**Bachelor of Technology (Biotechnology), UIET, KUK**

**Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester-I*)***

***(Common with earlier scheme of Semester-I B.Tech Biotechnology which was effective from session 2018-19)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** | **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1A | BS-111 | Applied Physics | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 1B | BS-101 | Chemistry | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2A | ES-105 | Programming for Problem Solving | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2B | HM-101 | English | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | BS-131 | Applied Mathematics-I | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 4A | ES-109 | Engineering Graphics & Design | 1:2:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4B | ES-111L | Manufacturing Processes Workshop | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 5A | BS-141 | Biology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5B | ES-101 | Basic Electrical Engineering | 4:1:0 | 5 | 5 | 75 | 25 | 0 | 100 | 3 |
| 6A | BS-113L | Applied Physics Lab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 6B | BS-103L | Chemistry Lab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 7A | ES-107L | Programming for Problem Solving Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 7B | ES-103L | Basic Electrical Engineering Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 8A | ES-113L | Engineering Graphics & Design Practice | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 8B | HM-103L | Language Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
|  |  | Total | 12:5:8/12:3:10 | 25/25 | 21.0/20.0 | 375/300 | 185/200 | 90/150 | 650A/650B |  |

**Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. Marked B in one particular semester. Induction Program (Three weeks duration) is a part of scheme of first year in I st semester for all branches**

**Bachelor of Technology (Biotechnology), UIET, KUK**

**Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester-II*)***

***(Common with earlier scheme of Semester-II B.Tech Biotechnology which was effective from session 2018-19)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.****No.** | **Course No./ Code** | **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours)** |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1A | BS-111 | Applied Physics | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 1B | BS-101 | Chemistry | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2A | ES-105 | Programming for Problem Solving | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2B | HM-101 | English | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | BS-132 | Applied Mathematics-II | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 4A | ES-109 | Engineering Graphics & Design | 1:2:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4B | ES-111L | Manufacturing Processes Workshop | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 5A | BS-141 | Biology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5B | ES-101 | Basic Electrical Engineering | 4:1:0 | 5 | 5 | 75 | 25 | 0 | 100 | 3 |
| 6A | BS-113L | Applied Physics Lab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 6B | BS-103L | Chemistry Lab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 7A | ES-107L | Programming for Problem Solving Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 7B | ES-103L | Basic Electrical Engineering Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 8A | ES-113L | Engineering Graphics & Design Practice | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 8B | HM-103L | Language Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
|  |  | Total | 12:5:8/12:3:10 | 25/25 | 21.0/20.0 | 375/300 | 185/200 | 90/150 | 650A/650B |  |

**Note: (1) A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. Marked B in one particular semester.**

**(2) All students have to undertake the industrial training for 4 to 6 weeks after 2nd semester which will be evaluated in 3rd semester.**

 **Bachelor of Technology (Biotechnology), UIET, KUK**

**Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester -III*)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** | **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | BTS-201 | Biochemistry | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | BTS-203 | Microbiology | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | BTS-205 | Molecular Biology | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | BTS-207 |  Genetics and Cell Biology | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | BTS-211 | Cell and Molecular Biology Lab | 0:0:4 | 4 | 2 |  | 40 | 60 | 100 | 3 |
| 6 | BTS-213 | Biochemistry Lab | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 7 | BTS-215 | Microbiology Lab | 0:0:3 | 3 | 1.5 |  | 40 | 60 | 100 | 3 |
| 8 | PTS-201 | Technical Seminar | 0:0:2 | 2 | 1 |  | 100 | 0 | 100 | 3 |
| 9 | HTM-901 | Universal Human Values II : Understanding Harmony |  3:0:0 | 3 | 3 |  75 | 25 | 0 | 100 | 3 |
| 10 | PTS-203 | Industrial Training-I |  0:0:2 | 2 | 1 |  | 100 | 0 |  100 | 3 |
|  |  |  Total | 14:0:14 | 28 |  21.0 | 375 | 445 | 180 | 1000 |  |

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**Credit-Based (2021-22 Onwards)**

 ***SCHEME OF STUDIES/EXAMINATIONS (*Semester -IV*)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** |  **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | PTC-202 | Industrial Biotechnology | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 2 | PTC-204 | Green Biotechnology and Pollution Abatement | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | PTC-206 | Immunology and Advanced Diagnostic Techniques | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | PTC-208 | Recombinant DNA Technology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | BTS-202 | Principles of Thermodynamics and Organic Chemistry | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 6 | PTC-210 | Industrial Biotechnology Lab | 0:0:4 | 4 | 2 |  | 40 | 60 | 100 | 3 |
| 7 |  PTC-212 | Immunology and Advanced Diagnostic Techniques Lab | 0:0:2 | 2 | 1 |  | 40 | 60 | 100 | 3 |
| 8 |  PTC-214 | Recombinant DNA Technology Lab | 0:0:4 | 4 | 2 | - | 40 | 60 | 100 | 3 |
| 9 | ATU-202\* | Environmental Sciences | 3:0:0 | 3 |  | 75 | 25 |  | 100 | 3 |
|  |  |  Total | 13:3:10 | 26 |  18 | 450 | 270 | 180 | 900 |  |

**\*ATU-202** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

**Note:** All the students have to undergo 4-6 weeks industrial training after IV semester and to be evaluated in V semester.

**Bachelor of Technology (Biotechnology), UIET, KUK**

 **Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester -V*)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** |  **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | PTC-301 | Metabolic Engineering | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 2 | PTC-303 | Biophysical and Bioanalytical Techniques | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | PTC-305 | Structural Biology | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 4 | PTC-307 | Bioprocess Engineering | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 5 | PTC-309 | Bioinformatics and Computational Biology | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 6 | PTE-1\* | Professional Elective-I | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 7 |  PTC-311 | Bioinformatics and Computational Biology Lab | 0:0:2 | 2 | 2 |  | 40 | 60 | 100 | 3 |
| 8 |  PTC-313 | Biophysical and Bioanalytical Techniques Lab | 0:0:3 | 3 | 1.5 |  | 40 | 60 | 100 | 3 |
| 9 |  PTC-315 | Metabolic Engineering Lab | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 10 | OTS-1\*\* | Open Subject-I | 2:0:0 | 2 | 2 | 75 | 25 |  | 100 | 3 |
| 11 | ATU-301 | Indian Constitution | 2:0:0 | 2 | 2 | 75 | 25 |  | 100 | 3 |
| 12 |  PTS-301 |  Industrial Training |  0:0:2 | 2 |  1 |  | 100 |  | 100 |  3 |
| 13 | \*\*ATU-903 | Essence of Indian Traditional Knowledge | 3:0:0 | 3 |  | 100 | - | - | 100 | 3 |
|  |   |  Total | 19:1:10 | 30 |  23 | 700 | 420 | 180 | 1300 |  |

**\*\*ATU-903** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

Professional Elective-I\* Open Subject- I\*\*

PTE-301 Good Manufacturing and Lab Practices OTS-301 Biomaterial Technology

PTE-303 Genome Editing OTS-303 Internet of Things

PTE-305 Biochemical and Enzyme Technology OTS-305 Image Processing/MOOC Course

PTE-307 Bioreactor Analysis and Design OTS-307 3D Printing & Design /MOOC Course``

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**Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester -VI*)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** |  **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | PTC-302 | Downstream Processing and Bioseparation Engineering | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2 | PTC-304 | Synthetic and Systems Biology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | PTC-306 | Animal and Plant Biotechnology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | PTC-308 | Data Science in Genome Technology | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | PTE-II\* | Professional Elective-II | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 6 | OTS-II\*\* | Open Subject-II | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 7 | PTC-308 | Data Science in Genome Technology Lab | 0:0:2 | 2 | 1 |  |  40 | 60 | 100 | 3 |
| 8 | PTC-310 | Downstream Processing Lab | 0:0:2 | 2 | 1 |  |  40 | 60 | 100 | 3 |
| 9 |  PTC-312 |  Animal and Plant Biotechnology Lab | 0:0:4 | 4 | 2 |  | 40 | 60 | 100 | 3 |
| 10 |  PTS-302 | Technical Seminar | 0:0:2 | 2 | 1 | - | 100 | 0 | 100 | 3 |
|  11 |  HSMC-1 |  Elective-1\*\*\* |  3;0:0 | 3 |  3 | 75 | 25 | 0 | 100 |  3 |
|  |  |  Total | 17:4:10 | 31 |  26 | 525 | 395 | 180 |  1100 |  |

Students shall have to select one elective from each group of Program Elective-II, Open Subjects-II and HSMC Elective-1.

Professional Elective-II\* Open Subject- II\*\* HSMC Elective-1\*\*\*

PTE-302 Machine Learning OTS-302 Artificial Intelligence HSMC-301 Engineering Economics

PTE-304 Waste Management and Upcycling OTS-304 Quantum Computing/MOOC Course HSMC-302 Management-1 (Organizational Behaviour)

PTE-306 Stem Cell Technology OTS-306 Cyber Security /MOOC Course HSMC-303 Operations Research

PTE-308 Nanobiotechnology OTS-308 Design Thinking HSMC-304 Effective Technical Communication

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**Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester -VII*)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** |  **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | PTC-401 | Food and Nutrition Biology | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 2 | PTC-403 | Artificial Intelligence in Affordable Healthcare | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | PTE-III | Program Elective-III\* | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | PTE-IV | Program Elective-IV\* | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | OTS-III | Open Subject-III\*\* | 2:0:0 | 2 | 2 | 75 |  25 | 0 | 100 | 3 |
| 6 | OTS-IV | Open Subject-IV\*\* | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 7 | HSMC-II | Elective-II\*\*\* | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 8 | PTC-405 | Food and Nutrition Biology Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
|  9  |  PTS-401 | Project-I |  0:0:4 | 4 |  2 |  | 40 | 60  |  100 |  3 |
|  10 |  PTS-403 | Industrial Training |  2:0:0 | 2 |  2 |  | 100 |  | 100 |  3 |
|  |  |  Total | 17:2:6 | 25 |  22 | 525 | 355 | 120 |  1000 |  |

Students shall have to select one elective from each group of Program Elective-III/IV, Open Subjects-III/IV and HSMC Elective-II.

Program Elective-III\* Program Elective-IV\*

PTE-401 Gene Expression and Transgenics PTE-409 Quality Control Management in Biotechnology

PTE-403 Essentials of Virology PTE-411 Biosensors & Bioinstrumentation

PTE-405 Tissue Engineering PTE-413 Biomedical Engineering

PTE-407 Biostatistics PTE-415 Omics Technology

Open Subject-III\*\* Open Subject-IV\*\* HSMC Elective-II\*\*\*

OTS-401 Robotics OTS-409 Bioterrorism and National Security HSMC-401 Introduction to Industrial Management

OTS-403 Virtual Reality OTS-411 Biosimilar Technology HSMC-402 Industrial Psychology

OTS-405 Plant Biology OTS-413 Comparative and Functional Genomics HSMC-403 Innovation, Startups & Entrepreneurship

OTS-407 MOOC Course OTS-415 MOOC Course HSMC-404 Intellectual Property Rights (IPR) & Regulatory

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 **Credit-Based (2021-22 Onwards)**

***SCHEME OF STUDIES/EXAMINATIONS (*Semester -VIII*)***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course No./ Code** |  **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | **Duration****of exam (Hours**) |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | PTS-402 | Project-II | 0:0:12 | 18 | 9 |  |  40 | 60 | 100 | 3 |
|  |  |  Total |  0:0:12 |  18 |  9 |  | 40 | 60 | 100 |  |

**Students opting for B.Tech. (HONS.) Biotechnology with minor specialization in Computational Biology, Drug Engineering, Genome Engineering and Technology, Artificial Intelligence & Machine Learning, Blockchain, Data Science, Internet of Things, Cyber Security, 3D Printing, Energy Engineering and Robotics shall have to earn 18 to 20 extra credits from the subjects mentioned in the annexures besides completing 160 credits of regular B.Tech. Biotechnology degree. The subjects mentioned in the annexures may be covered from MOOCs/SWAYAM portal.**

**Nomenclature for B.TECH. Degreein Emerging Areas of Biotechnology**

1. B. Tech. (Hons.) Biotechnology with Specialization in Computer Science and Biology
2. B. Tech. (Hons.) Biotechnology with Specialization in Drug Engineering
3. B. Tech. (Hons.) Biotechnology with Specialization in Genome Engineering & Technology
4. B. Tech. Biotechnology with Minor Degree in Artificial Intelligence & Machine Learning
5. B. Tech. Biotechnology with Minor Degree in Blockchain
6. B. Tech. Biotechnology with Minor Degree in Data Science
7. B. Tech. Biotechnology with Minor Degree in Internet of Things
8. B. Tech. Biotechnology with Minor Degree in Cyber Security
9. B. Tech. Biotechnology with Minor Degree in 3D Printing
10. B. Tech. Biotechnology with Minor Degree in Electrical Vahicle
11. B. Tech. Biotechnology with Minor Degree in Energy Engineering
12. B. Tech. Biotechnology with Minor Degree in Mechatronics
13. B. Tech. Biotechnology with Minor Degree in Robotics.

Table 1: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Artificial Intelligence and Machine Learning

|  |
| --- |
| **Artificial Intelligence and Machine Learning****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/AI-1 | Artificial Intelligence : Search Methods For Problem solving |
| SPMD/AI-2 | **OR**An Introduction to Artificial Intelligence |
| 2. | SPMD/AI-3 | Artificial Intelligence: Knowledge Representation and Reasoning |
| 3. | SPMD/AI-4 | Programming, Data Structures and Algorithms in Python |
| SPMD/AI-5 | **OR**Python for Data Science |
| 4. | SPMD/AI-6 | Introduction to Machine Learning |
| 5. | SPMD/AI-7 | Deep Learning |
| SPMD/AI-8 | **OR**Deep Learning for Computer Vision |
| 6. | SPMD/AI-9 | Reinforcement Learning |
| 7. | SPMD/AI-10 | AI: Constraint Satisfaction |
| 8. | SPMD/AI-11 | Computer Vision |
| 9. | SPMD/AI-12 | Natural Language Processing |
| SPMD/AI-13 | **OR**Applied Natural Language Processing |
| 10. | SPMD/AI-14 | Practical Machine Learning with Tensorflow |
| 11. | SPMD/AI-15 | Introduction to Data Analytics |
| SPMD/AI-16 | **OR**Data Science for Engineers |
| 12. | SPMD/AI-17 | Learning Analytics Tools |
| 13. | SPMD-1 | Design Thinking - A Primer |
| 14. | SPMD-2 | Ethics in Engineering Practice |

Table 2: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Internet of Things (IoT)

|  |
| --- |
| **Internet of Things (IoT)****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/IoT-1 | Introduction to Industry 4.0 and Industrial Internet of Things |
| SPMD/IoT-2 | **OR**Introduction to Internet of Things |
| 2. | SPMD/IoT-3 | Electronic Systems for Sensor Applications |
| 3. | SPMD/IoT-4 | Optical Fiber Sensors |
| SPMD/IoT-5 | **OR**Optical Sensors |
| 4. | SPMD/IoT-6 | Introduction to Machine Learning |
| 5. | SPMD/IoT-7 | Selection of Nanomaterials for Energy Harvesting and Storage Application |
| 6. | SPMD/IoT-8 | Python for Data Science |
| 7. | SPMD/IoT-9 | Deep Learning |
| SPMD/IoT-10 | **OR**Deep Learning for Computer Vision |
| 8. | SPMD/IoT-11 | Reinforcement Learning |
| 9. | SPMD/IoT-12 | Cloud computing |
| SPMD/IoT-13 | **OR**Google Cloud Computing Foundations |
| 10. | SPMD/IoT-14 | Modern Application Development |
| 11. | SPMD/IoT-15 | Introduction to Data Analytics |
| SPMD/IoT-16 | **OR**Data Science for Engineers |
| 12. | SPMD/IoT-17 | Computer Networks and Internet Protocol |
| 13. | SPMD/IoT-18 | Introduction to Database Systems |
| 14. | SPMD-1 | Design Thinking – A Primer |
| 15. | SPMD-2 | Ethics in Engineering Practice |

Table 3: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Blockchain

|  |
| --- |
| **Blockchain****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/BL-1 | Introduction to Blockchain Technology and Applications |
| SPMD/BL-2 | **OR**Blockchain Architecture Design and Use Cases |
| 2. | SPMD/BL-3 | Introduction to Internet of Things |
| 3. | SPMD/BL-4 | Information Security – 5 – Secure Systems Engineering |
| 4. | SPMD/BL-5 | Introduction to Machine Learning |
| 5. | SPMD/BL-6 | Ethical Hacking |
| 6. | SPMD/BL-7 | GPU Architectures and Programming |
| 7. | SPMD/BL-8 | Computer Networks and Internet Protocol |
| 8. | SPMD/BL-9 | Cloud computing |
| SPMD/BL-10 | **OR**Google Cloud Computing Foundations |
| 9. | SPMD/BL-11 | Foundations of Cryptography |
| 10. | SPMD/BL-12 | Information Theory and Coding |
| 11. | SPMD/BL-13 | Introduction to Database Systems |
| 12. | SPMD/BL-14 | Internetwork Security |
| 13. | SPMD-1 | Design Thinking – A Primer |
| 14. | SPMD-2 | Ethics in Engineering Practice |

Table 4: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Robotics

|  |
| --- |
| **Robotics****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/RB-1 | Foundations of Cognitive Robotics |
| 2. | SPMD/RB-2 | Introduction to Robotics |
| SPMD/RB-3 | **OR**Robotics |
| 3. | SPMD/RB-4 | Mechanism and Robot Kinematics |
| 4. | SPMD/RB-5 | Computer Architecture and Organization |
| 5. | SPMD/RB-6 | Power Electronics |
| 6. | SPMD/RB-7 | Principle of Hydraulic Machines and System Design |
| 7. | SPMD/RB-8 | Programming, Data Structures and Algorithms Using Python |
| 8. | SPMD/RB-9 | Control Systems |
| 9. | SPMD/RB-10 | Fundamentals of Artificial Intelligence |
| 10. | SPMD/RB-11 | Introduction to Machine Learning |
| 11. | SPMD/RB-12 | Dynamical System and Control |
| 12. | SPMD/RB-13 | Introduction to Embedded System Design |
| 13. | SPMD/RB-14 | Introduction to Internet of Things |
| SPMD/RB-15 | **OR**Introduction to Industry 4.0 and Industrial Internet of Things |
| 14. | SPMD-1 | Design Thinking – A Primer |
| 15. | SPMD-2 | Ethics in Engineering Practice |

Table 5: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Data Science

|  |
| --- |
| **Data Science****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/DS-1 | Python for Data Science |
| SPMD/DS-2 | **OR**Programming, Data Structures and Algorithms in Python |
| 2. | SPMD/DS-3 | Introduction to Data Analytics |
| SPMD/DS-4 | **OR**Data Science for Engineers |
| 3. | SPMD/DS-5 | Programming, Data Structures and Algorithms in Python |
| SPMD/DS-6 | **OR**Python for Data Science |
| 4. | SPMD/DS-7 | Introduction to Machine Learning |
| 5. | SPMD/DS-8 | Deep Learning |
| SPMD/DS-9 | **OR**Deep Learning for Computer Vision |
| 6. | SPMD/DS-10 | Reinforcement Learning |
| 7. | SPMD/DS-11 | Artificial Intelligence : Search Methods For Problem solving |
| SPMD/DS-12 | **OR**An Introduction to Artificial Intelligence |
| 8. | SPMD/DS-13 | Artificial Intelligence: Knowledge Representation and Reasoning |
| 9. | SPMD/DS-14 | Computer Vision |
| 10. | SPMD/DS-15 | Natural Language Processing |
| SPMD/DS-16 | **OR**Applied Natural Language Processing |
| 11. | SPMD/DS-17 | Practical Machine Learning with Tensorflow |
| 12. | SPMD/DS-18 | Learning Analytics Tools |
| 13. | SPMD-1 | Design Thinking – A Primer |
| 14. | SPMD-2 | Ethics in Engineering Practice |

Table 6: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Cyber Security

|  |
| --- |
| **Cyber Security****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/CS-1 | Cryptography And Network Security |
| 2. | SPMD/CS-2 | Ethical Hacking |
| 3. | SPMD/CS-3 | [Information Security – 5 – Secure Systems Engineering](https://nptel.ac.in/courses/106/106/106106199/) |
| 4. | SPMD/CS-4 | Privacy and Security in Online Social Media |
| 5. | SPMD/CS-5 | Information Theory and Coding |
| 6. | SPMD/CS-6 | Introduction to Information Security |
| 7. | SPMD/CS-7 | Introduction to Cryptology |
| 8. | SPMD/CS-8 | Computational Number Theory & Cryptography |
| 9. | SPMD/CS-9 | Hardware Security |
| 10. | SPMD/CS-10 | Internetwork Security |
| 11. | SPMD/CS-11 | Introduction to Machine Learning |
| 12. | SPMD/CS-12 | Introduction to Internet of Things |
| 13. | SPMD-1 | Design Thinking – A Primer |
| 14. | SPMD-2 | Ethics in Engineering Practice |

Table 7: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in 3D Printing

|  |
| --- |
| **3D Printing** **(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/3D-1 | Rapid Manufacturing |
| 2. | SPMD/3D-2 | Electronics Equipment Integration and Prototype Building |
| 3. | SPMD/3D-3 | Product Design and Development |
| 4. | SPMD/3D-4 | The Future of Manufacturing Business: Role of Additive Manufacturing |
| 5. | SPMD/3D-5 | Functional and Conceptual Design |
| 6. | SPMD/3D-6 | Introduction to Polymer Science |
| 7. | SPMD/3D-7 | Innovation by Design |
| 8. | SPMD/3D-8 | Design, Technology and Innovation |
| 9. | SPMD-1 | Design Thinking – A Primer |
| 10. | SPMD-2 | Ethics in Engineering Practice |

Table 8: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Electric Vehicles

|  |
| --- |
| **Electric Vehicles** **(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/EV-1 | Fundamentals of Electric Vehicles: Technology & Economics |
| 2. | SPMD/EV-2 | Fundamentals of Electrical Engineering |
| 3. | SPMD/EV-3 | Electrical Machines |
| 4. | SPMD/EV-4 | Physics of Materials |
| SPMD/EV-5 | **OR**Powder Metallurgy |
| 5. | SPMD/EV-6 | Introduction to CFD |
| 6. | SPMD/EV-7 | Structural Analysis of Nanomaterials |
| 7. | SPMD/EV-8 | Ecology and Environment |
| 8. | SPMD/EV-9 | Dynamic Behavior of Materials |
| 9. | SPMD/EV-10 | Welding of Advanced High Strength Steels for Automotive Applications |
| 10. | SPMD/EV-11 | Dynamical System and Control |
| 11. | SPMD-1 | Design Thinking - A Primer |
| 12. | SPMD-2 | Ethics in Engineering Practice |

Table 9: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Energy Engineering

|  |
| --- |
| **Energy Engineering** **(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/EE-1 | Fundamentals of Conduction and Radiation |
| SPMD/EE-2 | **OR**Fundamentals of Convective Heat Transfer |
| 2. | SPMD/EE-3 | Energy Conservation and Waste Heat Recovery |
| 3. | SPMD/EE-4 | Ecology and Environment |
| 4. | SPMD/EE-5 | Energy Economics and Policy |
| 5. | SPMD/EE-6 | Bioenergy |
| SPMD/EE-7 | **OR**Waste to Energy Conversion |
| 6. | SPMD/EE-8 | Non-Conventional Energy Resources |
| SPMD/EE-9 | **OR**Technologies for Clean and Renewable Energy Production |
| 7. | SPMD/EE-10 | Selection of Nanomaterials for Energy Harvesting and Storage Application |
| 8. | SPMD/EE-11 | Solar Energy Engineering and Technology |
| 9. | SPMD-1 | Design Thinking - A Primer |
| 10. | SPMD-2 | Ethics in Engineering Practice |

Table 10: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor

Degree in Mechatronics

|  |
| --- |
| **Mechatronics** **(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/ME-1 | Power Electronics |
| 2. | SPMD/ME-2 | Semiconductor Optoelectronics |
| SPMD/ME-3 | **OR**Semiconductor Devices and Circuits |
| 3. | SPMD/ME-4 | Digital Circuits |
| 4. | SPMD/ME-5 | Analog Electronic Circuits |
| 5. | SPMD/ME-6 | Control Systems |
| SPMD/ME-7 | **OR**Control Engineering |
| 6. | SPMD/ME-8 | Introduction to Internet of Things |
| 7. | SPMD/ME-9 | Introduction to Fuzzy Set Theory, Arithmetic and Logic |
| SPMD/ME-10 | **OR**Switching Circuits and Logic Design |
| 8. | SPMD/ME-11 | Microcontrollers and Applications |
| 9. | SPMD/ME-12 | Introduction to Embedded System Design |
| 10. | SPMD/ME-13 | Introduction to Robotic |
| 11. | SPMD/ME-14 | Optical Fiber Sensors |
| 12. | SPMD/ME-15 | Automation in Manufacturing |
| 13. | SPMD-1 | Design Thinking - A Primer |
| 14. | SPMD-2 | Ethics in Engineering Practice |

Table 11: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Computer Science and Biology

|  |
| --- |
| **Computer Science and Biology****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/CB-1 | Computational Systems Biology |
| 2. | SPMD/CB-2 | Introduction to Database Systems |
| 3. | SPMD/CB-3 | Introduction to Artificial Intelligence |
| SPMD/CB-4 | **OR**Artificial Intelligence Search Methods for Problem Solving |
| 4. | SPMD/CB-5 | Image Signal Processing |
| 5. | SPMD/CB-6 | Introduction to Internet of Things |
| 6. | SPMD/CB-7 | Introduction to Computer Graphics |
| SPMD/CB-8 | **OR**Computer Graphics |
| 7. | SPMD/CB-9 | MATLAB Programming for Numerical Computation |
| 8. | SPMD/CB-10 | Programming, Data Structures and Algorithms in Python |
| 9. | SPMD/CB-11 | Introduction to Machine Learning |
| 10. | SPMD/CB-12 | Data Mining |
| 11. | SPMD/CB-13 | Introduction to Dynamical Models in Biology |
| 12. | SPMD/CB-14 | Biometrics |
| 13. | SPMD/CB-15 | BioInformatics: Algorithms and Applications |
| 14. | SPMD/CB-16 | Introduction to Proteogenomics |
| 15. | SPMD/CB-17 | Foundations of Cryptography |
| 16. | SPMD/CB-18 | Modern Application Development |
| 17. | SPMD/CB-19 | Ethical Hacking |
| 18. | SPMD/CB-20 | Computer Aided Drug Design |
| 19. | SPMD/CB-21 | Functional Genomics |
| 20. | SPMD-1 | Design Thinking - A Primer |
| 21. | SPMD-2 | Ethics in Engineering Practice |

Table 12: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Drug Engineering

|  |
| --- |
| **Drug Engineering****(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| ***Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.*** |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/DE-1 | Drug Delivery: Principles and Engineering |
| 2. | SPMD/DE-2 | Experimental Biotechnology |
| 3. | SPMD/DE-3 | Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries |
| 4. | SPMD/DE-4 | Environmental Quality Monitoring & Analysis |
| 5. | SPMD/DE-5 | Computer Aided Drug Design |
| 6. | SPMD/DE-6 | Current Regulatory Requirements for Conducting Clinical Trials in India for Investigational New Drugs/New Drug |
| 7. | SPMD/DE-7 | Introduction to Dynamical Models in Biology |
| 8. | SPMD/DE-8 | Medical Biomaterials |
| 9. | SPMD/DE-9 | Metals in Biology |
| 10. | SPMD/DE-10 | Gene Therapy |
| 11. | SPMD/DE-11 | Introduction to Cardiovascular Fluid Mechanics |
| 12. | SPMD/DE-12 | Optical Sensors |
| 13. | SPMD/DE-13 | Nano Structured Materials- Synthesis, Properties, Self-assembly and Applications |
| 14. | SPMD/DE-14 | Transport Phenomena in Biological Systems |
| 15. | SPMD/DE-15 | Aspects of Biochemical Engineering |
| 16. | SPMD/DE-16 | Process Control Design, Analysis and Assessment |
| 17. | SPMD/DE-17 | Industrial Biotechnology |
| 18. | SPMD/DE-18 | Interactomics |
| 19. | SPMD/DE-19 | Health Research Fundamentals |
| 20. | SPMD/DE-20 | Computational Systems Biology |
| 21. | SPMD/DE-21 | Human Molecular Genetics |
| 22. | SPMD-1 | Design Thinking - A Primer |
| 23. | SPMD-2 | Ethics in Engineering Practice |

Table 13: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Genome Engineering & Technology

|  |
| --- |
| Genome Engineering & Technology**(Minimum credits to be earned are EIGHTEEN-TWENTY)** |
| *Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.* |
| **Sr. No.** | **Code** | **Subject Nomenclature** |
| 1. | SPMD/GE-1 | Introduction to Proteogenomics |
| 2. | SPMD/GE-2 | Interactomics: Basics & Applications |
| 3. | SPMD/GE-3 | Drug Delivery: Principles and Engineering |
| 4. | SPMD/GE-4 | Experimental Biotechnology |
| 5. | SPMD/GE-5 | Bioengineering: An Interface with Biology and Medicine |
| 6. | SPMD/GE-6 | Functional Genomics |
| 7. | SPMD/GE-7 | Protein and Gel Based Proteomics |
| 8. | SPMD/GE-8 | Cell Culture Technologies |
| 9. | SPMD/GE-9 | Tissue Engineering |
| 10. | SPMD/GE-10 | Biomedical Nanotechnology |
| 11. | SPMD/GE-11 | Introductory Mathematical Methods for Biologists |
| 12. | SPMD/GE-12 | Nanotechnology in Agriculture |
| 13. | SPMD/GE-13 | Introduction to Proteomics |
| 14. | SPMD/GE-14 | Applications of Interactomics using Genomics and Proteomics Technologies |
| 15. | SPMD/GE-15 | Transport Phenomena in Biological Systems |
| 16. | SPMD/GE-16 | Proteomics and Genomics |
| 17. | SPMD/GE-17 | Medical Biomaterials |
| 18. | SPMD/GE-18 | Theromodynamics for Biological Systems: Classical and Statistical Aspect |
| 19. | SPMD/GE-19 | Mass Spectrometry Based Proteomics |
| 20. | SPMD/GE-20 | Advanced Clinical Proteomics |
| 21. | SPMD/GE-21 | Application of Spectroscopic Methods in Molecular Structure Determination |
| 22. | SPMD/GE-22 | Gene Therapy |
| 23. | SPMD-1 | Design Thinking - A Primer |
| 24. | SPMD-2 | Ethics in Engineering Practice |

|  |  |
| --- | --- |
| **BS-111** | **Applied Physics** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **1** | **-** | **4** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To introduce the basics of physics to the students for applications in Engineering field.** |
| **Course Outcomes** |
| **CO 1** | **Introduce the fundamentals of interference and diffraction and their applications.** |
| **CO 2** | **To make the students aware of the importance of polarization and Laser in technology.** |
| **CO 3** | **Applications of optical fiber and ultrasonics in various fields.** |
| **CO 4** | **Introduce the nuclear radiations and its biological effects.** |

**Unit - I**

**Interference:** Principle of Superposition, Conditions for interference, Division of wave-front: Fresnel’s Biprism and Applications, Division of amplitude: Wedge-shaped film, Newton’s rings, Michelson Interferometer and Applications.

**Diffraction:** Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

##### Unit – II

**Polarization:** Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent ‘s half shade polarimeter, Biquartzpolarimeter.

**Laser:** Introduction, Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein’s Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, He-Ne Laser, Semiconductor Laser, Characteristics of Laser, Applications of Laser.

##### Unit – III

**Optical Fiber:** Introduction, Principle of propagation of light waves in optical fibers: total internal reflection, acceptance angle, numerical aperture, V- number; Modes of propagation, Types of optical fibers: single mode fiber, multimode fibers; Fiber optics communication system, Advantages of optical fiber communication, Applications of optical fibers.

**Ultrasonics:** Ultrasonic waves, Properties of ultrasonic waves, Production of ultrasonic waves: Magnetostriction and Piezoelectric methods, Detection of ultrasonic waves, Measurement of velocity of ultrasonic waves, Applications of ultrasonic waves.

##### Unit – IV

**Nuclear radiations and its Biological Effects:** Classification of nuclear radiations, Interaction of charged particle (light and heavy) and gamma radiations with matter (basic concepts), Dosimetric units, Relative Biological Effectiveness (RBE), Typical doses from commons sources in the environment, Biological Effects, Maximum Permissible Dose, (MPD), Shielding, Radiation safety in the nuclear radiation laboratory.

**Biomaterials:** Introduction, Classification of biomaterials, Applications.

##### Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
3. A Textbook of Optics, S. Chand & Company Ltd.
4. Techniques for Nuclear and Particle Physics Experiments: A How-to Approach, Springer-Verlag.
5. Introduction to Nuclear and Particle Physics, PHI Learning Private Limited.
6. Biomaterials: The intersection of Biology and Materials Science, Pearson, New Delhi.

##### Note: The paper setter will set the paper as per the question paper templates provided.

|  |  |
| --- | --- |
| **BS- 113L** | **Applied Physics Lab** |
| **L** | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **3** | **1.5** | **30** | **20** | **50** | **3h** |
| **Purpose** | **Give the knowledge of basic practicals of Physics in Engineering.** |
| **Course Outcomes** |
| **CO1** | **To make the students familiar with the experiments related with optics.** |
| **CO2** | **To give the knowledge of handling of the experiments related with resistance using different methods.** |

**Note: Student will be required to perform at least 10 experiments out of the following list.**

* 1. To verify Newton’s formula and hence to find the focal length of the given convex lens.
	2. To find the frequency of A.C. mains by using Sonometer and horse shoe magnet.
	3. To find the resistance of a galvanometer by post office box.
	4. To find low resistance by Carrey-Foster bridge.
	5. To find the value of high resistance by substitution method.
	6. To compare the capacitances of two capacitors by De-Sauty’s bridge and hence to find the dielectric constant of a medium.
	7. To convert a galvanometer into an ammeter of desired range and verify the same.
	8. To find the wavelength of monochromatic light by Newton’s ring experiment.
	9. To find the wavelength of sodium light by Michelson’s interferometer.
	10. To find the resolving power of telescope.
	11. To find the wavelength of sodium light using Fresnel bi-prism.
	12. To find the wavelength of various colours of white light with the help of plane transmission diffraction grating.
	13. To find the specific rotation of sugar solution by using a Polarimeter.

##### Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, Pragati Prakashan.

|  |  |
| --- | --- |
| **BS-101** | **Chemistry** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **1** | **-** | **4** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To familiarize the students with basic and applied concept in chemistry** |
| **CO1** | **An insight into the atomic and molecular structure** |
| **CO2** | **Analytical techniques used in identification of molecules** |
| **CO3** | **To understand Periodic properties** |
| **CO4** | **To understand the spatial arrangement of molecules** |

**UNIT - I**

**Atomic and molecular structure (10 lectures)**

Molecular orbitals of diatomic molecules (N2, O2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of [Co(NH3)6], [Ni(CO)4], [PtCl2(NH3)2] and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

**UNIT - II**

**Spectroscopic techniques and applications (8 lectures)**

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

**UNIT - III**

**Use of free energy in chemical equilibria (4 lectures)**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.

**Periodic properties (4 Lectures)**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H2O, NH3, PCl5, SF6, CCl4, Pt(NH3)2Cl2

**UNIT - IV**

**Stereochemistry (6 lectures)**

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

**Organic reactions and synthesis of a drug molecule (4 lectures)**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

##### Suggested Books:

1. University chemistry, by B. M. Mahan, Pearson Education
2. Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition<http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

##### Note: The paper setter will set the paper as per the question paper templates provided.

|  |  |
| --- | --- |
| **BS-103L** | **Chemistry Lab** |
| **L** | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **3** | **1.5** | **30** | **20** | **50** | **3h** |

**LIST OF EXPERIMENTS**

* 1. To Determine the surface tension of a given liquid
	2. To determine the relative viscosity of a given liquid using Ostwald’s viscometer
	3. To identify the number of components present in a given organic mixture by thin layer chromatography
	4. To determine the alkalinity of a given water sample
	5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
	6. Synthesis of a drug (paracetamol/Aspirin)
	7. Determination of chloride content of a given water sample
	8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
	9. To determine the total iron content present in a given iron ore solution by redox titration
	10. Determination of the partition coefficient of a substance between two immiscible liquids
	11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
	12. To find out the λmax and concentration of unknown solution by a spectrophotometer
	13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
	14. To determine the amount of dissolved oxygen present in a given water sample
	15. To find out the pour point and cloud point of a lubricating oil
	16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
	17. Using Redwood Viscometer find out the viscosity of an oil sample

**Note: Atleast 9 experiments to be performed from the list**.

|  |  |
| --- | --- |
| **ES-105** | **Programming for Problem Solving** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** |  **3** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To familiarize the students with the basics of Computer System and C Programming** |
| **Course Outcomes** |
| **CO 1** | **Describe the overview of Computer System and Levels of Programming Languages.** |
| **CO 2** | **Learn to translate the algorithms to programs (in C language).** |
| **CO 3** | **Learn description and applications of conditional branching, iteration and recursion.** |
| **CO 4** | **To use arrays, pointers and structures to formulate algorithms and programs.** |

**UNIT – I**

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

##### UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

##### UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

##### UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union. Data files: Opening and closing a file, I/O operations on files.

##### Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, “C Programming Language” Pearson Education India.
2. Subrata Saha,Subhodip Mukherjee:Basic Computation & Programming with ‘C’-Cambridge University Press. 3.Ajay Mittal, “Programming in C - A Practical Approach”, Pearson.

E Balagurusamy :Programming in ANSI C,TMH Education.

1. Pradip Dey and ManasGhose, “Computer Fundamental and Programming in C”, Oxford Pub.
2. ForouzanBehrouz, “Computer Science: A Structured Programming Approach Using C”, Cengage Learning.
3. 7.Ashok Kamthane, “Programming in C, 3e”, Pearson Education India..

8. Yashwant Kanetker, “Let us C”, BPB Publications.

9. A K Sharma, “ Fundamentals of Computers & Programming” DhanpatRai Publications

10. Rajaraman V., “Computer Basic and C Programming”, Prentice Hall of India Learning.

**Note: The paper setter will set the paper as per the question paper templates provided.**

|  |  |
| --- | --- |
| **ES-107L** | **Programming for Problem Solving Lab** |
| **L** | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **30** | **20** | **50** | **3h** |
| **Purpose** | **To Introduce students with problem solving using C Programming language** |
| **Course Outcomes** |
| **CO 1** | **To formulate the algorithms for simple problems** |
| **CO 2** | **Implementation of arrays and functions.** |
| **CO 3** | **Implementation of pointers and user defined data types.** |
| **CO 4** | **Write individual and group reports: present objectives, describe test procedures and results.** |

**LIST OF PROGRAMS**

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal’s triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

##### Note: At least 10 programs are to be performed & executed from the above list.

|  |  |
| --- | --- |
| **HM-101** | **English** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **-** | **-** | **2** | **75** | **25** | **100** | **3h** |
| **Course Outcomes** |
| **CO 1** | **Building up the vocabulary** |
| **CO 2** | **Students will acquire basic proficiency in English including writing skills** |

**UNIT- 1**

**Vocabulary Building**

1.1 The concept of Word Formation

* 1. Root words from foreign languages and their use in English
	2. Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
	3. Synonyms, antonyms, and standard abbreviations.

 **UNIT- 2**

**Basic Writing Skills**

* 1. Sentence Structures
	2. Use of phrases and clauses in sentences
	3. Importance of proper punctuation
	4. Creating coherence
	5. Organizing principles of paragraphs in documents
	6. Techniques for writing precisely

 **UNIT- 3**

**Identifying Common Errors in Writing**

* 1. Subject-verb agreement
	2. Noun-pronoun agreement
	3. Misplaced modifiers
	4. Articles
	5. Prepositions
	6. Redundancies
	7. Clichés

 UNIT-4

**Nature and Style of sensible Writing**

* 1. Describing
	2. Defining
	3. Classifying
	4. Providing examples or evidence
	5. Writing introduction and conclusion
	6. Comprehension
	7. Précis Writing
	8. Essay Writing

##### Suggested Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007 (iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
3. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006
4. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
5. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

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##### Note: The paper setter will set the paper as per the question paper templates provided.

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| **HM-103L** | **Language Lab** |
| **L** | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **30** | **20** | **50** | **3h** |

**OBJECTIVES**

* 1. Listening Comprehension
	2. Pronunciation, Intonation, Stress and Rhythm
	3. Common Everyday Situations: Conversations and Dialogues
	4. Communication at Workplace
	5. Interviews
	6. Formal Presentations

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| **BS-131** | **APPLIED MATHEMATICS-I** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **1** | **-** | **4** | **75** | **25** | **100** | **3 h** |
| **Purpose** | The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in Limit, Continuity, Differential & Integral Calculus and Complex Numbers. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are asunder: |
| **Course Outcomes** |
| **CO1** | To introduce the idea of sets, relations, functions, trigonometric functions, inverse trigonometric functions, these concepts are prerequisite to learn the concepts of differentiation and integration. |
| **CO 2** | To introduce the Complex numbers which is fundamental to solve any kind of quadratic equations, Limit is precondition to understand the concept of rate of change and derivative. |
| **CO 3** | To develop the essential tool of Continuity and Differentiability needed in evaluating higher order derivatives of functions. |
| **CO 4** | To introduce the tools of Indefinite and Definite integrals of functions in a comprehensive manner that are used in various techniques dealing engineering problems. |

 **UNIT-I** (12 hrs)

##### Sets, Relations, Functions

**Sets and its types:** Operations on sets, complement of a set, Cartesian Product of sets, relations , functions, types of functions, **Trigonometric functions:** Introduction, Angles, Trigonometric functions, Trigonometric functions of sum and difference of two angles, Trigonometric equations, **Inverse Trigonometric functions:** Introduction, basic concepts and its properties.

 **UNIT-II** (12 hrs)

##### Pre-Calculus

**Complex Numbers:** Introduction, Algebra of Complex Numbers, Modulus and the conjugate of a complex number, quadratic equations, **Limits and Derivatives:** Introduction, Limits, Limits of Trigonometric Functions, Derivatives (single variable).

 **UNIT-III** (12 hrs)

##### Differential Calculus

**Continuity and Differentiability**: Introduction, Continuity, Differentiability, Exponential and Logarithmic functions, Logarithmic differentiation, Derivatives of functions in parametric forms, second order derivatives, **Application of Derivatives (single variable)**: Increasing and decreasing functions, Maxima and Minima.

 **UNIT-IV** (12 hrs)

##### Integral Calculus

**Integrals:** Introduction, Integration as an Inverse process of Differentiation, Method of Integration, Integration by Partial Fractions, Integration by Parts, **Definite Integrals**: Fundamental theorem of Calculus, Evaluation of Definite Integrals by Substitution, properties of Definite Integrals.

##### Suggested Books:

* + 1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
		2. Mathematics Textbook for Class 11th& 12th by NCERT.
		3. Howard Anton: Calculus, Wiley Publication.
		4. E. Kreyszig: Advanced Engineering Mathematics, Wiley India.

##### Note: The paper setter will set the paper as per the question paper templates provided.

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| **BS-132** | **APPLIED MATHEMATICS-II** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **4** | **1** | **-** | **4.5** | **75** | **25** | **100** | **3 h** |
| Purpose | The objective of this course is to familiarize the prospective Biotechnology Engineers withtechniques in essential tool of linear algebra, how to solve a differential equation, utility of higher order derivatives in engineering domain, and fitting of a curve to given data. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications thatthey would find useful in their disciplines. More precisely, the objectives are as under: |
| Course Outcomes |
| CO1 | To introduce the essential tool of matrices and linear algebra in a comprehensive manner to solve the large system of linear equations. |
| CO 2 | To introduce the statistical process used for estimating the parameters of a given curve or function to fit to a given data set using various degrees and types of curve fitting techniques. |
| CO 3 | To introduce effective mathematical tools for the solutions of differential equations that model physical processes. |
| CO 4 | To extend some concept of differential calculus for more than one variables. |

 **UNIT-I** (10 Hrs)

##### Linear Algebra:

Introduction to matrices, its types, algebraic operations, transpose, determinant, minors and adjoint of a matrix. Elementary transformations, Inverse of a square matrix: Cramer’s rule, Rank of a matrix, elementary matrices, Gauss Jordon method to find inverse using elementary transformations.

System of Linear equations: General representation, Homogeneous and Non-homogeneous system of linear equations, Consistency of linear system of equations, Gauss Elimination method to solve the system of linear equations.

 **UNIT-II** (12 Hrs)

##### Theory of Equations:

Introduction, formation of equations, Relation between roots and coefficients, Reciprocal Equations, Transformation of equations.

##### Curve Fitting:

Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form *y*  *axb* , fitting of an exponential curve of the form *Y= abx* .

 **UNIT-III** (10 hrs)

**Ordinary differential equations:**

Introduction, order and degree of the differential equation, Formation of differential equation, Solution of the differential equation, Solution of the differential equation with variables separable and differential equations reducible to variable separable form, exact differential equation, and equations reducible to exact differential equations, linear and Bernoulli’s equations, Euler’s equations.

 **UNIT-IV** (08 hrs)

##### Multivariable Calculus:

Partial derivatives, Total differential, Chain rule for differentiation, Partial derivatives of higher orders, Homogeneous functions, Euler’s theorem on homogeneous functions, differentiation of an implicit function, Jacobian, Maxima and minima of a function of two variables, Lagrange’s method of undetermined multipliers.

##### Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. H. Anton, Irl C Bivens, Stephen Davis: Calculus 10th Edition, John Wiley & Sons.
3. E. Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. E. Kreyszig and S. Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint 2015.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press.
6. Mathematics Textbook for Class 11th& 12th by NCERT.

##### Note: The paper setter will set the paper as per the question paper templates provided.

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| **Course Code** | **ES-109** |
| **Course Title** | **Engineering Graphics& Design** |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Major****Test** | **Minor****Test** | **Total** | **Time** |
| **1** | **2** | **0** | **3** | **75** | **25** | **100** | **3h** |

**Course Outcomes**

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| **Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.** |
| **CO-1** | **To learn about construction of various types of curves and scales.** |
| **CO-2** | **To learn about orthographic projections of points, lines and planes.** |
| **CO-3** | **To Learn about the sectional views and development of Right regular solids** |
| **CO-4** | **To Learn about the construction of Isometric Projections and conversion of Isometric views****to Orthographic views and vice-versa.** |

**UNIT - I**

**IntroductiontoEngineeringDrawing**:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

**UNIT - II**

**Orthographic Projections:**

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

**ProjectionsofRegular Solids:**

Solid with axis inclinedtoboththePlanes;

**UNIT - III**

**Sections andSectionalViewsofRightRegular Solids**:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

**UNIT - IV**

**Isometric Projections:**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

##### Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

##### Note: The paper setter will set the paper as per the question paper templates provided.

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| **Course code** | **ES-113L** |
| **Coursetitle** | **Engineering Graphics & Design Practice** |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **3** | **1.5** | **30** | **20** | **50** | **3h** |
| **Pre-requisites(if any)** | **-** |

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| **Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.** |
| **CO-1** | **To give an overview of the user interface and toolboxes in a CAD software.** |
| **CO-2** | **To understand to customize settings of CAD software and produce CAD drawing.** |
| **CO-3** | **To practice performing various functions in CAD softwares.** |
| **CO-4** | **To Learn about solid modelling and demonstration of a simple team design project.** |

**Module 1: Overview of Computer Graphics:**

Listing the computer technologies that impact on graphical communication, Demonstrating Knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus(Button Bars),The Command Line(where applicable),The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

**Module2: Customization & CAD Drawing:**

Setup of the drawing page and the printer ,including scale settings, Setting up of units and drawing limits ;ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

**Module3: Annotations, layering & other functions:**

Applying dimensions to objects ,applying annotations to drawings ;Setting up and use of Layers ,layers to create drawings ,Create ,edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen);Printing documents to paper using the print command ;orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation ,Computer-aided design(CAD) software modeling of parts and assemblies .Parametric and non-parametric solid, surface, and wire frame models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises .Dimensioning guidelines ,tolerancing techniques; dimensioning and scale multi views of dwelling;

**Module4: Demonstration of a simple team design project**:

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blue print form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modeling software for creating associative models at the component and assembly levels; floor plans that include: windows ,doors ,and fixtures such as WC, bath ,sink ,shower ,etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

##### Suggested Books(ES-113L):

* 1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
	2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
	3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
	4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
	5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
	6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
	7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
	8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
	9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
	10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
	11. (Corresponding set of)CAD Software Theory and User Manuals
	12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
	13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
	14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
	15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
	16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

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| **Course code** | **ES-111L** |  |
| **Coursetitle** | **Manufacturing Processes Workshop** |  |
| **Scheme and****Credits** | **L** | **T** | **P** | **Credits** | **Practical** | **Minor Test** | **Total** | **Time** |
| **0** | **0** | **3** | **1.5** | **60** | **40** | **100** | **3h** |
| **Pre-requisites (if any)** |  |  |

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| **Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.** |
| **CO-1** | **To familiarize with different manufacturing methods in industries and work on CNC machine.** |
| **CO-2** | **To learn working in Fitting shop and Electrical and Electronics shops,** |
| **CO-3** | **To practice working on Carpentry and Plastic moulding/glass cutting jobs.** |
| **CO-4** | **To gain hands on practice experience on Metal casting and Welding jobs.** |

**ManufacturingProcessesWorkshop Contents**

1. Manufacturing Methods-casting, forming, machining ,joining, advanced manufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plastic moulding ,glass cutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

**Suggested Books:**

* 1. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology” , 7th edition, Pearson Education India Edition.
	2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “ Elements of Workshop Technology” , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
	3. Gowri P. Hariharan and A. Suresh Babu,” Manufacturing Technology – I” Pearson Education, 2008.
	4. Roy A. Lindberg, “ Processes and Materials of Manufacture” , 4th edition, Prentice Hall India, 1998
	5. Rao P.N., “ Manufacturing Technology” , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

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| BS-141 |  Biology (Revised ) |
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time Hrs. |
|  2 |  1 |  - |  3 |  75 |  25 |  100 |  3 |
| Purpose |  To familiarize the students with the basics of Biology and Biotechnology |
|  Course Outcomes |
| CO1 | Introduction to Living world, Cell & Organisms.  |
| CO2 | Introduction to Biomolecules and Biocatalyst |
| CO3 | Introduction of basic Concept of Genetics & immune system |
| CO4 | Introduction of basic Concept of Genetic Engineering, Biochemistry & Role of Biology in Different Fields  |

 **Unit – I**

**Introduction to living world:** Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus and endoplasmic reticulum. Difference between prokaryotic and eukaryotic cell. Difference between animal and plant cell.

**Classification of Organisms**: Classify the organisms on the basis of Cellularity Unicellular and Multicellular organisms. Energy and Carbon Utilization- Autotrophs, Hetrotrophs and Lithotrops. Nitrogen Excretion:- Ammonotelic, Uricotelic and Ureotelic. Habitat- Acquatic & Terrestrial.

 **Unit-II**

**Introduction to Biomolecules:** Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids & Enzymes.

**Enzymes as Biocatalysts:** General characteristics, nomenclature and classification of Enzymes. Effect of temperature, pH, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action.

 **Unit-III**

**Genetics:-**Mendel’s laws of inheritance. Variation and speciation. Concepts of recessiveness and dominance. Genetic Disorders: Single gene &Multiple genes disorders in human.

**Human Traits**: Genetics of blood groups, Diabetes Type I & II.

**Role of immune system in health and disease**: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

 **Unit-IV**

**Concepts of Genetic Engineering:** Definition; Tools used in recombinant DNA Technology: Enzymes, Vectors & Passenger DNA.

**Catabolism:** Glycolysis and Krebs cycle, Photosynthesis:- Light and Dark Reaction. Concept of Exothermic and endothermic reactions

**Role of Biology:** Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Bio-MEMS and Biosensors.

**Text Book:**

1. Introduction to Biotechnology, By Deswal & Deswal, Dhanpat Rai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.

D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.

**Suggested Books:**

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.

4. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press Washington DC.

5. Kuby’s Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.

6. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.

**Note: The paper setter will set the paper as per the question paper templates provided**

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| **ES-101** | **BASIC ELECTRICAL ENGINEERING** |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **4** | **1** | **-** | **5** | **75** | **25** | **100** | **3** |
| **Purpose** | **To familiarize the students with the basics of Electrical Engineering** |
| **Course Outcomes** |
| **CO1** | **Deals with steady state circuit analysis subject to DC.** |
| **CO 2** | **Deals with AC fundamentals & steady state circuit response subject to AC.** |
| **CO 3** | **Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.** |
| **CO 4** | **Explains the Basics of Electrical Machines & Electrical installations** |

##### Unit-I

**D.C. circuits**: Ohm’s Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit. Star- Delta transformation for resistors.**Network Theorems:** Superposition, Thevenin’s, Norton’s and Maximum power transfer theorems in a resistive network.

##### Unit-II

**AC Fundamentals:** Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

**A.C. Circuits**: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts. including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

##### Unit-III

**Balanced Three Phase Systems:** Generation of alternating 3- phase emf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

**Single Phase Transformer** (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon. Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

##### Unit-IV

**Electrical Machines** (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

**Electrical Installations (LT Switchgear):** Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

##### Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg. by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals: by Bobrow, Oxford Univ. Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena & Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

##### Note: The paper setter will set the paper as per the question paper templates provided.

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| **ES-103L** | **BASIC ELECTRICAL ENGINEERING LAB** |
| **L** |  | **T** | **Practical** | **Credit** | **Minor Test** | **(Practical)** | **Total**  | **Time (Hrs)** |
| **-** |  | **-** | **2** | **1** | **20** | **30** | **50** | **3** |
| **Purpose** | **To familiarize the students with the Electrical Technology Practicals** |
| **Course Outcomes** |
| **CO1** | **Understand basic concepts of Network theorems** |
| **CO 2** | **Deals with steady state frequency response of RLC circuit parameters solution techniques** |
| **CO 3** | **Deals with introductory Single Phase Transformer practicals** |
| **CO 4** | **Explains the constructional features and practicals of various types of Electrical Machines** |

**LIST OF EXPERIMENTS**

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin’s Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency&

 Q- factor for various Values of R, L, and C.

1. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency&

 Q - Factor for various values of R, L, and C.

1. To perform O.C. and S.C. tests on a single phase transformer.
2. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
3. To perform speed control of DC shunt motor.
4. To perform starting & reversal of direction of a three phase induction motor.
5. Measurement of power in a 3 phase balanced system by two watt meter method.
6. Study of Cut sections of DC Machines, Induction Motor
7. To study components of various LT Switchgears

##### Note: At least 9 out of the listed experiments to be performed during the semester.