTUM AND COMPUTATIONAL CHEMISTRY****6 + 6**

Quantum Chemistry – Basics, quantum numbers, shapes of atomic orbitals, Molecular Orbital Theory – ( $\text{H}_2$ ,  $\text{O}_2$ ,  $\text{N}_2$ ), Schrödinger equation (Derivation) – Qubits and Quantum Memory, Computational Chemistry – Molecular modeling – Basic Computational Methods – Software tools – iGemdock, Chem draw, Molview, Jmol – Introduction to AI and its role in the field of Chemistry

**LIST OF EXPERIMENTS**

1. Estimate the viscosity of a given polymer solution using an Ostwald viscometer and determine molecular weight of the given polymer
2. Synthesis of a polymer (Bakelite / polyaniline (PANI) and assess the physical properties of the polymer
3. Potentiometric determination and comparative study of EMF in different solutions
4. Determine maximum wavelength of absorption of a given solution to verify Beer's Law and to find unknown concentration of the given sample by Spectrophotometry / Colorimetry
5. Determination of corrosion rate of Iron and its prevention by electroplating / electroless plating
6. Synthesis of  $\text{ZnO}$  /  $\text{TiO}_2$  / Ag nanoparticles and study of their photocatalytic degradation of Methylene Blue dye
7. Recovery of Copper from waste Printed Circuit Boards (PCBs) and quantitative determination of copper content
8. Measurement of electrical conductivity of solutions using a conductometric Sensor
9. Perform molecular docking using freely available online software to investigate the binding affinity a ligand with the protein
10. Construct the 2D structure of a given compound and generate its 3D molecular model using computational tools for visualization and structural analysis

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Wiley India Pvt. Ltd., "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd., New Delhi, 2013
2. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry", 12th edition, Chand Publishing, New Delhi, 2024

3. R.V. Gadag and A. Nityananda Shetty, "Engineering Chemistry", 3rd edition, I.K. International Publishing House, New Delhi, 2014

**REFERENCES:**

1. Fred W Billmeyer, "Textbook of Polymer Science", 4th edition, John Wiley & Sons, New York, 1999
2. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", 4th edition, Academic Press, London, 2020
3. Kirby W Beard, Linden's "Handbook of Batteries", 5th edition, McGraw Hill, New York, 2019
4. John Larminie and Andrew Dicks, "Fuel Cell Systems Explained", 3rd edition, John Wiley & Sons, Chichester, 2012
5. Fontana M. G., "Corrosion Engineering", 3rd edition, McGraw-Hill Book Company, New York, 1986
6. V. Raghavan, "Materials Science and Engineering: A First Course", 6th edition, Prentice Hall of India, New Delhi, 2015
7. M.F. Ashby and D.R.H. Jones, "Engineering Materials" 2: An Introduction to Microstructures, Processing and Design, 4th edition, Elsevier, UK, 2012
8. Ira N Levine, "Quantum Chemistry", 7th edition, Pearson, Boston, 2013



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## SEMESTER II

| U25RCSG04 | Python Programming<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: ESC |   |   |   |   |
|-----------|------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                          | L             | T | P | J | C |
|           |                                                                                          | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To introduce the fundamental concepts of Python programming, including syntax, data types, operators, and input/output operations
- To develop problem-solving skills through the use of control structures, functions, recursion, and modular programming techniques
- To provide proficiency in Python collections, file handling, exception handling, and program organization using modules and packages
- To familiarize students with basic object-oriented programming concepts and the use of Python libraries for data analysis applications

## COURSE OUTCOMES:

- CO 1:** Explain Python programming fundamentals, including data types, operators, input/output operations, and debugging techniques **Understand**
- CO 2:** Develop Python programs using decision-making statements, iterative constructs, functions, recursion, and variable scope concepts **Apply**
- CO 3:** Implement string processing and Python collections such as lists, tuples, sets, and dictionaries to solve computational problems **Apply**
- CO 4:** Develop modular Python programs using file handling, exception handling, modules, and packages **Apply**
- CO 5:** Develop simple object-oriented programs and apply NumPy and Pandas libraries for basic data analysis applications **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |

## SYLLABUS:

## UNIT I: PYTHON FUNDAMENTALS

9

Introduction to Python – Features and Applications of Python – Installing Python – Python Interpreter – Script and Interactive Modes – Identifiers and Keywords – Variables – Data Types – Type Conversion – Operators and Expressions – Input and Output Operations – Comments and Documentation – Error Types – Testing and Debugging Basics

**UNIT II: CONTROL STRUCTURES AND FUNCTIONS**

9

Conditional Statements – Nested Conditional Statements – Iterative Statements: while Loop, and for Loop – Loop Control Statements – Functions – Function Definition and Invocation – Function Arguments and Return Values – Scope of Variables – Recursive Functions – Applications of Functions in Problem Solving

**UNIT III: STRINGS AND PYTHON COLLECTIONS**

9

Strings and String Operations – Lists and List Operations – List Comprehensions – Tuples and Tuple Operations – Sets and Set Operations – Dictionaries and Dictionary Operations – Packing and Unpacking

**UNIT IV: FILE HANDLING, MODULES AND EXCEPTION HANDLING**

9

Modules and Packages – Importing Modules – Built-in Functions – File Handling – Opening and Closing Files – Reading and Writing Files – File Methods – Exception Handling – try, except, else and finally Blocks – User Defined Exceptions

**UNIT V: OBJECT-ORIENTED PROGRAMMING AND DATA ANALYSIS**

9

Classes and Objects – Creating Classes and Objects – Constructors – Instance Variables and Methods – Introduction to NumPy – Creating Arrays – Array Operations – Indexing and Slicing – Introduction to Pandas – Series and DataFrames – Reading and Displaying Data – Simple Data Analysis Applications.

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Python programming: Using problem solving approach", 1st Edition, Oxford Press, 2017
2. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, Shroff/O'Reilly Publication, 2017

**REFERENCES:**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 2nd Edition, McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", 1st Edition, Pearson India Education Services Pvt. Ltd., 2016



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## SEMESTER II

| U25RBM201 | Analog Electronics for Biomedical Applications | Category: PCC |   |   |   |   |
|-----------|------------------------------------------------|---------------|---|---|---|---|
|           |                                                | L             | T | P | J | C |
|           |                                                | 1             | 0 | 2 | 0 | 2 |

QP PATTERN: A

## PRE-REQUISITES:

- U25RECG02 - ELECTRONIC DEVICES AND CIRCUITS

## COURSE OBJECTIVES:

- To develop a comprehensive understanding of operational amplifiers (ideal & practical) and their applications in biosignal conditioning and processing
- To apply design and experimental skills in constructing biomedical circuits (amplifiers, filters, converters) using operational amplifiers for biosignal acquisition and analysis

## COURSE OUTCOMES:

|       |                                                                                          |            |
|-------|------------------------------------------------------------------------------------------|------------|
| CO 1: | Illustrate the operation of ideal and practical operational amplifiers                   | Understand |
| CO 2: | Determine the performance characteristics of operational amplifiers                      | Apply      |
| CO 3: | Construct the converters using operational amplifiers to digitalize the biosignals       | Apply      |
| CO 4: | Apply the principles of operational amplifiers to design biosignal conditioning circuits | Precision  |
| CO 5: | Experiment with ICs to implement and test biosignal processing circuits                  | Precision  |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | 1    | -    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | 1   | 1    | 1    | 1    | -    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | 1   | 1    | 1    | 2    | -    |

## SYLLABUS:

## UNIT I: BASICS OF OPERATIONAL AMPLIFIERS

5

Ideal Operational Amplifier – General Operational Amplifier – Configurations: Inverting, Non-inverting and Buffer amplifier – Differential and Common – Mode Operation

## UNIT II: CHARACTERISTICS OF OPERATIONAL AMPLIFIERS

5

AC performance characteristics: Frequency response, Bandwidth and Slew rate – DC performance characteristics: Input bias current, Input offset current and Input offset voltage

## UNIT III: DIGITIZING BIOSIGNALS

5

Digital to Analog Conversion: R-2R Ladder type – Sample-and-hold circuits – Analog to Digital Conversion: Successive Approximation type – Converter Performance Specifications

**UNIT IV: BIOSIGNAL CONDITIONING**

15

Design of Summing and Difference Amplifier – Design of Differentiator and Integrator – Design of Instrumentation Amplifier – Design of Comparators – Design of Active Filters

**UNIT V: BIOREFERENCE GENERATORS**

15

Sine waveform: Wien Bridge Oscillator and Phase Shift Oscillator – Square waveform: Schmitt trigger – Triangular waveform – Sawtooth waveform

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4 th Edition, McGraw-Hill Education, 2016
2. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 6 th Edition, New Age International Pvt.Ltd., 2021

**REFERENCES:**

1. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6 th Edition, Prentice Hall, 2001
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 11 th Edition, Pearson Education, 2015

  
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## SEMESTER I &amp; II

| U25RMEG01 | Engineering Graphics<br>(Common to BM, CE, CH, EE, ME, MI) | Category: ESC |   |   |   |   |
|-----------|------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                            | L             | T | P | J | C |
|           |                                                            | 0             | 0 | 4 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To impart knowledge of BIS standards and conventions in engineering graphics for the accurate construction of curves, projections and developments
- To develop the ability to visualize and represent 3D objects in 2D space through orthographic projections, sectional views and development of surfaces
- To enhance the drafting skills to interconvert between isometric and orthographic views for practical engineering

## COURSE OUTCOMES:

|       |                                                                                                                                               |            |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Illustrate engineering curves with BIS standards for effective engineering communication                                                      | Understand |
| CO 2: | Apply the principles of orthographic projection to represent points, straight lines, plane surfaces, and solids on engineering drawing sheets | Apply      |
| CO 3: | Construct projections of truncated and frustums solids and develop the lateral surfaces of solids                                             | Apply      |
| CO 4: | Convert the isometric views of simple objects to orthographic views and vice versa                                                            | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 2       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 3       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 4       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |

## LIST OF EXPERIMENTS

- Introduction, drawing instruments and its uses, sheet layout, BIS conventions, lines, lettering and dimensioning practices lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints, parallelism, inclination and perpendicularity (Not for Exam)
- Manual construction of ellipse, parabola and hyperbola by eccentricity method
- Construction of involute of square and circle by manual drafting
- Projection of points in all four quadrants by manual drafting
- Projection of lines inclined to both horizontal and vertical planes by manual drafting
- Projection of planes inclined to both horizontal and vertical planes by manual drafting
- Projection of solids inclined to one plane and parallel to other planes
- Section of solids with base resting on HP
- Development of lateral surfaces of solids with base on HP
- Construction of isometric views of simple and truncated solids
- Sketching orthographic views from pictorial representation of 3D objects



12. Sketching simple components using modelling software

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 60 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. N.D. Bhatt and V.M. Panchal, "Engineering Drawing", Charotar Publishing House, Gujarat, 55th edition, 2025
2. K. Venugopal and V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2022
3. D.M.Kulkarni, A.P.Rastogi and A.K.Sarkar, "Engineering Graphics with AutoCAD", PHI Learning Private Limited, New Delhi, Revised Edition, 2021

**REFERENCES:**

1. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017
2. Sam Tickoo, "AutoCAD 2024 for Engineers and Designers", Dreamtech Press, 2024



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## SEMESTER II



| U25RCSG06 | Python Programming Laboratory<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: ESC |   |   |   |   |
|-----------|-----------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                     | L             | T | P | J | C |
|           |                                                                                                     | 0             | 0 | 2 | 0 | 1 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the fundamental concepts of Python programming and problem-solving using Python language constructs
- To apply control structures, functions, strings, and Python collections for developing efficient applications
- To develop modular applications using file handling, exception handling, modules, and packages.
- To implement basic object-oriented programming concepts and utilize Python libraries for data analysis applications

## COURSE OUTCOMES:

|       |                                                                                                                     |       |
|-------|---------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Implement Python programs using basic language constructs, data types, operators, and input/output operations       | Apply |
| CO 2: | Develop Python programs using decision-making statements, looping constructs, functions, and recursion              | Apply |
| CO 3: | Implement applications using strings, lists, tuples, sets, and dictionaries for data processing and problem solving | Apply |
| CO 4: | Develop modular applications using file handling, exception handling, modules, and packages                         | Apply |
| CO 5: | Design applications using basic object-oriented programming concepts and Python libraries such as NumPy and Pandas  | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |

## LIST OF EXPERIMENTS

1. Development of Python programs demonstrating variables, data types, operators, and input/output operations
2. Implementation of applications using conditional statements and nested conditional constructs
3. Development of iterative applications using for loops, while loops, and loop control statements
4. Design and implementation of console-based applications for mathematical and logical problem solving
5. Development of applications using user-defined functions and recursive functions
6. Implementation of string processing applications using Python string operations and methods
7. Development of applications using lists, tuples, sets, and dictionaries
8. Implementation of applications using list comprehensions and collection-based problem solving
9. Development of modular applications using built-in and user-defined modules
10. Implementation of file handling applications for reading, writing, and appending data

  
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11. Development of robust applications using exception handling and user-defined exceptions
12. Design and implementation of applications using classes, objects, constructors, and instance methods
13. Development of applications demonstrating inheritance and method overriding
14. Implementation of numerical computing applications using NumPy arrays and array operations
15. Development of simple data analysis applications using Pandas Series and DataFrames

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 30 Periods

**REFERENCES:**

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, Programming and Problem Solving with Python, 2nd Edition, McGraw Hill Education, 2018

  
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## SEMESTER I &amp; II



| U25RMCC03 | Design Thinking<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|---------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                       | L             | T | P | J | C |
|           |                                                                                       | 1             | 0 | 2 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To Understand the basics of Design Thinking, its principles, processes, and tools used
- To empathize with stakeholders and frame problems using structured tools and techniques
- To generate ideas and present solutions effectively using design tools

## COURSE OUTCOMES:

|                                                                                     |            |
|-------------------------------------------------------------------------------------|------------|
| CO 1: Explain purpose and features of design thinking process                       | Understand |
| CO 2: Use required tools to empathize with the stockholders to identify the problem | Apply      |
| CO 3: Comment the identified problem elaborately and clearly                        | Apply      |
| CO 4: Develop a conceptual solution for a societal problem                          | Apply      |
| CO 5: Present the identified solution to all the stakeholders                       | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | 1   | 1   | -   | 1   | 1    | 2    | -    | -    |
| CO 2       | 2   | 1   | -   | -   | -   | 1   | 1   | -   | 1   | 1    | 2    | -    | -    |
| CO 3       | 2   | 1   | 1   | -   | -   | 1   | 1   | 3   | 1   | 1    | 2    | -    | -    |
| CO 4       | 3   | 3   | 2   | -   | -   | 1   | 1   | 3   | 1   | 1    | 2    | -    | -    |
| CO 5       | 3   | 2   | -   | -   | -   | 1   | 1   | 3   | 3   | 1    | 2    | -    | -    |

## SYLLABUS:

## UNIT I: FUNDAMENTALS OF DESIGN THINKING

5 + 10

Introduction to Design Thinking: Definition, relevance, and applications – Design Thinking – Personal Visualization, The Wheel of Life, and Balancing Priorities – Understanding and appreciating the concept of 'Design' – The 3 Laws of Design Thinking

## UNIT II: THE EMPATHIZE AND DEFINE STAGE

5 + 10

Understanding Stakeholders – Role of Empathy in Design Thinking – Tools: Persona, Journey Mapping, Stakeholder Mapping, CATWOE, Cartographic Perspective (L0), and Empathy Map – Case Study. Problem Framing and Reframing – Role of a Design Thinker – Tools: Five Whys, Anti-Pattern, Problem Paraphrasing, Introduction to LORD Skillset – Case Study



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**UNIT III: THE DIVERGENCE AND CONVERGENCE AND COMMUNICATION STAGE****5 + 10**

Ideation through Divergent and Convergent Thinking – Tools: Brainstorming, 10gm – 100gm–1000gm. Presenting Design Outcomes – Tools: 4Cs Framework – Case Study

**LIST OF EXPERIMENTS**

1. Design a solution for a societal problem that can be in line with sustainable development, thrust areas, industrial problems etc. under various themes like Health & Wellness: MedTech, Biotech, and HealthTech Agriculture & Rural: Agriculture, FoodTech, and Rural Development Green Energy: Renewable/Sustainable Energy and Clean and Green Technology Advanced Tech: Blockchain and Cyber Security, Robotics and Drones, and Space Technology Smart Infrastructure: Smart Automation, Smart Education, Smart Vehicles, Transportation and Logistics Daily Utility & Leisure: Fitness and Sports, Tourism, Disaster Management, Games, and Toys Sustainability & Smart Cities: waste-to-wealth, disaster management, or digital twin models for resource management

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", 1st edition, New York, HarperCollins Publishers Ltd, New York, 2018
2. Idris Mootee, "Design Thinking for Strategic Innovation", 1st edition, John Wiley & Sons Inc, 2013

**REFERENCES:**

1. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009
2. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
3. Liedtka, Andrew King, Kevin Bennett, Book – "Solving Problems with Design Thinking – Ten Stories of What Works", Columbia Business School Publishing, 2013
4. Mauricio Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena, Beatriz Russo, "Design thinking: Business Innovation", MJV Press, 2011
5. Burgelman, Christensen, and Wheelwright, "Strategic Management of Technology and Innovation", 5th Edition, McGraw Hill Publications, 2017



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## SEMESTER II

| U25RMCC05 | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|------------------------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                                        | L             | T | P | J | C |
|           |                                                                                                                        | 1             | 0 | 0 | 0 | 1 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To learn weaving, ceramic and construction technology of Tamils
- To understand the agriculture, irrigation and manufacturing technology of Tamils
- To realize the development of scientific Tamil and Tamil computing

## COURSE OUTCOMES:

|       |                                                                                              |            |
|-------|----------------------------------------------------------------------------------------------|------------|
| CO 1: | Understand the weaving and ceramic technology of ancient Tamil people nature                 | Understand |
| CO 2: | Understand the construction technology, building materials in Sangam period and case studies | Understand |
| CO 3: | Infer the metal process, coin and beads manufacturing with relevant archeological evidence   | Understand |
| CO 4: | Realize the agriculture methods, irrigation technology and pearl diving                      | Understand |
| CO 5: | Apply the knowledge of scientific Tamil and Tamil computing                                  | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| 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    | -    | -    | -    |

## SYLLABUS:

## UNIT I: WEAVING AND CERAMIC TECHNOLOGY

3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries

## UNIT II: DESIGN AND CONSTRUCTION TECHNOLOGY

3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo-Saracenic architecture at Madras during British Period

## UNIT III: MANUFACTURING TECHNOLOGY

3

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel, Copper and gold – Coins as source of history – Minting of Coins – Bead-making industries – Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beads – Archeological evidences – Gem stone types described in Silappathikaram

**UNIT IV: AGRICULTURE AND IRRIGATION TECHNOLOGY****3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society

**UNIT V: SCIENTIFIC TAMIL & TAMIL COMPUTING****3**

Development of Scientific Tamil – The role of journals in the development of scientific Tamil – Scientific Tamil vocabulary – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 15 Periods

**TEXTBOOKS:**

1. Tamils and Technology, K. Jayanthi Ravikrishna, Sri Krishna publications, Mahalakshmi Nagar, Velappanchavadi, First Edition 2023
2. Tamils and Technology, S. Priyadharshini, V. K. Publications

**REFERENCES:**

1. The Contributions of the Tamils to Indian Culture, Dr. M. Valarmathi, International Institute of Tamil Studies, C.I.T Campus, Tharamani, Chennai, First Edition 1995
2. Studies in the History of India with Special Reference to Tamil Nadu, Dr. K. K. Pillay, 1979



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## SEMESTER II

|           |                                                                                                           |               |   |   |   |   |
|-----------|-----------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
| U25RMCC07 | Professional Skill Development - II<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|           |                                                                                                           | L             | T | P | J | C |
|           |                                                                                                           | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

|       |                                                                                                                                                                                  |       |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities | Apply |
| CO 2: | Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation                  | Apply |
| CO 3: | Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning                            | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 2   | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | -   | -   | 3   | -   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

  
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## SEMESTER III

| U25MA302 | Probability and Statistics<br>(Common to BM, CE, CH, EC, EE, ME, MI) | Category: BSC |   |   |   |   |
|----------|----------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                      | L             | T | P | J | C |
|          |                                                                      | 2             | 0 | 2 | 0 | 3 |

QP PATTERN: A

## PRE-REQUISITES:

- U25MA101 - Calculus and Differential Equations / U25RMA101 - Multivariable Calculus and Applications

## COURSE OBJECTIVES:

- To introduce the fundamental concepts of probability and statistics relevant to engineering
- To facilitate with students, use their understanding of statistical methods for data analysis and inference in their areas of study
- To develop probabilistic models to handle uncertainty and charts to check for quality control in engineering systems

## COURSE OUTCOMES:

|       |                                                                                                                                            |            |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Explain the fundamental concepts of probability and examine discrete probability distributions                                             | Understand |
| CO 2: | Apply suitable continuous distributions, such as uniform, exponential and normal to interpret and analyse statistical data                 | Apply      |
| CO 3: | Calculate and evaluate covariance and correlation to examine the relationship between two random variables using pairs of random variables | Apply      |
| CO 4: | Determine the estimation theory of parameters, testing of hypotheses for means and apply the Chi-square test for attribute independence    | Apply      |
| CO 5: | Perform analysis of variances to compare the means of multiple samples and apply control charts to check for quality control               | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 3       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 4       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 5       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 1    |

## SYLLABUS:

## UNIT I: ONE-DIMENSIONAL DISCRETE RANDOM VARIABLES

6 + 6

Probability – Conditional probability, independence – Baye's theorem – Discrete random variables, probability mass functions – Cumulative distribution functions – Mean and variance – Binomial, Poisson and geometric distributions

## UNIT II: ONE-DIMENSIONAL CONTINUOUS RANDOM VARIABLES

6 + 6

Continuous random variables – Probability density functions – Cumulative distribution functions – Mean and variance – Uniform, exponential, normal distributions



**UNIT III: TWO-DIMENSIONAL PROBABILITY DISTRIBUTIONS****6 + 6**

Two dimensional discrete and continuous random variables – Marginal probability distributions – Independence – Covariance – Correlation

**UNIT IV: INFERENCE STATISTICS****6 + 6**

Estimation - Point estimation – Interval estimation – Hypothesis testing – Hypotheses concerning means – Large, small samples - Chi square test for independence of attributes

**UNIT V: ANOVA AND STATISTICAL QUALITY CONTROL****6 + 6**

Analysis of variance – Completely randomized designs – Randomized block designs – Control charts for measurements ( $\bar{X}$ , R charts) – Control charts for attributes (p, np)

**LIST OF EXPERIMENTS**

1. One-Dimensional Discrete Random Variables – Mean and Variance of discrete RVs. – Discrete Probability distributions
2. One-Dimensional Continuous Random Variables – Mean and Variance of Continuous RVs. – Continuous Probability distributions
3. Two- Dimensional Probability Distributions – Marginal Probability distributions – Covariance and Correlation
4. Inferential Statistics – Estimation theory – Testing of hypotheses
5. ANOVA and SQC – Analysis of Variance. – Control charts ( $\bar{X}$ , R, p, np)

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley, 2018
2. Richard A. Johnson, "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, New Delhi, 2017

**REFERENCES:**

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson Education, New Delhi, 2016
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi 2020
3. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic press, USA, 2020
4. Robert V. Hogg, Elliot Tanis and Dale Zimmerman, "Probability and Statistical Inference", Pearson Education, USA, 2014



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## SEMESTER III

| U25BM301 | Human Anatomy and Physiology | Category: PCC |   |   |   |   |
|----------|------------------------------|---------------|---|---|---|---|
|          |                              | L             | T | P | J | C |
|          |                              | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the structural and functional organization of major human body systems
- To explain the physiological mechanisms regulating normal body functions
- To apply basic anatomical and physiological concepts in biomedical contexts

## COURSE OUTCOMES:

|       |                                                                                                                                                 |       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Apply the fundamental concepts of cell structure to explain the real world human physiological processes                                        | Apply |
| CO 2: | Apply cardiac and respiratory physiology to interpret heart function and gas exchange processes relevant to biomedical assessment               | Apply |
| CO 3: | Utilize skeletal and urinary system concepts to interpret bone functions, urine formation, and regulatory processes for maintaining homeostasis | Apply |
| CO 4: | Make use of nervous and digestive physiology to interpret neural functions, autonomic actions, digestive mechanisms, and metabolic control      | Apply |
| CO 5: | Organize endocrine and sensory functions to show how hormonal and sensory pathways coordinate body activities                                   | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | 1   | -   | -   | -   | -    | -    | 1    | -    |
| CO 3       | 3   | 2   | 1   | 1   | 1   | 1   | -   | -   | -   | -    | -    | 1    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 1   | 1   | -   | -   | -   | -    | -    | 1    | -    |
| CO 5       | 3   | 2   | 1   | 1   | 1   | 1   | -   | -   | -   | -    | -    | 1    | -    |

## SYLLABUS:

## UNIT I: THE CELL AND GENERAL PHYSIOLOGY

9

Human cell: Structure, organelles and their functions – Cell membrane – Tissue types: epithelial, connective, muscle, nervous – Electrophysiology fundamentals: membrane potential, resting potential, action potential – Homeostasis – Blood Cells: Structure and Function – Blood vessels: Vein, Artery and Capillaries – Blood Groups – Blood clotting

## UNIT II: CARDIOVASCULAR AND RESPIRATORY SYSTEMS

9

Structure of heart – Properties of Cardiac muscle – Cardiac cycle – Cardiac output – Heart sound – Volume and pressure changes and regulation of heart rate – Coronary Circulation – Respiratory System: Organization of the respiratory tract – mechanics of breathing – lung volumes and capacities – gas exchange and transport of oxygen and carbon dioxide – Regulation of respiration and acid-base balance

**UNIT III: SKELETAL AND URINARY SYSTEMS**

9

Skeletal system: Bone Structure, types and functions – Physiology of bone formation – Axial Skeleton and Appendicular Skeleton – Joint: classification and function – Cartilage structure, types and functions – Urinary system: Structure of Kidney and Nephron – Mechanism of Urine formation – Urinary reflex – Water and blood pressure regulation by urinary system

**UNIT IV: NERVOUS AND DIGESTIVE SYSTEMS**

9

Nervous system: Structure and types of neurons and neuroglia – Cross-sectional Anatomy of Brain-Physiology of nervous system – Autonomic nervous system and its functions – Digestive system: Structure and function of alimentary canal and digestive glands – Physiology of digestion, absorption, and assimilation – Metabolism of carbohydrates, proteins, and lipids – Integration of digestive and metabolic control in energy balance

**UNIT V: ENDOCRINE AND SPECIAL SENSORY SYSTEM**

9

Endocrine glands: Pituitary, Thyroid, Parathyroid, Adrenal – Hormones and their functions – Special Sensory system – Anatomy of Eye – Mechanism of Vision – Errors of Refraction – Anatomy of Ear – Mechanism of Hearing – Taste and smell receptors – Anatomy of Skin – Functions of Skin

**CONTACT PERIODS:****Lecture:** 45 Periods**Tutorial:** - Periods**Practical:** - Periods**Project:** - Periods**Total:** 45 Periods**TEXTBOOKS:**

1. Waugh, A., & Grant, A., "Ross & Wilson Anatomy and Physiology in Health and Illness", Elsevier, 2022
2. Hall, J. E., "Guyton and Hall Textbook of Medical Physiology", 15th edition, Elsevier, 2025

**REFERENCES:**

1. Marieb, E. N., "Essential of Human Anatomy and Physiology", 8th edition. Pearson Education, New Delhi, 2022
2. Pocock, G., & Richards, C. D., "The Human Body: An Introduction for Biomedical and Health Sciences", Oxford University Press, 2022


  
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| U25BM302 | Biomedical Sensors and Instrumentation | Category: PCC |   |   |   |   |
|----------|----------------------------------------|---------------|---|---|---|---|
|          |                                        | L             | T | P | J | C |
|          |                                        | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

**COURSE OBJECTIVES:**

- To equip students with the fundamental principles of biomedical instrumentation systems, including the characteristics of transducers and the essentials of signal conditioning for accurate physiological measurement
- To develop the ability to analyze bio-potential signals and evaluate electrical safety requirements, ensuring the effective and safe application of medical electronic equipment

**COURSE OUTCOMES:**

|       |                                                                                                                |         |
|-------|----------------------------------------------------------------------------------------------------------------|---------|
| CO 1: | Evaluate the static and dynamic performance characteristics of the instruments comprising transducers          | Analyze |
| CO 2: | Differentiate between various transducer types for a given biomedical application                              | Analyze |
| CO 3: | Diagnose artifacts and anomalies in acquired bio-potential signals (ECG, EEG, EMG)                             | Analyze |
| CO 4: | Construct signal conditioning system for biomedical measurements and devise methods to mitigate inherent noise | Apply   |
| CO 5: | Evaluate electrical safety hazards in medical equipment and apply safety standards                             | Analyze |

**CO - PO MAPPING:**

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 3       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | 3    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 5       | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | -    | 3    | -    |

**SYLLABUS:****UNIT I: INSTRUMENTATION AND PERFORMANCE CHARACTERIZATION**

9

Introduction to Basic Instrumentation System: Block diagram and function of each block – Transducers: classification (Active/Passive, Analog/Digital) – Static Characteristics: Accuracy, Precision, Resolution, Sensitivity, Linearity, Hysteresis, Range, Span – Dynamic Characteristics: Zero, First, and Second order system responses; Speed of Response, Fidelity, Lag, Dynamic Error – Errors in Measurement: Types (Gross, Systematic, Random), basic statistical analysis

**UNIT II: PRINCIPLES AND SELECTION OF BIOMEDICAL TRANSDUCERS**

9

Displacement, Position, and Motion Transducers: Potentiometric, LVDT, Piezoelectric – Pressure Transducers: Strain Gauge, Capacitive, Piezoresistive for blood pressure monitoring – Temperature Transducers: Thermistors, RTDs, Thermocouples – Optical Sensors: Phototransistors, Optical Fibers and their applications – Biosensors: Definition, key components





**UNIT III: BIO-POTENTIAL INTERPRETATION AND ARTIFACT DIAGNOSIS**

9

Electrodes and its types – Electrocardiography (ECG): Standard 12-lead system, ECG waveform interpretation (P, QRS, T) and artifacts – Electroencephalography (EEG): Electrode placement (10-20 system), Frequency bands, and artifacts such as ocular and muscle interference – Electromyography (EMG): The electrical activity of muscles, Signal characteristics, and common artifacts like motion artifact

**UNIT IV: SIGNAL CONDITIONING CIRCUITS FOR BIOMEDICAL APPLICATIONS**

9

General Considerations for Signal Conditioners – Amplifier Design: Preamplifier requirements, Instrumentation Amplifier design, Differential, Carrier, Chopper, and Isolation Amplifiers – Sources of Noise in Low-Level Measurements: Thermal (Johnson) Noise, Shot Noise,  $1/f$  Noise - Noise Reduction Strategies: Shielding, Guarding, and Grounding

**UNIT V: ELECTRICAL SAFETY, STANDARDS AND RISK VALIDATION**

9

Electric Shock Hazards: Physiological effects of current (macro vs. micro-shock) – Leakage Currents: Types (Earth, Enclosure, Patient Lead) and permissible limits – Safety Codes and Standards: Introduction to IEC 60601-1, AAMI, NFPA 99 – Methods for Ensuring Safety: Grounding Systems, Isolation, Equipotential Bonding – Electrical Safety Analyzer: Principles and operation of analyzers like the Fluke 612 for validating equipment safety compliance

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Khandpur, R. S., "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw Hill, 2014
2. Sawhney, A. K., "A Course in Electrical, Electronic Measurements and Instrumentation", Dhanpat Rai & Sons, 2019

**REFERENCES:**

1. Webster, J. G. (Ed.), "Medical Instrumentation: Application and Design" 4th edition, John Wiley & Sons, 2009
2. Carr, J. J., and Brown, J. M., "Introduction to Biomedical Equipment Technology", 4th edition, Pearson, 2001

## SEMESTER III

| U25ECG02 | Digital System Design<br>(Common to BM, EC) | Category: PCC |   |   |   |   |
|----------|---------------------------------------------|---------------|---|---|---|---|
|          |                                             | L             | T | P | J | C |
|          |                                             | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the fundamentals of digital logic circuits
- To design the combinational logic circuits
- To design the synchronous and asynchronous sequential circuits

## COURSE OUTCOMES:

|                                                                     |       |
|---------------------------------------------------------------------|-------|
| CO 1: Solve Boolean expressions and realize using universal gates   | Apply |
| CO 2: Design combinational circuits and implement using logic gates | Apply |
| CO 3: Develop synchronous sequential circuits using flip-flops      | Apply |
| CO 4: Design hazard-free asynchronous sequential circuits           | Apply |
| CO 5: Implement logic functions using programmable memory devices   | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 2       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 3       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 4       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 5       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |

## SYLLABUS:

## UNIT I: BOOLEAN THEOREMS AND LOGIC REDUCTION

9

Number system – Complements – Boolean theorems – Codes – Logic gates – NAND and NOR realization– Representation of boolean expression – SOP, POS, canonical form – Simplification of logic functions using K-map, Quine McCluskey method

## UNIT II: COMBINATIONAL LOGIC DESIGN

9

Adder-1 Bit adder/subtractor, parallel adder, 2's complement adder/subtractor – Implementation of combinational circuits – Multiplexers, demultiplexers, decoders, encoders – Code converters - Magnitude Comparator – Parity generator and checker

## UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS

9

Latches and flip-flops – Conversion of flip-flops – Analysis and design of clocked sequential circuits counters – UP/DOWN/ MOD Counter – Shift-registers – Ring and Johnson counter – Finite State Machines design – Mealy and Moore machine – Sequence detector design

**UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS**

9

Analysis and design of Asynchronous circuit design – Fundamental mode and Pulse mode – Race Conditions – Hazards in Asynchronous Circuits – Hazard-free logic design

**UNIT V: LOGIC FAMILIES AND MEMORY DEVICES**

9

Overview of Logic Families – Propagation Delay, Fan-in, Fan-out, Noise Margin – Programmable Logic Devices – Realization of logic functions using PROM, PLA, PAL

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. M.Morris Mano, Michael D Ciletti, "Digital Design", 6th edition, Pearson, 2018
2. Charles H. Roth, Jr, Larry L. Kinney "Fundamentals of logic design", 7th edition, Kluwer Academic Publishers, 2014

**REFERENCES:**

1. Thomas L.Floyd, "Digital Fundamentals", 11th edition, Prentice Hall, 2015
2. S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design", 5th Edition, Oxford University Press, India, 2018
3. Ronald J Tocci, Neal S Widmer, Gregory L Moss, "Digital Systems Principles and Applications", 10th edition, Pearson, 2009
4. D. Donald Givone, "Digital Principles and Design", 4th edition, Tata McGraw Hill, 2008



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| U25ADG02 | Data Structures and Algorithms<br>(Common to AD, BM, EC, EE, MI) | Category: PCC |   |   |   |   |
|----------|------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                  | L             | T | P | J | C |
|          |                                                                  | 3             | 0 | 2 | 0 | 4 |

QP PATTERN: A

**COURSE OBJECTIVES:**

- To understand the fundamental concepts of ADT and data structure types
- To learn linear and non linear data structures
- To explore tree and graph data structures

**COURSE OUTCOMES:**

- CO 1:** Implement linear data structures such as lists, stacks and queues using array-based and linked-list-based techniques Apply
- CO 2:** Apply searching and sorting techniques to solve real-time data organization problems Apply
- CO 3:** Apply tree-based data structures including binary trees, binary search trees and AVL trees to perform efficient data representation, traversal and manipulation Apply
- CO 4:** Apply graph representations and graph algorithms to solve problems involving traversal, shortest paths, topological ordering and minimum spanning trees Apply
- CO 5:** Explain the analysis of algorithms, time and space complexity Understand

**CO - PO MAPPING:**

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 3       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 4       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 5       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |

**SYLLABUS:****UNIT I: LINEAR DATA STRUCTURES – LIST, STACKS, QUEUES**

9 + 6

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list-based implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of linked list: Polynomial ADT, Radix sort, Multilist. Stack ADT – Operations – Applications – Symbol balancing – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – DeQueue – Applications of queues

**UNIT II: SEARCHING, SORTING AND HASHING TECHNIQUES**

9 + 6

Searching: Linear Search—Binary Search. Sorting: Bubble sort-Insertion sort-Selection sort- Merge sort - Quick sort. Hashing – Hash Functions – Separate Chaining – Open Addressing –Rehashing – Extendible Hashing

**UNIT III: NON-LINEAR DATA STRUCTURES – TREES**

9 + 6

Tree ADT – Tree traversals – Binary Tree ADT – Expression trees – Binary search tree ADT –AVL Trees

**UNIT IV: NON-LINEAR DATA STRUCTURES - GRAPHS****9 + 6**

Introduction to Graph – Types of graph-Representation of graphs – Graph traversal: Breadth-first traversal – Depth-first traversal – Topological ordering –Dijkstra's algorithm- Minimum spanning tree algorithms – Prims algorithm - Kruskal's Algorithm

**UNIT V: ALGORITHM ANALYSIS****9 + 6**

Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non recursive algorithms.

**LIST OF EXPERIMENTS**

1. A small library stores the list of newly arrived books in an array-based structure. The librarian wants to maintain the order of arrival. Given the arrival sequence: "AI Basics", "Data Science", "Python 101", "Algorithms", "Machine Learning", Insert them into an array-based List ADT. A book "Cyber Security" arrives and must be inserted at position 3. Later, "Python 101" is removed as it's damaged. Design the array-based List ADT operations to update the list and display the final order.
2. A hospital needs to maintain a waiting list of patients dynamically as patients arrive and get treated. Insert patients: John, Priya, Abdul, Meera in order. A senior citizen "Ravi" should be added after Priya. "Abdul" leaves before consultation. Using Linked List ADT, show how the list changes after each operation.
3. An airport check-in counter processes passengers using a circular queue system. Passengers arriving in order: P1, P2, P3, P4, P5. The queue size is 4 due to staff shortage. • Enqueue all passengers in order and show how overflow occurs. Two passengers are processed (dequeued). P6 and P7 arrive. Simulate these operations using array-based circular queue and show rear/front updates.
4. A bank uses a linked-list-based queue for serving customers. Customers: A, B, C arrive. Then D arrives. B and C are served. Implement the queue operations and show the dynamic linked list changes.
5. A sports event records running times of participants. The unsorted times are 15.2, 12.8, 20.5, 11.6, 19.3. The coach wants to sort the times to shortlist top performers. Apply Bubble Sort and Insertion Sort separately to sort the timings. Show the status of the list after each pass for both algorithms.
6. An online store wants to quickly sort product prices for discount analysis. Prices are 499, 199, 999, 350, 150, 750. Use Quick Sort (first element as pivot) and show partition steps. Use Merge Sort and show the splitting and merging stages.
7. A college stores roll numbers of students in a system. For a particular exam, the roll numbers are sorted [101, 115, 130, 145, 152, 170, 185]. • Apply Binary Search and show mid calculations for each iteration. Compare it with how Linear Search would behave for the same case. A teacher wants to find whether roll number 152 is present.
8. A company stores employee IDs in a hash table of size 10. Employee IDs: [1001, 1123, 1198, 1455, 1677]. Apply open addressing and closed addressing hashing techniques and show the optimal one.
9. A university stores student scores in a BST for quick rank retrieval. Scores: [75, 60, 90, 45, 65, 85, 95]. Construct the BST. Apply inorder, preorder, and postorder traversal. Later, student scores 45, 65 and 75 need removal due to correction. Show the tree after each deletion and state the rule used.
10. A delivery company wants to find the fastest delivery route between warehouses in a city. Given a weighted graph (distances between warehouses): A → B : 4 A → C : 2 B → D : 5 C → B : 1 C → D : 8 D → E : 6 Apply Dijkstra's algorithm starting from A and determine: Shortest path from A to all other warehouses. Distance table update for each step.
11. A telecom company wants to lay cables between cities at minimum cost. The network between cities is modeled as a weighted graph. Apply Prim's algorithm to find the Minimum Spanning Tree and list the edges selected at each step, growing MST, total cost.
12. A power grid network wants to connect electricity stations with minimal wiring cost. The weighted edges between stations are provided. Apply Kruskal's algorithm by sorting edges by weight.



**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 75 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Data Structures and Algorithms", 1st edition, Oxford University Press, 2025
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, "Fundamentals of Data Structures in C", 2nd Edition, Techno Series, 2024

**REFERENCES:**

1. R. Venkatesan, S. Lovelyn Rose, "Data Structures", 2nd Edition, Wiley, 2019
2. Seymour Lipschutz, "Data Structures", 2nd Edition, McGraw Hill Education, 2017
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", 1st Edition, Pearson Education Asia, 2013



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## SEMESTER III

| U25BM303 | Biomaterials | Category: PCC |   |   |   |   |
|----------|--------------|---------------|---|---|---|---|
|          |              | L             | T | P | J | C |
|          |              | 2             | 0 | 0 | 2 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To interpret the structure, properties, and functions of materials used in biomedical applications
- To explore the methods of fabrication and characterization of biomaterials for various biomedical applications

## COURSE OUTCOMES:

|       |                                                                                                                 |         |
|-------|-----------------------------------------------------------------------------------------------------------------|---------|
| CO 1: | Identify the types of biomaterials with their mechanical properties and biological interactions                 | Apply   |
| CO 2: | Differentiate various metallic and ceramic biomaterials by examining their properties and applications          | Analyze |
| CO 3: | Make use of polymeric materials in various biomedical applications                                              | Apply   |
| CO 4: | Utilize advanced characterization techniques to investigate the physical and surface properties of biomaterials | Apply   |
| CO 5: | Evaluate the various clinical and emerging applications of biomaterials                                         | Analyze |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 2       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | 1   | -    | 1    | 3    | -    |
| CO 5       | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | 1   | -    | 1    | 3    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO BIOMATERIALS

6 + 6

Definition and types of biomaterials – Mechanical properties: tensile, compressive, shear – Viscoelastic behavior – Fracture – Fatigue – Body response to implants – Wound healing – Blood compatibility

## UNIT II: METALS AND CERAMIC MATERIALS

6 + 6

Metallic implants – Stainless steel – Cobalt-chromium alloys – Titanium alloys – Nanostructured metallic implants – Ceramic implant – Bioinert – Bioresorbable – Bioactive ceramics

## UNIT III: POLYMERIC BIOMATERIALS

6 + 6

Structure of polymers and types of polymerization – Biopolymers – Collagen – Elastin – Cellulose – Synthetic polymers – Polyethylene – Polymethylmethacrylate – Hydrogels – Silicones

## UNIT IV: CHARACTERIZATION OF BIOMATERIALS

6 + 6

X-ray diffraction – Fourier transform infrared spectroscopy – Atomic force microscopy – Scanning electron microscopy – Transmission electron microscopy – Contact angle measurement

**UNIT V: MEDICAL APPLICATIONS OF BIOMATERIALS**

**6 + 6**

Orthopedic implants – Dental implants – Cardiovascular devices – Ophthalmology – Drug delivery systems – Tissue engineering

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** 30 Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford and Gopinath Mani., "Introduction to Biomaterials: Basic Theory with Engineering Applications", 2nd edition, Cambridge University Press, 2025
2. Guigen Zhang, Michael J. Yaszemski, Shelly E. Sakiyama-Elbert and William R Wagner., "Biomaterials Science: An Introduction to Materials in Medicine", 4th edition, Academic Press, 2020

**REFERENCES:**

1. Andrew F. Von Racum., "Handbook of Biomaterials Evaluation: Scientific, Technical and Clinical Testing of Implant Materials", 2nd edition, CRC Press, 2022
2. Gray E. Wnek and Gray L Browlin., "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc., New York, 2021



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## SEMESTER III

| U25BM304 | Human Anatomy and Physiology Laboratory | Category: PCC |   |   |   |   |
|----------|-----------------------------------------|---------------|---|---|---|---|
|          |                                         | L             | T | P | J | C |
|          |                                         | 0             | 0 | 2 | 0 | 1 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To estimate various blood cell types and hematological parameters
- To assess basic physiological and sensory functions using standard biomedical tests

## COURSE OUTCOMES:

|       |                                                                                                   |              |
|-------|---------------------------------------------------------------------------------------------------|--------------|
| CO 1: | Perform precise hematological tests and interpret normal blood parameter ranges                   | Precision    |
| CO 2: | Demonstrate accurate use of microscopes and cell counting for blood and tissue analysis           | Precision    |
| CO 3: | Assess, measure, and record vital physiological parameters for clinical evaluation                | Precision    |
| CO 4: | Conduct and interpret basic sensory function tests such as visual acuity and auditory assessments | Articulation |
| CO 5: | Accurately document laboratory observations, procedures, and results in a structured record       | Manipulation |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 4       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 5       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |

## LIST OF EXPERIMENTS

1. Study Compound Microscope and Neubauer chamber
2. Separation of Blood Components – Plasma and packed cells using centrifugation
3. Estimation of RBC Count using Neubauer chamber
4. Estimation of WBC count and differential leukocyte count
5. Estimation of Platelet Count
6. Identification of blood group and Rh factor
7. Determination of Hemoglobin concentration
8. Estimation of Bleeding and Clotting Time
9. Testing of Visual Activity (Snellen's Chart) and Hearing Ability (Tuning fork)
10. Essential first-aid procedures – management of wounds, burns, and fractures

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 30 Periods

## TEXTBOOKS:

1. Waugh, A., & Grant, A., "Ross & Wilson Anatomy and Physiology in Health and Illness", Elsevier, 2022



**REFERENCES:**

1. Hall, J. E., "Guyton and Hall Textbook of Medical Physiology", 15th edition, Elsevier, 2025



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## SEMESTER III

| U25BM305 | Biomedical Sensors and Instrumentation Laboratory | Category: PCC |   |   |   |   |
|----------|---------------------------------------------------|---------------|---|---|---|---|
|          |                                                   | L             | T | P | J | C |
|          |                                                   | 0             | 0 | 4 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To develop precision in operating biomedical instrumentation and constructing sensor interfaces for the accurate acquisition of physiological signals
- To cultivate the ability to articulate and integrate multiple skills for troubleshooting complex measurement systems and building functional prototypes

## COURSE OUTCOMES:

- CO 1: Identify the appropriate sensors and instruments for measuring a specified physiological parameter Precision
- CO 2: Construct sensor-based measurement circuits and select components to acquire appropriate signals Articulation
- CO 3: Coordinate the complete procedure for acquiring signals efficiently, troubleshooting with minimal errors Articulation
- CO 4: Analyze the acquired physiological data to interpret results and validate system performance against theoretical expectations Precision
- CO 5: Document the experimental procedure, results, and analysis in a structured technical report Manipulation

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | 1   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 3   | 2   | 2   | 1   | -   | -   | 1   | -   | -    | -    | 3    | -    |
| CO 3       | 3   | 3   | 2   | 2   | 1   | -   | -   | 1   | -   | -    | -    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 1   | -   | -   | 1   | -   | -    | -    | 3    | -    |
| CO 5       | 2   | 1   | -   | -   | -   | -   | 1   | 1   | 2   | -    | -    | 1    | -    |

## LIST OF EXPERIMENTS

- Familiarization with Laboratory Instrumentation and Interpretation of Data Sheets
- Characterization of a displacement Sensor using a Linear Variable Differential Transformer (LVDT)
- Acquisition of temperature data using appropriate sensors
- Evaluation of a strain gauge-based pressure sensor
- Recording and analysis using LabVIEW a. PPG Signals b. force Signals
- Construction and testing of an ECG amplifier using AD620/AD8232
- Design and simulation of an ECG amplifier using Simulink
- Recording and interpretation of the human electrocardiogram (ECG)
- Acquisition and analysis of Electromyogram (EMG) signals
- Assessment of electrical safety in medical devices using FLUKE ESA 612

## CONTACT PERIODS:

Lecture: - Periods

Tutorial: - Periods

Practical: 60 Periods

Project: - Periods

Total: 60 Periods

**TEXTBOOKS:**

1. Khandpur, R. S., "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw Hill, 2014
2. Sawhney, A. K., "A Course in Electrical, Electronic Measurements and Instrumentation", Dhanpat Rai & Sons, 2019

**REFERENCES:**

1. John G. Webster., "Medical Instrumentation: Application and Design", 4th edition, John Wiley & Sons, New York, 2009
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer., "Biomedical Instrumentation and Measurements", 2nd edition, Pearson Education, New Delhi, 2011
3. Robert B. Northrop., "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", 2nd edition, CRC Press, Boca Raton, 2012
4. National Instruments, "LabVIEW for Everyone: Graphical Programming Made Easy and Fun", 6th edition, Prentice Hall, Texas, 2020
5. H. Klee, R. Allen., "Simulation of Dynamic Systems with MATLAB and Simulink", 3rd edition, CRC Press, Boca Raton, 2019



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## SEMESTER III

| U25ECG03 | Digital System Design Laboratory<br>(Common to BM, EC) | Category: PCC |   |   |   |   |
|----------|--------------------------------------------------------|---------------|---|---|---|---|
|          |                                                        | L             | T | P | J | C |
|          |                                                        | 0             | 0 | 2 | 0 | 1 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To familiarize students with the fundamental concepts of digital logic, combinational circuits, and sequential circuits
- To enable students to design and implement combinational and sequential digital circuits using fundamental logic gates and digital design principles
- To provide hands-on experience in applying digital design techniques to real-time case studies and practical system implementations

## COURSE OUTCOMES:

- CO 1: Apply the fundamental concepts of digital logic to construct and verify basic logic circuits Apply
- CO 2: Analyze the design requirements and implement combinational and sequential circuits Analyze
- CO 3: Examine the behavior of digital circuits through implementation and verification Analyze
- CO 4: Demonstrate individual competency or effective teamwork in designing and implementing the experimental results Apply
- CO 5: Apply ethical standards and present experimental results effectively Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 2       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 3       | 3   | 3   | 2   | 2   | -   | -   | -   | 2   | 2   | -    | 1    | 1    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | -   | 2   | -   | -    | 1    | 1    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | 2   | 2   | 2   | -    | 1    | 1    | -    |

## LIST OF EXPERIMENTS

1. Verify the logical functions of gates
2. Implementation of combinational logic design using MUX IC's
3. Design and implementation of various data path elements (Adder/Subtractor)
4. Design a circuit to convert one code into another using basic logic gates
5. Design and implement a 4-bit even parity generator and checker
6. Verify the logical functions of flip-flop
7. Design and implementation of synchronous sequential circuit (Counters/ Shift registers)
8. Design and implementation of asynchronous mod counters
9. Design a Mealy/Moore sequence detector for detecting the given sequence

## CONTACT PERIODS:

Lecture: - Periods

Tutorial: - Periods

Practical: 30 Periods

Project: - Periods

Total: 30 Periods

**REFERENCES:**

1. M.Morris Mano, Michael D Ciletti, "Digital Design", 6th edition, Pearson, 2018



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## SEMESTER III

| U25MNC02 | Essence of Indian Traditional Knowledge<br>(Common to all programmes) | Category: MNC |   |   |   |   |
|----------|-----------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                       | L             | T | P | J | C |
|          |                                                                       | 1             | 0 | 0 | 0 | 0 |

QP PATTERN: A

## COURSE OBJECTIVES:

- Understand the Concept of culture in ancient, medieval and modern period.
- Know the need and importance of Indian languages and Literature.
- Understand the various religion and philosophy in various periods.

## COURSE OUTCOMES:

|                                                                   |            |
|-------------------------------------------------------------------|------------|
| CO 1: Understand Philosophy of Indian culture                     | Understand |
| CO 2: Distinguish the Indian languages and literature.            | Understand |
| CO 3: Learn the philosophy of ancient, medieval and modern Indian | Remember   |
| CO 4: Acquire the information about the fine arts in India        | Apply      |
| CO 5: Know the contribution of scientists different eras          | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |
| CO 2       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |
| CO 3       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |
| CO 4       | -   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| CO 5       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO CULTURE

5

Culture, Civilization, Culture and heritage, General characteristics of culture, Importance of culture in human literature, Indian culture, Ancient India, Medieval India, Modern India

## UNIT II: INDIAN LANGUAGES AND LITERATURE

5

Indian Languages and Literature-I: The role of Sanskrit, Significance of scriptures to current society, Indian philosophies, other Sanskrit literature, Literature of south India Indian Languages and Literature-II: Northern Indian Languages & literature, Temples and Temple types, Sculptors 's specialties, Temples Individualities Festivals and hopes

## UNIT III: RELIGION AND PHILOSOPHY

5

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (Selected Movements only)



**UNIT IV: ARTS, SCIENCE, TECHNOLOGY& ENGINEERING IN INDIA**

5

Indian painting, Handicrafts, Music, Divisions of Indian classical music, Modern Indian music, Dance and drama, Indian architecture (ancient, medieval and modern), Science and technology in India, Development of science in different periods, Sushruta and Charaka, sages of South India, herbal treatments, Surgery methods of healers, Yoga and pranayama practices, Herbal usages and medication-making methods.

**UNIT V: EDUCATION SYSTEM IN INDIA**

5

Education in ancient, Medieval and modern India, Aims of education, subjects, languages, science and scientists of Ancient India, Medieval India and Modern India

**CONTACT PERIODS:**

**Lecture:** 25 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 25 Periods

**TEXTBOOKS:**

1. Kapil Kapoor, "Text and Interpretation: The India Tradition", ISBN: 81246033375, 2005.
2. "Science in Sanskrit", Sanskrita Bharti Publisher, ISBN: 978-8187276333, 2007.

**REFERENCES:**

1. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989.
2. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN: 9788120810990, 2014.
3. S. Narain, "Examinations in Ancient India", Arya Book Depot, 1993.
4. NCERT, "Position Paper on Arts, Music, Dance and Theatre", 2000.
5. B. Kumar Mohanta & Vipin Kumar Singh, "Traditional Knowledge System and Technology in India", 2012.



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## SEMESTER III

|           |                                                                    |               |   |   |   |   |
|-----------|--------------------------------------------------------------------|---------------|---|---|---|---|
| U25RMCC08 | Professional Skill Development - III<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|           |                                                                    | L             | T | P | J | C |
|           |                                                                    | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities **Apply**
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation **Apply**
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 2   | 3   | 3   | 2   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | -   | -   | 3   | -   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 0 Periods

  
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## SEMESTER IV

| U25MA402 | Stochastic Processes in Engineering Systems | Category: BSC |   |   |   |   |
|----------|---------------------------------------------|---------------|---|---|---|---|
|          |                                             | L             | T | P | J | C |
|          |                                             | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To introduce foundational concepts of stochastic processes relevant to engineering systems
- To model, analyze, and interpret random processes in biomedical and electronic domains
- To develop analytical skills for stochastic modeling and problem-solving

## COURSE OUTCOMES:

|       |                                                                                        |            |
|-------|----------------------------------------------------------------------------------------|------------|
| CO 1: | Understand basic stochastic processes and classify different types of random processes | Understand |
| CO 2: | Analyze Markov chains and apply them to discrete-time system modeling.                 | Apply      |
| CO 3: | Apply Poisson processes and renewal theory in engineering systems                      | Apply      |
| CO 4: | Model and analyze continuous-time Markov processes and queuing systems                 | Apply      |
| CO 5: | Understand the fundamentals of queuing models and performance metrics                  | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 3       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 4       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 5       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |

## SYLLABUS:

UNIT I: INTRODUCTION TO RANDOM PROCESSES 9

Definition and classification of stochastic processes – Stationary processes – Strict-sense and wide-sense, ergodic processes – Mean function, autocorrelation and cross-correlation functions

UNIT II: DISCRETE-TIME MARKOV CHAINS 9

Definition and properties – Transition probability matrix – Chapman-Kolmogorov equations – Classification of states – Recurrent, transient, periodic, aperiodic, irreducibility – Limiting distributions – Stationary distributions.

UNIT III: POISSON PROCESS AND RENEWAL THEORY 9

Introduction to Poisson process – Inter-arrival and waiting times – Exponential distribution properties – Memoryless property, renewal process – Renewal function and renewal reward theorem

UNIT IV: CONTINUOUS-TIME MARKOV CHAINS 9

Definition and properties – Birth and death processes – Kolmogorov forward and backward equations – Steady-state analysis – Transition rates and Limiting probabilities



## UNIT V: QUEUING MODELS

9

Introduction to queuing systems – Kendall notation, single-server queues (M/M/1) – Multi-server queues (M/M/c) – General service time queues (M/G/1)

### CONTACT PERIODS:

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

### TEXTBOOKS:

1. Roy D Yates and David J Goodman, "Probability and Stochastic Processes", Wiley India, New Delhi, 2021
2. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queuing, and Computer Science Applications", 2nd Ed., Wiley, 2002

### REFERENCES:

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", CRC Press, USA, 2018
2. Sheldon M. Ross, "Stochastic Processes", 2nd Ed., Wiley, 1996
3. Medhi, J. "Stochastic Processes", 2nd Ed., New Age International Publishers, 1994
4. Stark, H and Woods, J. "Probability and Random Processes with Applications to Signal Processing", 3rd Ed., Pearson, 2002



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## SEMESTER IV

| U25BM405 | Integrated Biosciences | Category: PCC |   |   |   |   |
|----------|------------------------|---------------|---|---|---|---|
|          |                        | L             | T | P | J | C |
|          |                        | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To provide fundamental knowledge of biochemical, immunological, microbiological, and pathological principles relevant to biological and biomedical systems
- To develop the ability to apply and analyze basic bioscience concepts in understanding physiological processes, disease mechanisms, and biomedical applications

## COURSE OUTCOMES:

- CO 1:** Utilize biochemical and biophysical properties to interpret basic biological and physiological processes **Apply**
- CO 2:** Interpret the metabolic changes and disorders associated with carbohydrates, lipids, and proteins **Apply**
- CO 3:** Examine immune responses involving immune cells, antigens, antibodies, hypersensitivity, and immunotherapy **Analyze**
- CO 4:** Make use of microscopy, microbial culture, growth, and staining techniques to identify and characterize microorganisms **Apply**
- CO 5:** Inspect the cellular and tissue-level mechanisms and their disease pathologies **Analyze**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 3       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 5       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | 1    | -    |

## SYLLABUS:

## UNIT I: BIOCHEMISTRY

9 + 6

Structure of water and its significance – Covalent and Non-covalent Interactions – Acids, Bases, pH and Acid-Base Homeostasis – Biological Buffers – Henderson-Hasselbalch Equation – Acid-Base Disorders: Acidosis and Alkalosis – Viscosity and Surface Tension – Principle of Adsorption and Diffusion – Osmosis and Osmotic Pressure

## UNIT II: BIOMOLECULES

9 + 6

Carbohydrates: Classification, Structure and Functions – Glycolysis and Energy Production – Hormonal Regulation – Lipids: Classification, Structure and Functions – Triglyceride Synthesis and Lipolysis – Lipoproteins: Structure, Types and Significance – Proteins: Structure and Functions – Abnormalities: Diabetes mellitus, hypercholesterolemia and phenylketonuria

**UNIT III: IMMUNOLOGY****9 + 6**

Cells and Organs of the Immune System – Innate Immunity – Adaptive Immunity – Antigens, Immunogenicity and Epitopes – Antibody: Structure, Functions and Immunoglobulin Isotypes – Monoclonal and Recombinant Antibodies – Cell and humoral mediated immunity – Hypersensitivity Reactions and Their Types – Immunotherapeutics

**UNIT IV: MICROBIOLOGY****9 + 6**

Principles of Microscopy and Resolution – Fluorescence Microscopy – Confocal Microscopy – Microbial Culturing and Aseptic Techniques – Culture Media – Microbial Growth Curve – Staining methods: simple staining, differential staining – Acid fast staining, negative staining – Hematoxylin and eosin staining

**UNIT V: PATHOLOGY****9 + 6**

Cell Injury: Causes and Mechanisms – Necrosis – Apoptosis – Cellular adaptations of growth and differentiation: Atrophy, Hypertrophy – Hyperplasia, dysplasia, metaplasia – Edema – Thrombosis – Embolism – Bleeding disorders, leukemias, lymphomas

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 75 Periods

**TEXTBOOKS:**

1. Rafi MD, "Textbook of Biochemistry for Medical Student", 4th Edition, University Press, 2021
2. Joanne M. Willey, Joanne Willey, Kathleen M. Sandman, Dorothy H. Wood, "Prescott's Microbiology", 12th Edition, McGraw Hill, 2022

**REFERENCES:**

1. Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, Victor W. Rodwell, P. Anthony Weil, "Harper's Illustrated Biochemistry", 33rd Edition, McGraw Hill, 2026
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen, "Kuby Immunology", 8th Edition, WH Freeman, 2018
3. Ramzi S. Cotran, Vinay Kumar, Stanley L. Robbins, "Pathologic Basis of Diseases", 10th Edition, Elsevier India, 2020



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## SEMESTER IV

| U25BM402 | Hospital Administration | Category: PCC |   |   |   |   |
|----------|-------------------------|---------------|---|---|---|---|
|          |                         | L             | T | P | J | C |
|          |                         | 3             | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To apply management principles to enhance decision-making and improve organizational efficiency in hospital administration
- To analyze operational and managerial performance across hospital service areas using appropriate analytical approaches
- To integrate ethical frameworks and governance standards into administrative practices for responsible hospital management

## COURSE OUTCOMES:

- CO 1:** Develop prerequisites for efficient hospital administration, approaches to build organizational uniqueness and strategies for enhancing the effectiveness of hospital committees **Apply**
- CO 2:** Identify relevant performance indicators to monitor and improve the efficiency of core and specialized hospital service areas **Apply**
- CO 3:** Analyze the operational and management challenges within ancillary and support service departments **Analyze**
- CO 4:** Examine the principles of human resource and financial management **Analyze**
- CO 5:** Infer ethical frameworks and legal provisions governing hospital management **Analyze**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | 1   | -   | -   | -   | -    | 1    | -    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | 1   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 3       | 3   | 3   | 2   | 2   | -   | 1   | -   | -   | -   | 1    | 1    | -    | -    |
| CO 4       | 3   | 3   | 2   | 2   | -   | 2   | -   | -   | -   | 1    | 1    | -    | -    |
| CO 5       | 3   | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: HOSPITAL ADMINISTRATOR AND ORGANIZATIONAL FRAMEWORK

9

India's National Health policy – Hospital Administrator: abilities, roles and responsibilities – Hospital Organization: types, organizational principles, functions and structure – Hospital Committees: administrative, regulatory, clinical, facilities, quality and safety

## UNIT II: CORE AND SPECIALIZED SERVICES

9

Accident and Emergency Services: functions, facilities and workflow – Outpatient and Inpatient Services: scope, infrastructure and practices – Critical Care Services: organization, infrastructure and staffs – Diagnostic Services: range, point-of-care, and outsourcing



**UNIT III: ANCILLARY AND SUPPORT SERVICES**

9

Medical Records Management: nature and contents of medical records, filing methods, storage and retention – Hospital Pharmacy Management: organization and regulations – Linen and Laundry: physical infrastructure, equipment and workflow – Fire Management: local fire plan and staff training – Hospital Safety and Security: safety codes and risk management

**UNIT IV: HUMAN RESOURCES AND FINANCE MANAGEMENT**

9

Human Resource Management: functions, minimum wages act, contract labor, service rules and performance appraisal systems – Hospital Financial Management: pricing, key performance indicators, reimbursement systems and lean management

**UNIT V: ETHICS AND LAWS**

9

Ethics: ethical issues in hospitals, establishing ethical framework and resolving ethical conflicts – Laws Applicable to Hospitals: hospital establishment, environmental safety, licensing of professionals, medicolegal and patient care

**CONTACT PERIODS:**

|                            |                            |                             |                           |                          |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|
| <b>Lecture:</b> 45 Periods | <b>Tutorial:</b> - Periods | <b>Practical:</b> - Periods | <b>Project:</b> - Periods | <b>Total:</b> 45 Periods |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|

**TEXTBOOKS:**

1. Mario de Souza, "Hospital Management", 1st edition, Jaypee Brothers Medical Publishers, 2019
2. Ministry of Health and Family Welfare, "National Health Policy", Government of India, 2017

**REFERENCES:**

1. BV Subrahmanyam, "Hospital Management and Administration Principles and Practice Including Law", 1st edition, CBS Publishers and Distributors, 2023
2. GD Kundurs, "Hospitals: Facilities Planning and Management", 19th Reprint, McGraw Hill Education, 2018
3. Alan Gillies, "Healthcare Management: Global Perspectives", 1st edition, Routledge, 2024

  
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## SEMESTER III &amp; IV

| U25CSG11 | Object Oriented Programming Using Java<br>(Common to AD, AM, BM, CB, CS, EC, EE, IT, MI, SC) | *Category: PCC |   |   |   |   |
|----------|----------------------------------------------------------------------------------------------|----------------|---|---|---|---|
|          |                                                                                              | L              | T | P | J | C |
|          |                                                                                              | 3              | 0 | 0 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To introduce object-oriented programming concepts and Core Java programming fundamentals
- To develop Java applications using classes, inheritance, polymorphism, interfaces, and exception handling mechanisms
- To provide programming skills in multithreading, collections framework, and file handling using Java APIs
- To enable students to develop modular and reusable Java applications using standard libraries and object-oriented design principles

## COURSE OUTCOMES:

- CO 1:** Describe object-oriented programming concepts and Java fundamentals for developing simple applications **Understand**
- CO 2:** Develop Java applications using inheritance, polymorphism, abstract classes, interfaces, and packages **Apply**
- CO 3:** Develop Java programs incorporating exception handling and multithreading concepts **Apply**
- CO 4:** Develop Java applications using collections, generics, and related utility classes **Apply**
- CO 5:** Develop Java applications using file handling, stream processing, and object serialization techniques **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    |
| CO 2       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 3       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 4       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |
| CO 5       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO OBJECT-ORIENTED PROGRAMMING AND JAVA BASICS

9

Procedure-Oriented vs Object-Oriented Java Features and Platform: JVM, JRE, JDK – Java Program Structure & Memory Layout – Classes and Objects – Static and non-static members, static and non-static Methods, Constructors – Access Modifiers, Abstraction and Encapsulation – Scanner and System classes

## UNIT II: INHERITANCE AND POLYMORPHISM

9

Inheritance and types – Polymorphism: Method Overloading and Overriding – Abstract Classes and Methods – Interfaces. Java packages : Built in and user defined packages



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**UNIT III: EXCEPTION HANDLING AND MULTITHREADING****9**

Exception Handling: try, catch, throw, throws, finally – Built in exception classes and User defined Exceptions – Multithreading: Thread Lifecycle, Creating Threads, Thread Class and Runnable Interface, Thread Priorities, Synchronization – Inter-thread Communication, Deadlock prevention

**UNIT IV: COLLECTIONS FRAMEWORK AND GENERICS****9**

Collections Framework – Generics and Type Safety – Wrapper Classes and Autoboxing/Unboxing – Interfaces and Classes: List, Set, Map, Queue – Implementations: ArrayList, LinkedList, HashSet, TreeSet, HashMap, TreeMap – Iterators – Comparator and Comparable Interfaces

**UNIT V: JAVA I/O AND FILES****9**

Java I/O Framework – Input and Output Streams – Readers and Writers – File I/O using File, FileReader, FileWriter, BufferedReader, BufferedWriter and Files – Console Input using Scanner and Console – Serialization and Deserialization – Object Streams

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, 2018
2. Cay S. Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11th Edition, Pearson Education, 2020

**REFERENCES:**

1. J. Nino and F. A. Hosch, "An Introduction to Programming and OO Design using Java", 1st Edition, John Wiley & Sons, 2018
2. Paul Deitel and Harvey Deitel, "Java SE 8 for Programmers", 3rd Edition, Pearson, 2015
3. E. Balagurusamy, "Programming with Java", 6th Edition, McGraw Hill Education, 2019

  
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## SEMESTER IV

| U25BM403 | Biophysical Signals and Systems | Category: PCC |   |   |   |   |
|----------|---------------------------------|---------------|---|---|---|---|
|          |                                 | L             | T | P | J | C |
|          |                                 | 2             | 0 | 2 | 0 | 3 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the basic properties of signals and systems
- To utilize Laplace and Z transform for discrete time signals and systems
- To integrate signals and systems to analyze physiological parameters

## COURSE OUTCOMES:

|              |                                                                                                                                              |         |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>CO 1:</b> | Implement the concepts of various types of signals and systems to perform basic operations and analyze their behavior in practical scenarios | Apply   |
| <b>CO 2:</b> | Demonstrate the application of time-domain operations on signals to study and interpret the resulting waveform characteristics               | Apply   |
| <b>CO 3:</b> | Employ frequency-domain techniques using Z-transform to solve and analyze discrete-time systems                                              | Apply   |
| <b>CO 4:</b> | Interpret Fourier-based spectral analysis and FFT techniques to analyze and interpret biomedical signals                                     | Analyze |
| <b>CO 5:</b> | Evaluate and interpret the performance of digital filter structures (IIR and FIR) for biomedical signal applications                         | Analyze |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 4       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 5       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO SIGNALS AND SYSTEMS

6 + 6

Definition, classification, and representation of signals – Basic operations, sampling, and quantization – Sampling theorem, aliasing, reconstruction, and quantization errors – Biomedical signal classification and sampling rates – Biological system types, responses, and noise sources in biomedical signals

## UNIT II: TIME DOMAIN ANALYSIS OF DISCRETE-TIME SYSTEMS

6 + 6

Discrete-time signals/systems: intro, properties, classification – LTI systems – Convolution (math, table, graphical, circular) – Difference-equation systems with homogeneous/particular solutions – Signal correlation (cross/auto) – Biomedical uses of 1D/2D convolution and correlation

**UNIT III: FREQUENCY DOMAIN CHARACTERIZATION USING Z-TRANSFORM****6 + 6**

Z-transform and ROC: intro, properties, standard sequence Z-transforms – One-sided/two-sided forms – Solving difference equations – Frequency response via poles/zeros – Laplace–Z relation – Inverse Z-transform and biomedical applications

**UNIT IV: FOURIER AND FFT-BASED FREQUENCY DOMAIN ANALYSIS****6 + 6**

Fourier series of periodic sequences; DFT: intro, properties, standard signals, frequency analysis – Linear convolution via DFT – FFT (Radix-2, DIT, DIF, Goertzel) – Spectrum power, spectral density, DFT–Z link – Biomedical relevance of DFT/FFT and spectral interpretation

**UNIT V: DIGITAL FILTER STRUCTURES AND REALIZATION TECHNIQUES****6 + 6**

LTI classification: IIR/FIR, recursive/non-recursive – IIR structures-Direct I/II, Cascade, Parallel – FIR structures-Direct, Cascade, Frequency-Sampling, Lattice – Zero-pole effects – IIR/FIR stability, characteristics, performance in biomedical processing

**LIST OF EXPERIMENTS**

1. Generation and visualization of common periodic and aperiodic waveforms; convolution of discrete-time signals using MATLAB
2. Implementation of correlation and linear filtering of discrete sequences; analysis and plotting of impulse and step responses of discrete-time systems
3. Frequency response analysis of discrete-time systems and interpretation of system characteristics
4. Solution of Linear Constant Coefficient Difference Equations (LCCDE) using computational tools
5. Computation of Z-Transform and Inverse Z-Transform for discrete sequences and their verification through MATLAB
6. Computation of Discrete Fourier Transform (DFT) and implementation of Fast Fourier Transform (FFT) using DIT and DIF algorithms with magnitude and phase interpretation

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 60 Periods

**TEXTBOOKS:**

1. Salivahanan, S., Vallavaraj, A., & Gnanapriya, C., "Digital signal processing", 4th edition, McGraw-Hill Education India, 2019
2. Oppenheim, A. V., Willsky, A. S., & Nawab, S. H., "Signals and systems", 2nd edition, Pearson Education, 2013

**REFERENCES:**

1. Rangayyan, R. M., "Biomedical signal analysis", 3rd edition, Wiley–IEEE Press, 2024
2. Oppenheim, A. V., & Schafer, R. W., "Discrete-time signal processing", 3rd edition, Pearson Education, 2010
3. Lathi, B. P., "Principles of linear systems and signals", 2nd edition, Oxford University Press, 2009

  
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## SEMESTER IV

| U25BM406 | Integrated Biosciences Laboratory | Category: PCC |   |   |   |   |
|----------|-----------------------------------|---------------|---|---|---|---|
|          |                                   | L             | T | P | J | C |
|          |                                   | 0             | 0 | 4 | 0 | 2 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To impart practical skills in the preparation of solutions and buffers, biochemical analysis, microbial culturing, and staining techniques
- To develop proficiency in applying biochemical and microbiological techniques for the analysis and interpretation of biological samples and microorganisms

## COURSE OUTCOMES:

- CO 1:** Prepare molar, normal, and buffer solutions using appropriate laboratory calculations and procedures **Precision**
- CO 2:** Determine glucose, protein, and cholesterol concentrations using biochemical estimation methods **Precision**
- CO 3:** Perform microbial culture and isolation techniques to obtain and maintain pure cultures using culture media **Precision**
- CO 4:** Examine the effects of temperature and salt concentration on microbial growth based on experimental observations **Articulation**
- CO 5:** Differentiate microorganisms and tissue components using simple staining, Gram staining, and Hematoxylin and Eosin staining **Articulation**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 2       | 3   | 2   | 1   | 1   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 4       | 3   | 3   | 2   | 2   | 1   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |
| CO 5       | 3   | 3   | 2   | 2   | -   | -   | -   | 1   | 1   | -    | 1    | 1    | -    |

## LIST OF EXPERIMENTS

- Preparation of solutions – Normality and molar solutions
- Preparation of buffer solution
- Estimation of Glucose by the Orthotolidine Method
- Estimation of Protein by the Biuret Method
- Estimation of Cholesterol by Zak's Method
- Culture media preparation and Pure culture techniques (Pour plate method, spread plate, streak plate)
- Effect of temperature on the growth of microorganisms
- Effect of salt concentration on the growth of microorganisms
- Simple and Gram Staining
- Hematoxylin and Eosin Staining

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 60 Periods      **Project:** - Periods      **Total:** 60 Periods

**REFERENCES:**

1. Rafi MD, "Textbook of Biochemistry for Medical Student", 4th Edition, University Press, 2021
2. Joanne M. Willey, Joanne Willey, Kathleen M. Sandman, Dorothy H. Wood, "Prescott's Microbiology", 12th Edition, McGraw Hill, 2022



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| U25CSG13 | Object Oriented Programming Using Java Laboratory<br>(Common to AD, AM, BM, CB, CS, EC, EE, IT, MI, SC) | Category: PCC |   |   |   |   |
|----------|---------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                                         | L             | T | P | J | C |
|          |                                                                                                         | 0             | 0 | 2 | 0 | 1 |

QP PATTERN: A

**COURSE OBJECTIVES:**

- To understand the fundamental concepts of object-oriented programming using Java for developing modular and reusable applications
- To apply inheritance, polymorphism, exception handling, and multithreading concepts in developing robust Java applications
- To develop collection-based and file-processing applications using Java I/O, generics, and collections framework for real-world problem solving

**COURSE OUTCOMES:**

- CO 1:** Implement the fundamental concepts of object-oriented programming, Java program structure, classes, objects, and encapsulation principles **Apply**
- CO 2:** Develop Java applications using inheritance, polymorphism, abstract classes, interfaces, and packages **Apply**
- CO 3:** Implement exception handling and multithreading mechanisms for developing reliable and concurrent applications **Apply**
- CO 4:** Utilize collections framework, generics, and sorting mechanisms for efficient data management and processing **Apply**
- CO 5:** Develop file handling and object persistence applications using Java I/O streams, serialization, and deserialization techniques **Apply**

**CO - PO MAPPING:**

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | -    | 1    |
| CO 5       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | -    | 1    |

**LIST OF EXPERIMENTS**

1. Design and implementation of Java programs demonstrating classes, objects, constructors, and methods
2. Development of applications illustrating static and non-static members, access modifiers, abstraction, and encapsulation
3. Implementation of console-based applications using Scanner and System classes for input and output processing
4. Design and implementation of applications demonstrating inheritance and its various types
5. Development of applications illustrating compile-time and runtime polymorphism using method overloading and method overriding
6. Implementation of applications using abstract classes, interfaces, and dynamic method dispatch mechanisms
7. Design and development of modular Java applications using built-in and user-defined packages
8. Implementation of robust exception handling mechanisms using built-in and user-defined exceptions



9. Development of multithreaded applications using Thread class and Runnable interface
10. Design and implementation of synchronized multithreaded applications with inter-thread communication
11. Development of applications demonstrating thread lifecycle management and deadlock prevention techniques
12. Implementation of generic collection-based applications using List, Set, Map, and Queue interfaces
13. Design of applications utilizing Comparator and Comparable interfaces for customized sorting operations
14. Development of file processing applications using Java I/O streams, readers, writers, and buffered streams
15. Implementation of object persistence mechanisms using serialization and deserialization techniques

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 30 Periods

**REFERENCES:**

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, 2018
2. Cay.S.Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11th Edition, Pearson Education, 2020



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## SEMESTER IV

| U25MNC03 | Indian Constitution<br>(Common to all programmes) | Category: MNC |   |   |   |   |
|----------|---------------------------------------------------|---------------|---|---|---|---|
|          |                                                   | L             | T | P | J | C |
|          |                                                   | 1             | 0 | 0 | 0 | 0 |

QP PATTERN: A

## COURSE OBJECTIVES:

- To understand the evolution and importance of the Constitution.
- To understand salient features of the Indian Constitution and philosophy of Fundamental Rights
- To gain the knowledge about the state government and local level administration

## COURSE OUTCOMES:

|       |                                                                                                                         |            |
|-------|-------------------------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Understand the historical background of the Constitution making and its importance for building a democratic India      |            |
| CO 2: | Understand the value of Fundamental Rights and Duties for becoming a good citizen of India                              | Understand |
| CO 3: | Analyze the powers of the Central Government                                                                            | Analyze    |
| CO 4: | Understand the role and responsibilities of State and Local Administration                                              | Understand |
| CO 5: | Apply knowledge in strengthening constitutional institutions like Election Commission and UPSC for sustaining democracy | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |

## SYLLABUS:

## UNIT I: HISTORICAL BACKGROUND OF INDIAN CONSTITUTION

5

Introduction to Indian Constitution: Constitution Meaning of the term, History of Making of the Indian Constitution, Evolution of the Indian Constitution, Drafting Committee (Composition and Working).

## UNIT II: FEATURES OF INDIAN CONSTITUTION

5

Philosophy and salient features of the Indian Constitution, Citizenship, Fundamental Rights, Duties and their significance, Directive Principles of State Policy, Rights Protective Mechanisms in India; Right to Education Act 2009; Right to Information 2005.

## UNIT III: UNION GOVERNMENT

5

Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive, President of India (with Powers and Functions), Prime Minister and Council of Ministers (with Powers and Functions), Cabinet and Central Secretariat, Union Judiciary (Supreme Court).

**UNIT IV: STATE GOVERNMENT AND LOCAL ADMINISTRATION**

5

Governor, Chief Minister and Council of Ministers, State Secretariat – Roles and Responsibilities, District Administration, Head, Municipalities – Mayor and Role of Elected Representatives, Panchayati Raj, Zila Panchayat – Roles and Responsibilities, Block Level and Village Level Organizational Hierarchy

**UNIT V: CONSTITUTIONAL INSTITUTIONS**

5

Election Commission of India – Powers and Functions, Electoral Process in India, Methods of Constitutional Amendments and their Limitations, Important Constitutional and Emergency Provisions. Case Studies.

**CONTACT PERIODS:**

**Lecture:** 25 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 25 Periods

**TEXTBOOKS:**

1. Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India Pvt. Ltd., New Delhi.
2. Subash Kashyap, "Indian Constitution", National Book Trust.

**REFERENCES:**

1. M. Laxmikanth, "Indian Polity", McGraw Hill Education India, 2013.
2. M. P. Jain, "Indian Constitution Law," 7th Edition, Lexis Nexis, 2014.
3. Raj Kumar, "Ambedkar and Constitution", Commonwealth Publication Pvt. Ltd., New Delhi, 2011

  
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## SEMESTER IV

|           |                                                                   |               |   |   |   |   |
|-----------|-------------------------------------------------------------------|---------------|---|---|---|---|
| U25RMCC09 | Professional Skill Development - IV<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|           |                                                                   | L             | T | P | J | C |
|           |                                                                   | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities **Apply**
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation **Apply**
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 2   | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | -   | -   | 3   | -   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods



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