

# ACADEMIC REGULATIONS

(Choice Based Credit System)



**CSE - Data Science**

**B. Tech (Regular-Full time)**

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

**&**

**B.Tech.(Lateral Entry Scheme)**

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2024 - 25** on wards)



**SWARNANDHRA**

**COLLEGE OF ENGINEERING & TECHNOLOGY**

(AUTONOMOUS)

SEETHARAMAPURAM, NARSAPUR 534280, W.G.DT., A.P.

## **INSTITUTION VISION AND MISSION**

### **VISION**

To produce global competent, ethical and dynamic professionals by creating Centre of Excellence in Technical Education for societal empowerment.

### **MISSION**

**M1:** To provide quality education with knowledge and skills for rural and urban students.

**M2:** To collaborate the industries with academia for empowering the students to meet global standards.

**M3:** To induce highly ethical entrepreneurship in young minds with good leadership quality or the society.

**M4:** To enhance the institution in Research and Development by human intellectual capability.

## **DEPARTMENT VISION AND MISSION**

### **VISION**

To educate and enrich effective and responsible Mechanical Engineers to fulfil the need so find us try and society.

### **MISSION**

**M1:** To lay a strong foundation of technical knowledge by concentrating on fundamental concepts of Mechanical engineering.

**M2:** To develop creative thinking and innovative methods for solving complex engineering problems.

**M3:** To develop team spirit, leadership and professional qualities.

**M4:** To strengthen research abilities in collaboration with industry.

## **PROGRAM EDUCATIONAL OBJECTIVES (PEOS)**

**PEO1** – Graduates acquire solid foundation in Engineering, Science and Technology for a successful career in Mechanical Engineering.

**PEO2** – Graduates become effective collaborators and innovators to address technical and engineering challenges.

**PEO3** – Graduates shall get employed in industries, pursue higher studies, handle research assignments and become entrepreneurs.

**PEO4** – Graduates attain communication and leadership skills, and possess professional and ethical values.

**PROGRAM OUT COMES (POs)**

Engineering Graduates will be able to:

- PO1.Engineeringknowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems..
- PO2.Problemanalysis:** Identify, formulate, review research literature, and analyze complex engineering problem sreachng substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. Conduct investigations of complex problems:** Use researchbased knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5.Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modernen gineering and IT tools including prediction and modelling to complex engineering activitieswithan understanding of the limitations.
- PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7.Environmentandsustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9.Individualandteamwork:** Function effectively as an individual, and as a member or leader in diverseteams, and in multi disciplinary settings.
- PO10.Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receiveclearinstructions.
- PO11.Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin ateam, to manage projects and in multi disciplinary environments.
- PO12. Lifelong learning:** Recognize the need for, and have the preparation and ability to engage inindependent and life long learning in the broadest context of technological change.

**PROGRAM SPECIFIC OUT COMES (PSOs)**

- PSO1: An ability to apply mathematical methodologies to solve computation task, model real world problem using Deep Learning, Machine learning, Artificial Intelligence.
- PSO2: Use modern tools and techniques in the area of Data Science

## Academic Regulations (R23) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

### 1. Award of the Degree

(a) Award of the B.Tech. Degree if he/she fulfils the following:

I. Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).

II. Registers for 160 credits and secures all 160 credits.

(b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:

I. Student secures additional 15 credits fulfilling all the requisites of a B.Tech. programme i.e., 160 credits.

II. Registering for Honors is optional.

III. Honors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

### 3. Admissions

Admission to the B. Tech Program shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either based on the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

### 4. Program related terms

**Credit:** A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

**Credit Definition:**

|                                 |            |
|---------------------------------|------------|
| 1 Hr. Lecture (L) per week      | 1 credit   |
| 1 Hr. Tutorial (T) per week     | 1 credit   |
| 1 Hr. Practical (P) per week    | 0.5 credit |
| 2 Hrs. Practical (Lab) per week | 1 credit   |

a) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.

b) **Choice Based Credit System (CBCS):** The CBCS provides a choice for students to select from the prescribed courses.

### 5. Semester/Credits:

i) A semester comprises 90 working days and an academic year is divided into two semesters.

ii) The summer term is for eight weeks during summer vacation. Internship/ apprenticeship / work-based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.

iii) Regular courses may also be completed well in advance through MOOCs satisfying prerequisites.

## 6. Structure of the Undergraduate Programme

All courses offered for the undergraduate programme (B. Tech.) are broadly classified as follows:

| S.No. | Category   |
|-------|--|
| 1.    | Humanities and Social Science including Management (HM)                    |
| 2.    | Basic Sciences (BS)  |
| 3.    | Engineering Sciences (ES)  |
| 4.    | Professional Core (PC)   |
| 5.    | Electives – Professional (PE) & Open (OE); Skill Enhancement Courses (SEC) |
| 6.    | Internships & Project work (PR)  |
| 7.    | Mandatory Courses (MC)   |

## 7. Course Classification:

All courses offered for the undergraduate programme in Engineering & Technology (B.Tech. degree programmes) are broadly classified as follows:

| S.No. | Broad Course Classification | Course Category                    | Description  |
|-------|-----------------------------|------------------------------------|--|
| 1.    | Foundation Courses          | Foundation courses                 | Includes Mathematics, Physics and Chemistry; fundamental engineering courses; humanities, social sciences and management courses                   |
| 2.    | Core Courses                | Professional Core Courses (PC)     | Includes subjects related to the parent discipline/department/branch of Engineering  |
| 3.    | Elective Courses            | Professional Elective Courses (PE) | Includes elective subjects related to the parent discipline/department/ branch of Engineering  |
|       |                             | Open Elective Courses (OE)         | Elective subjects which include interdisciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering |
|       |                             | Skill enhancement courses (SEC)    | interdisciplinary/job-oriented/domain courses which are relevant to the industry   |
| 4.    | Project & Internships       | Project                            | B.Tech. Project or Major Project   |
|       |                             | Internships                        | Summer Internships – Community based and Industry Internships; Industry oriented Full Semester Internship  |
| 5.    | Audit Courses               | Mandatory non-credit courses       | Covering subjects of developing desired attitude among the learners  |

## 8. Programme Pattern

- i. Total duration of the of B. Tech (Regular) Programme is four academic years.
- ii. Each academic year of study is divided into two semesters.
- iii. Minimum number of instruction days in each semester is 90 days.
- iv. There shall be mandatory student induction program for freshers, with a three weeks duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
- v. Health/wellness/yoga/sports and NSS /NCC /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students.
- vi. Courses like Environmental Sciences, Indian Constitution, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.
- vii. Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.
- viii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.
- ix. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in emerging areas within the chosen field of study.
- x. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.
- xi. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.
- xii. Students shall undergo mandatory summer internships, for a minimum of eight weeks duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year.
- xiii. There shall also be mandatory full internship in the final semester of the programme along with the project work.
- xiv. Undergraduate degree with Honors is introduced for the students having good academic record.
- xv. College takes measures to implement Virtual Labs (<https://www.vlab.co.in>) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.
- xvi. College will assign a faculty advisor/mentor after admission to a group of students from same department to provide guidance in courses registration/ career growth/placements/opportunities for higher studies/GATE/other competitive exams etc.
- xvii. Preferably 25% of course work for the theory courses in every semester shall be conducted in the blended mode of learning.

## 9. Evaluation Process

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical courses. Summer Internships shall be evaluated for 50 marks, Full Internship & Project work in final semester shall be evaluated for 200 marks, mandatory courses with no

credits shall be evaluated for 30 mid semester marks.

A student has to secure not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester and end examination marks taken together for the theory, practical, design, drawing subject or project etc. In case of a mandatory course, he/she should secure 40% of the total marks.

### **Theory Courses**

| <b>Assessment Method</b>       | <b>Marks</b> |
|--------------------------------|--------------|
| Continuous Internal Assessment | 30           |
| Semester End Examination       | 70           |
| <b>Total</b>                   | <b>100</b>   |

- For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.
- For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.
- If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.
- If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of 'T' for theory subject and 'L' for practical subject.

#### **(a) Continuous Internal Evaluation**

- For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective paper (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.
- Objective paper shall contain for 05 short answer questions with 2 marks each or maximum of 20 bits for 10 marks. Subjective paper shall contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer one from each either-or type of questions. Each question carries 10 marks. The marks obtained in the subjective paper are condensed to 15 marks.

#### **Note:**

- The objective paper shall be prepared in line with the quality of competitive examinations questions.
- The subjective paper shall contain 3 either or type questions of equal weightage of 10 marks. Any fraction shall be rounded off to the next higher mark.
- Assignments shall be in the form of problems, mini projects, design problems, slip tests, quizzes etc., depending on the course content. It should be continuous assessment throughout the semester and the average marks shall be considered.

**For Example:**

Marks obtained in first mid: Absent

Marks obtained in second mid: 25

Final mid semester Marks:  $(25 \times 0.8) + (0 \times 0.2) = 20$

**b) End Examination Evaluation:**

The **end semester** examination will be conducted for 70 marks which covers full syllabus. In end examination pattern, **Part–A** consists of five short questions from all units (Brainstorming/Thought provoking/Case study) for 10 marks. **Part – B** has **5 questions** with internal choice from each unit and valued for 60marks.

End examination of theory courses consisting of two parts of different subjects, for Example: Basic Electrical & Electronics Engineering shall have the following pattern:

- i) Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.
- ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1 mark.
- iii) In each part, questions from 2 to 7, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
- iv) The questions from 2 to 7 shall be set by covering one unit of the syllabus for each question.

**Practical Courses**

| Assessment Method              | Marks      |
|--------------------------------|------------|
| Continuous Internal Assessment | 30         |
| Semester End Examination       | 70         |
| <b>Total</b>                   | <b>100</b> |

- i. For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.
- ii. Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the record/viva and 15 marks for the internal test.
- iii. The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same department or expert from other institutions.
  - Procedure: 20 marks
  - Experimental work & Results: 30 marks
  - Viva voce: 20 marks.
- iv. In a practical subject consisting of two parts (Eg: Basic Electrical & Electronics Engineering Lab), the end examination shall be conducted for 70 marks as a single laboratory in 3 hours. Mid semester examination shall be evaluated as above for 30 marks in each part and final mid semester marks shall be arrived by considering the average of marks obtained in two parts.
- c) For the subject having design and/or drawing, such as Engineering Drawing, the distribution of marks shall be 30 for mid semester evaluation and 70 for end examination.

| Assessment Method              | Marks      |
|--------------------------------|------------|
| Continuous Internal Assessment | 30         |
| Semester End Examination       | 70         |
| <b>Total</b>                   | <b>100</b> |

- i. Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weightage of 80% to better mid marks and 20% for the other. The subjective paper shall contain 3 either or type questions of equal weightage of 5 marks. There shall be no objective paper in mid semester examination. The sum of day-to-day evaluation and the mid semester marks will be the final sessional marks for the subject.
- ii. The end examination pattern for Engineering Graphics, shall consists of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination. However, the end examination pattern for other subjects related to design/drawing, multiple branches, etc is mentioned along with the syllabus.
- d) There shall be no external examination for mandatory courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a reexamination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.
- e) The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

## 10. Skill oriented Courses

- i) There shall be five skill-oriented courses offered during III to VII semesters.
- ii) Out of the five skill courses two shall be skill-oriented courses from the same domain. Of the remaining three skill courses, one shall be a soft skill course and the remaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.
- iii) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/assignments/viva/mid semester test. The end examination similar to practical examination pattern shall be conducted by the senior expert in the subject from the same department or expert from other institutions.
- iv) The Head of the Department shall identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The marks/grades shall be assigned to the students by the above committee based on their performance.

- v) The student shall be given an option to choose either the skill courses being offered by the Department or to choose a certificate course being offered by industries/Professional bodies or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency. A committee shall be formed at the level of the Department to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.
- vi) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the BOS at the beginning of the semester. The principal of the respective college shall forward such proposals to the University for approval.
- vii) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the Department.

### **11. Massive Open Online Courses (MOOCs):**

- a. A Student has to pursue and complete one course compulsorily through MOOCs approved by the University. A student can pursue courses other than core through MOOCs and it is mandatory to complete one course successfully through MOOCs for awarding the degree. A student is not permitted to register and pursue core courses through MOOCs.
- b. A student shall register for the course (Minimum of either 8 weeks or 12 weeks) offered through MOOCs with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the student's progression. The student needs to earn a certificate by passing the exam. The student shall be awarded the credits assigned in the curriculum only by submission of the certificate. Examination fee, if any, will be borne by the student.
- c. Students who have qualified in the proctored examinations conducted through MOOCs platform can apply for credit transfer as specified and are exempted from appearing internal as well as external examination (for the specified equivalent credit course only) conducted by the College.
- d. Necessary amendments in rules and regulations regarding adoption of MOOC courses would be proposed from time to time.

### **12. Credit Transfer Policy**

Adoption of MOOCs is mandatory, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the College shall allow up to a maximum of 20% of the total courses being offered in a particular programme i.e., maximum of 32 credits through MOOCs platform.

- i) The Institution shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses.
- ii) Student registration for the MOOCs shall be only through the respective department of the institution, it is mandatory for the student to share necessary information with the department.
- iii) Credit transfer policy will be applicable to the Professional & Open Elective courses only.
- iv) The concerned department shall identify the courses permitted for credit transfer.

- v) The Institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.
- vi) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.
- vii) In case of delay in results, the Institution will re-issue the marks sheet for such students.
- viii) Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.
- ix) The institution shall submit the following to the examination section of the university:
  - a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
  - b) Undertaking form filled by the students for credit transfer.
- x) The universities shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

**Note:** Students shall be permitted to register for MOOCs offered through online platforms approved by the University from time to time.

### 13. Academic Bank of Credits (ABC)

The University has implemented Academic Bank of Credits (ABC) to promote flexibility in curriculum as per NEP 2020 to

- i. provide option of mobility for learners across the universities of their choice
- ii. provide option to gain the credits through MOOCs from approved digital platforms.
- iii. facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
- iv. execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students' account.

### 14. Mandatory Internships

**Summer Internships :** Two summer internships either onsite or virtual each with a minimum of 08 weeks duration, done at the end of second and third years, respectively are mandatory. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the Undergraduate program. One of the two summer internships at the end of second year (Community Service Project) shall be society oriented and shall be completed in collaboration with government organizations/NGOs & others. The other internship at the end of third year is Industry Internship and shall be completed in collaboration with Industries. The student shall register for the internship as per course structure after commencement of academic year. The guidelines issued by the APSCHE / University shall be followed for carrying out and evaluation of Community Service Project and Industry Internship.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. The report and the oral presentation shall carry 50% weightage each. It shall be evaluated for 50 external marks. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the Institution.

**Full Semester Internship and Project work:** In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion

certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship.

The project report shall be evaluated with an external examiner. The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the College and is evaluated for 140 marks.

The college shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

### **15. Guidelines for offering a Minor**

To promote interdisciplinary knowledge among the students, the students admitted into B.Tech. in a major stream/branch are eligible to obtain degree in Minor in another stream.

The Minor program requires the completion of 12 credits in Minor stream chosen.

- i) Two courses for 06 credits related to a Minor are to be pursued compulsorily for the minor degree, but maybe waived for students who have done similar/equivalent courses. If waived for a student, then the student must take an extra elective course in its place. It is recommended that students should complete the compulsory courses (or equivalents) before registering for the electives.
- ii) Electives (minimum of 2 courses) to complete a total of 12 credits.

**Note:** A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for Minor by opting for the courses offered through various verticals/tracks under Open Electives.

### **16. Guidelines for offering Honors**

The objective of introducing B.Tech.(Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

- i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.
- ii) A student shall earn additional 15 credits for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 160 credits).
- iii) A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.
- iv) The Department shall arrange separate class work and timetable of the courses offered under Honors program.

- v) Courses that are used to fulfil the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.
- vi) Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.
- vii) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.
- viii) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.
- ix) **A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program.** No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree programme.
- x) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
- xi) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering

#### **Enrolment into Honors:**

- i) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline
- ii) The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.
- iii) If a student is detained due to lack of attendance either in Major or in Honors, registration shall be cancelled.
- iv) Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.
- v) Honors is to be completed simultaneously with a Major degree program.

#### **Registration for Honors:**

- i) The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honors.
- ii) The selected students shall submit their willingness to the principal through his/her parent department offering Honors. The parent department shall maintain the record of student pursuing the Honors.
- iii) The students enrolled in the Honors courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

#### **17. Attendance Requirements:**

- i) A student shall be eligible to appear for the external examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the subjects. Condonation of shortage of attendance in

aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

- ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.
- iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the University.
- iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
- v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.
- vi) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
- vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.
- viii) For induction programme attendance shall be maintained as per AICTE norms.

### 18. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 17.

- i) A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per university norms.
- ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any *decimal* fraction should be *rounded off* to *lower* digit) up to in the subjects that have been studied up to IV semester.
- iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any *decimal* fraction should be *rounded off* to *lower* digit) in the subjects that have been studied up to VI semester. And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.
- iv) When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

### 19. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

## Structure of Grading of Academic Performance

| Range in which the marks in the subject fall | Grade         | Grade points |
|--|---------------|--------------|
|  |               | Assigned     |
| 90 & above                                   | S (Superior)  | 10           |
| 80 - 89                                      | A (Excellent) | 9            |
| 70 - 79                                      | B (Very Good) | 8            |
| 60 - 69                                      | C (Good)      | 7            |
| 50 - 59                                      | D (Average)   | 6            |
| 40 - 49                                      | E (Pass)      | 5            |
| < 40   | F (Fail)      | 0            |
| Absent                                       | Ab (Absent)   | 0            |

- i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.
- ii) For non-credit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):  
The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA = \sum (C_i \times G_i) / \sum C_i$$

where,  $C_i$  is the number of credits of the  $i^{\text{th}}$  subject and  $G_i$  is the grade point scored by the student in the  $i^{\text{th}}$  course.

The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

$$CGPA = \sum (C_i \times S_i) / \sum C_i$$

where " $S_i$ " is the SGPA of the  $i^{\text{th}}$  semester and  $C_i$  is the total number of credits up to that semester.

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters S, A, B, C, D and F.

**Award of Class:** After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he/she shall be placed in one of the following four classes:

| Class Awarded                | CGPA Secured     |
|------------------------------|------------------|
| First Class with Distinction | $\geq 7.5$       |
| First Class                  | $\geq 6.5 < 7.5$ |
| Second Class                 | $\geq 5.5 < 6.5$ |
| Pass Class                   | $\geq 5.0 < 5.5$ |

**CGPA to Percentage conversion Formula –  $(\text{CGPA} - 0.5) \times 10$**

## 20. With-holding of Results

If the candidate has any dues not paid to the Institution or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld in such cases.

## 21. Multiple Entry / Exit Option

### (a) Exit Policy:

The students can choose to exit the four-year programme at the end of first/second/third year.

- i) **UG Certificate in (Field of study/discipline)** - Programme duration: First year (first two semesters) of the undergraduate programme, 40 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.
- ii) **UG Diploma (in Field of study/discipline)** - Programme duration: First two years (first four semesters) of the undergraduate programme, 80 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.
- iii) **Bachelor of Science (in Field of study/discipline) i.e., B.Sc. Engineering in(Field of study/discipline)**- Programme duration: First three years (first six semesters) of the undergraduate programme, 120 credits.

### (b) Entry Policy:

Modalities on multiple entry by the student into the B.Tech. programme will be provided in due course of time.

**Note:** The Universities shall resolve any issues that may arise in the implementation of Multiple Entry and Exit policies from time to time and shall review the policies in the light of periodic changes brought by UGC, AICTE and State government.

## 22. Gap Year Concept:

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/to establish startups. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The principal of the college shall forward such proposals submitted by the students. An evaluation committee constituted by the principal shall evaluate the proposal submitted by the student and the committee shall decide whether to permit the student(s) to avail the Gap Year or not

### **23. Transitory Regulations**

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

### **22. Minimum Instruction Days for a Semester:**

The minimum instruction days including exams for each semester shall be 90 days.

### **23. Medium of Instruction:**

The medium of instruction of the entire B. Tech undergraduate programme in Engineering & Technology (including examinations and project reports) will be in English only.

### **24. Student Transfers:**

Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh and the Universities from time to time.

### **25. General Instructions:**

- i. The academic regulations should be read as a whole for purpose of any interpretation.
- ii. Malpractices rules-nature and punishments are appended.
- iii. Where the words “he”, “him”, “his”, occur in the regulations, they also include “she”, “her”, “hers”, respectively.
- iv. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.
- v. The College may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Institution.
- vi. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Academic Council / Head of the institution is final.

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## ACADEMIC REGULATIONS (R23) FOR B.TECH. (LATERAL ENTRY SCHEME)

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year 2024-25 onwards)

### 1. Award of the Degree

(a) Award of the B.Tech. Degree if he/she fulfils the following:

- (i) Pursues a course of study for not less than three academic years and not more than six academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Six years).
- (ii) Registers for 120 credits and secures all 120 credits.

(b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:

- (i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 120 credits.
- (ii) Registering for Honors is optional.
- (iii) Honors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil the requirement for the award of the degree within six consecutive academic years from the year of admission, shall forfeit their seat.

### 3. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.2

- i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.
- ii. A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any decimal fraction should be rounded off to lower digit) in the subjects that have been studied up to VI semester.

And in case if student is already detained for want of credits for particular academic year, the student may make up the credits through supplementary exams of the above exams before the commencement of VII semester class work of next year.

### 4. Course Pattern

- i) The entire course of study is three academic years on semester pattern.
- iii) A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.
- iv) When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

5. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

**B.TECH. - COURSE STRUCTURE – R23**  
(Applicable from the academic year 2023-24 onwards)

**INDUCTION PROGRAMME**

| S.No. | Course Name   | Category | L-T-P-C |
|-------|---|----------|---------|
| 1     | Physical Activities -- Sports, Yoga and Meditation, Plantation                | MC       | 0-0-6-0 |
| 2     | Career Counselling  | MC       | 2-0-2-0 |
| 3     | Orientation to all branches -- career options, tools, etc.                    | MC       | 3-0-0-0 |
| 4     | Orientation on admitted Branch -- corresponding labs, tools and platforms     | EC       | 2-0-3-0 |
| 5     | Proficiency Modules & Productivity Tools                                      | ES       | 2-1-2-0 |
| 6     | Assessment on basic aptitude and mathematical skills                          | MC       | 2-0-3-0 |
| 7     | Remedial Training in Foundation Courses                                       | MC       | 2-1-2-0 |
| 8     | Human Values & Professional Ethics  | MC       | 3-0-0-0 |
| 9     | Communication Skills -- focus on Listening, Speaking, Reading, Writing skills | BS       | 2-1-2-0 |
| 10    | Concepts of Programming   | ES       | 2-0-2-0 |

**SEMESTER-I**

| S.No.        | Course Code | Category            | Title   | L         | T        | P        | C           | I M        | E M        |
|--------------|-------------|---------------------|---|-----------|----------|----------|-------------|------------|------------|
| 1            | 23BS1T02    | BS&H                | Engineering Physics                           | 3         | 0        | 0        | 3           | 30         | 70         |
| 2            | 23BS1T03    | BS&H                | Linear Algebra & Calculus                     | 3         | 0        | 0        | 3           | 30         | 70         |
| 3            | 23EE1T01    | Engineering Science | Basic Electrical & Electronics Engineering    | 3         | 0        | 0        | 3           | 30         | 70         |
| 4            | 23ME1T02    | Engineering Science | Engineering Graphics                          | 1         | 0        | 4        | 3           | 30         | 70         |
| 5            | 23CS1T01    | Engineering Science | Introduction to Programming                   | 3         | 0        | 0        | 3           | 30         | 70         |
| 6            | 23CS1L02    | Engineering Science | IT Workshop                                   | 0         | 0        | 2        | 1           | 30         | 70         |
| 7            | 23BS1L02    | BS&H                | Engineering Physics Lab                       | 0         | 0        | 2        | 1           | 30         | 70         |
| 8            | 23EE1L01    | Engineering Science | Electrical & Electronics Engineering Workshop | 0         | 0        | 3        | 1.5         | 30         | 70         |
| 9            | 23CS1L01    | Engineering Science | Computer Programming Lab                      | 0         | 0        | 3        | 1.5         | 30         | 70         |
| 10           | 23BS1P02    | BS&H                | NSS/NCC/Scouts & Guides/Community Service     | -         | -        | 1        | 0.5         | 100        | -          |
| <b>Total</b> |             |                     |   | <b>16</b> | <b>2</b> | <b>8</b> | <b>20.5</b> | <b>370</b> | <b>630</b> |

**SEMESTER-II**

| S.No         | Course Code | Category            | Title                                    | L         | T         | P         | C           | I M        | E M        |
|--------------|-------------|---------------------|--|-----------|-----------|-----------|-------------|------------|------------|
| 1            | 23HS2T01    | BS&H                | Communicative English                    | 2         | 0         | 0         | 2           | 30         | 70         |
| 2            | 23BS2T01    | BS&H                | Chemistry                                | 3         | 0         | 0         | 3           | 30         | 70         |
| 3            | 23BS2T04    | BS&H                | Differential Equations & Vector Calculus | 3         | 0         | 0         | 3           | 30         | 70         |
| 4            | 23ME2T01    | Engineering Science | Basic Civil & Mechanical Engineering     | 3         | 0         | 0         | 3           | 30         | 70         |
| 5            | 23CS2T01    | Professional Core   | Data Structures                          | 3         | 0         | 0         | 3           | 30         | 70         |
| 6            | 23HS2L01    | BS&H                | Communicative English Lab                | 0         | 0         | 2         | 1           | 30         | 70         |
| 7            | 23BS2L01    | BS&H                | Chemistry Lab                            | 0         | 0         | 2         | 1           | 30         | 70         |
| 8            | 23ME2L01    | Engineering Science | Engineering Workshop                     | 0         | 0         | 3         | 1.5         | 30         | 70         |
| 9            | 23CS2L01    | Professional Core   | Data Structures Lab                      | 0         | 0         | 3         | 1.5         | 30         | 70         |
| 10           | 23BS2P01    | BS&H                | Health and Wellness, Yoga and Sports     | -         | -         | 1         | 0.5         | 100        |            |
| <b>Total</b> |             |                     |  | <b>13</b> | <b>00</b> | <b>15</b> | <b>19.5</b> | <b>370</b> | <b>630</b> |

**SEMESTER-III**

| S.No         | Course Code | Category                 | Title  | L         | T        | P         | C         | I M        | E M        |
|--------------|-------------|--------------------------|--|-----------|----------|-----------|-----------|------------|------------|
| 1            | 23BS3T03    | BS&H                     | Discrete Mathematics & Graph Theory                                      | 3         | 0        | 0         | 3         | 30         | 70         |
| 2            | 23HS3T01    | BS&H                     | Universal human values – understanding harmony and Ethical human conduct | 2         | 1        | 0         | 3         | 30         | 70         |
| 3            | 23CD3T01    | Engineering Science      | Introduction to Data Science   | 3         | 0        | 0         | 3         | 30         | 70         |
| 4            | 23CS3T02    | Professional Core        | Advanced Data Structures & Algorithms                                    | 3         | 0        | 0         | 3         | 30         | 70         |
| 5            | 23CS3T03    | Professional Core        | Data Base Management Systems   | 3         | 0        | 0         | 3         | 30         | 70         |
| 6            | 23CD3L01    | Professional Core        | Data Science Lab   | 0         | 0        | 3         | 1.5       | 30         | 70         |
| 7            | 23CS3L02    | Professional Core        | Data Base Management Systems Lab   | 0         | 0        | 3         | 1.5       | 30         | 70         |
| 8            | 23AM3S01    | Skill Enhancement course | Python Programming   | 0         | 1        | 2         | 2         | 30         | 70         |
| 9            | 23BS3M01    | Audit Course             | Environmental Science  | 2         | 0        | 0         | -         | -          | -          |
| <b>Total</b> |             |                          |  | <b>15</b> | <b>2</b> | <b>10</b> | <b>20</b> | <b>240</b> | <b>560</b> |

**SEMESTER-IV**

| S.No   | Course Code | Category                           | Title  | L         | T        | P         | C         | I M        | E M        |
|--|-------------|------------------------------------|--|-----------|----------|-----------|-----------|------------|------------|
| 1  | 23BS4T03    | Management Course- I               | Optimization Techniques                      | 2         | 0        | 0         | 2         | 30         | 70         |
| 2  | 23BS4T05    | Engineering Science/ Basic Science | Statistical methods for Data science         | 3         | 0        | 0         | 3         | 30         | 70         |
| 3  | 23AM4T01    | Professional Core                  | Computer Organization                        | 3         | 0        | 0         | 3         | 30         | 70         |
| 4  | 23CD4T01    | Professional Core                  | Data Engineering                             | 3         | 0        | 0         | 3         | 30         | 70         |
| 5  | 23CS4T02    | Professional Core                  | Object-Oriented Programming Through JAVA     | 3         | 0        | 0         | 3         | 30         | 70         |
| 6  | 23CD4L01    | Professional Core                  | Data Engineering Lab                         | 0         | 0        | 3         | 1.5       | 30         | 70         |
| 7  | 23CS4L02    | Professional Core                  | Object-Oriented Programming Through JAVA Lab | 0         | 0        | 3         | 1.5       | 30         | 70         |
| 8  | 23CD4S01    | Skill Enhancement course           | Data Visualization using Power BI            | 0         | 1        | 2         | 2         | 30         | 70         |
| 9  | 23CD4Z01    | BS&H                               | Design Thinking & Innovation                 | 1         | 0        | 2         | 2         | 30         | 70         |
| <b>Total</b>   |             |                                    |  | <b>15</b> | <b>1</b> | <b>10</b> | <b>21</b> | <b>270</b> | <b>630</b> |
| Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation |             |                                    |  |           |          |           |           |            |            |

| I SEMESTER                     | L | T | P | C |
|--------------------------------|---|---|---|---|
|                                | 3 | - | - | 3 |
| 23BS1T02 - ENGINEERING PHYSICS |   |   |   |   |

**Course Objectives:**

To bridge the gap between the Physics in school at 10+2 level and UG level Engineering courses are designed by identifying the importance of the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors, enlightening the characteristics and applications of lasers and optical fibers.

**Course Outcomes:** At the end of the course students are able to

**CO1:** Familiarize with the basics of crystal and their structures (K1).

**CO2:** Summarize various types of polarization of Dielectrics and classify the Magnetic materials (K2).

**CO3:** Explain fundamentals of Quantum mechanics and apply it to one dimensional motion of particles (K3).

**CO4:** Identify the type of Semiconductor using Hall Effect (K2).

**CO5:** Describe the characteristics of Lasers and properties of Optical fibers and their applications (K2).

**UNIT - I: Crystallography and X-ray diffraction**

**Crystallography:** Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC

**X - ray diffraction:** Miller indices – separation between successive (h k l) planes. Bragg's law - X-ray Diffractometer – crystal structure determination by Laue and powder methods

**UNIT - II: Dielectric and Magnetic Materials**

**Dielectric Materials:** Introduction-Dielectric polarization- Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors-Types of polarizations - Electronic(Quantitative), Ionic(Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation

**Magnetic Materials:** Introduction-Magnetic dipole moment-Magnetization, Magnetic susceptibility and permeability – Atomic origin of magnetism

**Classification of magnetic materials:** Dia, para, Ferro, anti-ferro & Ferrimagnetic materials- Domain concept for Ferromagnetism & Domain walls (Qualitative)-Hysteresis- Soft and hard magnetic materials.

**UNIT-III**

**Quantum Mechanics and Free electron Theory:** Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations – Particle in a one-dimensional infinite potential well.

**Free Electron Theory:** Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory-Fermi-Dirac distribution-Density of states -Fermi energy

#### UNIT-IV

**Semiconductors:** Formation of energy bands – classification of crystalline solids – Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers–dependence of Fermi energy on carrier concentration and temperature-Drift and diffusion currents–Einstein's equation–Hall effect and its applications.

#### UNIT -V

**Lasers and Optical Fibers:** Introduction– Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion - Three level and four level laser pumping schemes - Ruby laser – Helium-Neon laser- Applications of Laser.

**Optical Fibers:** Introduction to Optical fibers- Critical angle of propagation- Total internal reflection-Acceptance angle and acceptance cone- Numerical aperture- Classification of optical fibers based on refractive index profile-Classification of optical fibers based on modes- Attenuation in optical fibers and Applications of optical fibers.

#### Textbooks:

1. A Text book of Engineering Physics, M.N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics -D.K.Bhattacharya and Poonam Tandon, Oxford press(2015)

#### Reference Books:

1. Engineering Physics -B.K.Pandey and S.Chaturvedi, Cengage Learning 2021.
2. Engineering Physics -Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics"-Sanjay D.Jain, D.Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics -M.R.Srinivasan, New Age international publishers(2009).

**Web Resources:** <https://www.loc.gov/rr/scitech/selected-internet/physics.html>

| I SEMESTER                          | L | T | P | C |
|-------------------------------------|---|---|---|---|
|                                     | 3 | - | - | 3 |
| 23BS1T03 - Liner Algebra & Calculus |   |   |   |   |

**Course Outcomes:** At the end of the course, the student will be able to

**CO1:** Solve a given system of linear equations (K2)

**CO2:** Develop the matrix algebra techniques that are needed by engineers for practical applications (K4)

**CO3:** Utilize mean value theorems for real life problems (K2)

**CO4:** Apply the concept of partial differentiation in various engineering applications (K3)

**CO5:** Evaluate double, triple integrals and their applications (K3)

### UNIT I: Matrices

Linear Transformation - Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Consistency of System of Linear Equations–Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

### UNIT II: Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

### UNIT III: Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

### UNIT IV: Partial differentiation and Applications (Multi variable calculus)

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

### UNIT V: Multiple Integrals (Multi variable Calculus)

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

### Textbook:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44<sup>th</sup> Edition

### Reference Book:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10<sup>th</sup> Edition

| I SEMESTER  | L | T | P | C |
|---|---|---|---|---|
|   | 3 | - | - | 3 |
| 23EE1T01 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING |   |   |   |   |

**PART – A**  
**BASIC ELECTRICAL ENGINEERING**

**Course Objectives:**

To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field)

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

**CO1.** Describe fundamental laws, operating principles of motors/generators, MC/MI instruments (K2)

**CO2.** Demonstrate the working of electrical machines, measuring instruments and power generation stations.(K2)

**CO3.** Apply mathematical tools and fundamental concepts to derive various equations related to electrical circuits and machines. (K3)

**CO4.** Calculate electrical load and electricity bill of residential and commercial buildings(K2)

**UNIT - I : DC & AC CIRCUITS**

**DC Circuits:** Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

**AC Circuits:** A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems)..

**UNIT - II: MACHINES AND MEASURING INSTRUMENTS**

**Machines:** Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

**Measuring Instruments:** Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Watt meter.

**UNIT - III: ENERGY RESOURCES, ELECTRICITY BILL & SAFETY MEASURES**

**Energy Resources:** Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

**Electricity bill:** Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc.

Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

**Equipment Safety Measures:** Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

**Text books:**

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition.
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013.
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition.

**REFERENCE BOOKS:**

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, McGraw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

**PART – B**  
**BASIC ELECTRONICS ENGINEERING**

**Course Objectives:**

To teach the fundamentals of semiconductor devices and its applications, principles of digital electronics

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

**CO1:** Describe the characteristics of various semiconductor devices (K1)

**CO2:** Construct voltage regulators and rectifiers (K3)

**CO3:** Able to explain about the amplifiers and instrumentation system (K2)

**CO4:** Able to explain the behavior of combinational and sequential circuits (K4)

**UNIT - I: SEMICONDUCTOR DEVICES**

**Introduction** - Introduction to Electronics, characteristics of PN Junction Diode, Zener Diode — Zener break down and its Characteristics, LED and its characteristics

**Transistors** — BJT- CB, CE, CC Configurations and Characteristics, FET-Characteristics, Transistor acts as Amplifier.

**UNIT - II: BASIC ELECTRONIC CIRCUITS AND INSTRUMENTATION**

**Rectifiers and power supplies:** Block diagram description of a dc power supply, working of rectifiers (HW, FW & Bridge), capacitor filter (no analysis), working of simple zener voltage regulator.

**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of RC coupled amplifier with its frequency response. (no analysis)

**Electronic Instrumentation:** Block diagram of an electronic instrumentation system.

### **UNIT III : DIGITAL ELECTRONICS**

**Number Systems & Logic Gates:** Overview of Number Systems, Logic gates

NOT, OR, AND, NOR, NAND, XOR, XNOR Truth Tables and Functionality, BCD codes, Excess-3 code, Gray code,

**Boolean Algebra:** Basic Theorems and properties of Boolean Algebra, Simple combinational circuits—Half and Full Adders & Half and Full Subtractor

**Introduction to sequential circuits,** Flip flops, Registers and counters (Elementary Treatment only)

#### **Textbooks:**

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

#### **Reference Books:**

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

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| 23ME1T02 - ENGINEERING GRAPHICS |   |   |   |   |

**Course Objectives:**

To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing

1. To impart knowledge on the projection of points, lines and plane surfaces
2. To improve the visualization skills for better understanding of projection of solids
3. To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
4. To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

**Course Outcomes:**

**CO1:** Understand the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections. (K2)

**CO2:** Draw and interpret orthographic projections of points, lines, planes and solids in front, top and side views.(K2)

**CO3:** Understand and draw projection of solids in various positions in first quadrant. (K1)

**CO4:** Explain principles behind development of surfaces.(K1)

**CO5:** Prepare isometric and perspective sections of simple solids.(K3)

**UNIT - I**

**Introduction:** Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

**Curves:** construction of ellipse, parabola and hyperbola by general, Cycloids, Involute, Normal and tangent to Curves.

**Scales:** Plain scales and diagonal scales.

**UNIT - II**

**Orthographic Projections:** Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

**Projections of Straight Lines:** Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

**Projections of Planes:** regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

### UNIT - III

**Projections of Solids:** Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

### UNIT - IV

**Sections of Solids:** Sections of solids in simple position only.

**Development of Surfaces:** Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

### UNIT - V

**Conversion of Views:** Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

**Computer graphics:** Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (Not for end examination).

### Textbook:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

### Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc, 2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

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| <b>23CS1T01 - INTRODUCTION TO PROGRAMMING</b> |   |   |   |   |

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

**CO1:** Under stand basics of computers, the concept of algorithm and algorithmic thinking. (K2)

**CO2:** Analyse a problem and develop an algorithm to solve it. (K3)

**CO3:** Implement various algorithms using the C programming language. (K3)

**CO4:** Understand more advanced features of C language. (K2)

**CO5:** Level of problem-solving skills and the ability to debug and optimizethe code. (K4)

## UNIT-I

Introduction to Programming and Problem Solving History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program Algorithms, flowcharts (Using Dia Tool), pseudocode. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operators, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

## UNIT-II

### Control Structures

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do while) Break, Continue, goto and exit.

## UNIT-III

### Arrays and Strings

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings- String Handling Functions.

## UNIT-IV

### Pointers & User Defined Datatypes

Pointers-Declaration, Initialization and Accessing, Pointer Arithmetic, Dynamic memory Allocation, array manipulation using pointers, User-defined data types-Structures and Unions.

## UNIT-V

### Functions & File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling- Types of File, File Modes, File Accessing functions.

Note: The syllabus is designed with C Language as the fundamental language of implementation.

**Text books:**

1. Programming in ANSI C by E.Balguruswamy, Tata Mc-Graw Hill
2. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall, 1988
3. Schaum's Outline of Programming with C, Byron S. Gottfried, McGraw-Hill Education, 1996

**Reference Books:**

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Thiraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd Edition

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| 23CS1L02 - IT WORKSHOP |   |   |   |   |

**Course Outcomes:**

CO1: Perform Hardware troubleshooting. (K2)

CO2: Understand Hardware components and inter dependencies. (K1)

CO3: Safeguard computer systems from viruses/worms. (K3)

CO4: Document/ Presentation preparation. (K1)

CO5: Perform calculations using spreadsheets. (K2)

**PC Hardware & Software Installation**

**Task 1:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

**Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

**Task 3:** Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

**Task 4:** Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both

Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

**Task 5:** Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

**Internet & World Wide Web**

**Task1:** Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

**Task 2:** Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

**Task 3:** Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

**Task 4:** Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

## **LaTeX and WORD**

**Task 1 – Word Orientation:** The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

**Task 2:** Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

**Task 3:** Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

**Task 4:** Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

## **EXCEL**

**Excel Orientation:** The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

**Task 1:** Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

**Task 2:** Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

## **LOOKUP/VLOOKUP**

**Task 3:** Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

## **POWER POINT**

**Task 1:** Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

**Task 2:** Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

**Task 3:** Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

## AI TOOLS – ChatGPT

**Task 1:** Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

**Task 2:** Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

**Task 3:** Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

## Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2<sup>nd</sup> edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfinson and Ken Quamme. – CISCO Press, Pearson Education, 3<sup>rd</sup> edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3<sup>rd</sup> edition

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| 23BS1L02- ENGINEERING PHYSICS LAB |   |   |   |   |

**Course Outcomes:** The students will be able to

**CO1:** Estimate the wave lengths of Laser source using diffraction grating (K2).

**CO2:** Plot the intensity of the magnetic field of circular coil carrying current with distance (K2).

**CO3:** Evaluate dielectric constant and magnetic susceptibility for dielectric and magnetic material respectively (K2).

**CO4:** Calculate the band gap of a given semiconductor (K3).

**CO5:** Evaluate general and mechanical properties of materials (K2)

### List of Experiments:

1. Determination of wavelength of Laser light using diffraction grating.
2. Estimation of Planck's constant using photo electric effect.
3. Determination of energy gap of a semiconductor using p-n junction diode.
4. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
5. Determination of temperature coefficients of a thermistor.
6. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.
7. Determination of Numerical aperture and Acceptance angle of a given optical fiber.
8. Determination of the resistivity of semiconductor by four probe method.
9. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
10. Determination of Frequency of AC supply using sonometre
11. Determination of time constant of CR circuit
12. Study of Characteristic curves (I/V) of a Zener diode to determine its Breakdown voltage.

**Note:** Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

### References:

- A Text book of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

### Web Resources

- [www.vlab.co.inhttps://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype](https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype)

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| <b>23EE1L02 - Electrical &amp; Electronics Engineering Workshop</b> |   |   |   |     |

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

**CO1.** Measure voltage, current and power in an electrical circuit. (K3)

**CO2.** Measure of Resistance using Wheat stone bridge (K4)

**CO3.** Discover critical field resistance and critical speed of DC shunt generators. (K4)

**CO4.** Investigate the effect of reactive power and power factor in electrical loads. (K5)

#### Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
  - Provide some exercises so that hardware tools and instruments are learned to be used by the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
  - Provide some exercises so that measuring instruments are learned to be used by the students.
3. Components:
  - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
  - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

### PART A: ELECTRICAL ENGINEERING LAB

#### List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

**Reference Books:**

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

**Note:** Minimum Six Experiments to be performed.

**PART B: ELECTRONICS ENGINEERING LAB****Course Objectives:**

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

**Course Outcomes:** At the end of the course, the student will be able to CO1: Identify & testing of various electronic components.

CO2: Understand the usage of electronic measuring instruments.

CO3: Plot and discuss the characteristics of various electron devices. CO4: Explain the operation of a digital circuit.

**List of Experiments:**

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Table of S –R, J-K & D flip flops using respective ICs.

Tools / Equipment required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

**References:**

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021
2. R. P. Jain, Modern Digital Electronics, 4th edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits -Conventional Flow Version Pearson Education, 2009.

**Note:** Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software

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| 23CS1L01- Computer Programming Lab |   |   |   |     |

**Course Outcomes:**

**CO1:** Read, understand, and trace the execution of programs written in C language. (K1)

**CO2:** Select the right control structure for solving the problem. (K2)

**CO3:** Develop C programs which utilize memory efficiently using programming constructs like pointers. (K3)

**CO4:** Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C. (K3)

**UNIT - I****WEEK 1**

**Objective:** Getting familiar with the programming environment on the computer and writing the first program.

**Suggested Experiments/Activities:**

**Tutorial 1:** Problem-solving using Computers.

**Lab1:** Familiarization with programming environment

- i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
- ii) Exposure to Turbo C, gcc
- iii) Writing simple programs using printf(), scanf()

**WEEK 2**

**Objective:** Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

**Suggested Experiments /Activities:**

**Tutorial 2:** Problem-solving using Algorithms and Flow charts.

**Lab 1:** Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

- i) Sum and average of 3 numbers
- ii) Conversion of Fahrenheit to Celsius and vice versa
- iii) Simple interest calculation

**WEEK 3**

**Objective:** Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

**Suggested Experiments/Activities:**

**Tutorial 3:** Variable types and type conversions:

**Lab 3:** Simple computational problems using arithmetic expressions.

- i) Finding the square root of a given number
- ii) Finding compound interest
- iii) Area of a triangle using heron's formulae
- iv) Distance travelled by an object

## UNIT II

### WEEK 4

**Objective:** Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

**Suggested Experiments/Activities:**

**Tutorial4:** Operators and the precedence and as associativity:

**Lab4:** Simple computational problems using the operator' precedence and associativity

- i) Evaluate the following expressions.
  - a.  $A+B*C+(D*E) + F*G$
  - b.  $A/B*C-B+A*D/3$
  - c.  $A+++B---A$
  - d.  $J= (i++) + (++i)$
- ii) Find the maximum of three numbers using conditional operator
- iii) Take marks of 5 subjects in integers, and find the total, average in float

### WEEK 5

**Objective:** Explore the full scope of different variants of “if construct” namely if-else, null else, if-else if\*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for “if construct”.

**Suggested Experiments/Activities:**

**Tutorial 5:** Branching and logical expressions:

**Lab 5:** Problems involving if-then-else structures.

- i) Write a C program to find the max and min of four numbers using if-else.
- ii) Write a C program to generate electricity bill.
- iii) Find the roots of the quadratic equation.
- iv) Write a C program to simulate a calculator using switch case.
- v) Write a C program to find the given year is a leap year or not.

### WEEK 6

**Objective:** Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

**Suggested Experiments/Activities:**

**Tutorial 6:** Loops, while and for loops

**Lab 6:** Iterative problems e.g., the sum of series

- i) Find the factorial of given number using any loop.
- ii) Find the given number is a prime or not.
- iii) Compute sine and cos series
- iv) Checking a number palindrome
- v) Construct a pyramid of numbers.

## UNIT III

### WEEK 7:

**Objective:** Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

**Suggested Experiments/Activities:**

**Tutorial 7:** 1 D Arrays: searching.

**Lab 7:** 1D Array manipulation, linear search

- i) Find the min and max of a 1-D integer array.
- ii) Perform linear search on 1D array.
- iii) The reverse of a 1D integer array
- iv) Find 2's complement of the given binary number.
- v) Eliminate duplicate elements in an array.

**WEEK 8:**

**Objective:** Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

**Suggested Experiments/Activities:**

**Tutorial 8:** 2 D arrays, sorting and Strings.

**Lab 8:** Matrix problems, String operations, Bubble sort

- i) Addition of two matrices
- ii) Multiplication two matrices
- iii) Sort array elements using bubble sort
- iv) Concatenate two strings without built-in functions
- v) Reverse a string using built-in and without built-in string functions

**UNIT IV**

**WEEK 9:**

**Objective:** Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

**Suggested Experiments/Activities:**

**Tutorial 9:** Pointers, structures and dynamic memory allocation

**Lab 9:** Pointers and structures, memory dereference.

- i) Write a C program to find the sum of a 1D array using malloc()
- ii) Write a C program to find the total, average of n students using structures
- iii) Enter n students data using calloc() and display failed students list
- iv) Read student name and marks from the command line and display the student details along with the total.
- v) Write a C program to implement realloc()

**WEEK 10:**

**Objective:** Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

**Suggested Experiments/Activities:**

**Tutorial 10:** Bitfields, Self-Referential Structures, Linked lists

**Lab10 :** Bitfields, linked lists

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

- i) Create and display a singly linked list using self-referential structure.
- ii) Demonstrate the differences between structures and unions using a C program.
- iii) iii)Write a C program to shift/rotate using bitfields.
- iv) Write a C program to copy one structure variable to another structure of the same type.

**UNIT V**

**WEEK 11:**

**Objective:** Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

**Suggested Experiments/Activities:**

**Tutorial 11:** Functions, call by value, scope and extent,

**Lab 11:** Simple functions using call by value, solving differential equations using Eulers theorem.

- i) Write a C function to calculate NCR value.
- ii) Write a C function to find the length of a string.
- iii) Write a C function to transpose of a matrix.
- iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

**WEEK 12:**

**Objective:** Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

**Suggested Experiments/Activities:**

**Tutorial 12:** Recursion, the structure of recursive calls

**Lab 12:** Recursive functions

- i)Write a recursive function to generate Fibonacci series.
- ii)Write a recursive function to find the lcm of two numbers.
- iii)Write a recursive function to find the factorial of a number.

iv) Write a C Program to implement Ackermann function using recursion.

v) Write a recursive function to find the sum of series.

### **WEEK 13:**

**Objective:** Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

#### **Suggested Experiments/Activities:**

**Tutorial 13:** Call by reference, dangling pointers

**Lab 13:** Simple functions using Call by reference, Dangling pointers.

- i) Write a C program to swap two numbers using call by reference.
- ii) Demonstrate Dangling pointer problem using a C program.
- iii) Write a C program to copy one string into another using pointer.
- iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

### **WEEK14:**

**Objective:** To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

#### **Suggested Experiments/Activities:**

**Tutorial 14:** File handling

**Lab 14:** File operations

- i) Write a C program to write and read text into a file.
- ii) Write a C program to write and read text into a binary file using fread() and fwrite()
- iii) Copy the contents of one file to another file.
- iv) Write a C program to merge two files into the third file using command-line arguments.
- v) Find no. of lines, words and characters in a file
- vi) Write a C program to print last n characters of a given file.

#### **Textbooks:**

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

#### **Reference Books:**

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

| I SEMESTER   | L | T | P | C   |
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| 23BS1P02 - NSS/NCC/Scouts & Guides/Community Service |   |   |   |     |

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

**CO1:** Understand the importance of discipline, character and service motto. (K2)

**CO2:** Solve some societal issues by applying acquired knowledge, facts, and techniques. (K2)

**CO3:** Explore human relationships by analyzing social problems. (K3)

**CO4:** Determine to extend their help for the fellow beings and downtrodden people. (K2)

**CO5:** Develop leadership skills and civic responsibilities. (K3)

## UNIT I

### Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

#### Activities:

- Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
- Conducting orientations programs for the students –future plans-activities-releasing road map etc.
- Displaying success stories-motivational biopics- award winning movies on societal issues etc.
- Conducting talent show in singing patriotic songs-paintings- any other contribution.

## UNIT II

### Nature & Care Activities:

- Best out of waste competition.
- Poster and signs making competition to spread environmental awareness.
- Recycling and environmental pollution article writing competition.
- Organising Zero-waste day.
- Digital Environmental awareness activity via various social media platforms.
- Virtual demonstration of different eco-friendly approaches for sustainable living.
- Write a summary on any book related to environmental issues.

## UNIT III

### Community Service Activities:

- Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authoritiesexperts-etc.

- ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
- iii) Conducting consumer Awareness. Explaining various legal provisions etc.
- iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
- v) Any other programmes in collaboration with local charities, NGOs etc.

**Reference Books:**

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;I, VidyaKutir Publication, 2021 ( ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., “Introduction to Environmental Engineering”, McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. “Introduction to Environmental Engineering and Science”, Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

**General Guidelines:**

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

**Evaluation Guidelines:**

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

| II SEMESTER                      | L | T | P | C |
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| 23HS2T01 - Communicative English |   |   |   |   |

**Course Objectives:**

The main objective of introducing this course, *Communicative English*, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

**Course Outcomes:**

**CO1:** Understand the context, topic, and pieces of specific information from social or Transactional dialogues. (K2)

**CO2:** Apply grammatical structures to formulate sentences and correct word forms. (K3)

**CO3:** Analyze discourse markers to speak clearly on a specific topic in informal discussions. (K3)

**CO4:** Evaluate reading / listening texts and to write summaries based on global comprehension of these texts. (K2)

**CO5:** Create a coherent paragraph, essay, and resume. (K2)

**UNIT - I**

**Lesson: HUMAN VALUES: Gift of Magi (Short Story)**

**Listening:** Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

**Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

**Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information.

**Writing:** Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

**Grammar:** Parts of Speech, Basic Sentence Structures-forming questions

**Vocabulary:** Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

**UNIT - II**

**Lesson: NATURE: The Brook by Alfred Tennyson (Poem)**

**Listening:** Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

**Speaking:** Discussion in pairs/small groups on specific topics followed by short structure talks.

**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

**Writing:** Structure of a paragraph - Paragraph writing (specific topics)

**Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions.

**Vocabulary:** Homonyms, Homophones, Homographs.

### UNIT - III

**Lesson: BIOGRAPHY: Elon Musk**

**Listening:** Listening for global comprehension and summarizing what is listened to.

**Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed

**Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

**Writing:** Summarizing, Note-making, paraphrasing

**Grammar:** Verbs - tenses; subject-verb agreement; Compound words, Collocations

**Vocabulary:** Compound words, Collocations

### UNIT - IV

**Lesson: INSPIRATION: The Toys of Peace by Saki**

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

**Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

**Writing:** Letter Writing: Official Letters, Resumes

**Grammar:** Reporting verbs, Direct & Indirect speech, Active & Passive Voice

**Vocabulary:** Words often confused, Jargons

### UNIT - V

**Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)**

**Listening:** Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

**Speaking:** Formal oral presentations on topics from academic contexts

**Reading:** Reading comprehension.

**Writing:** Writing structured essays on specific topics.

**Grammar:** Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

**Vocabulary:** Technical Jargons

**Textbooks:**

1. Pathfinder: Communicative English for Undergraduate Students, 1<sup>st</sup> Edition, Orient Black Swan, 2023

**Reference Books:**

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

| II SEMESTER          | L | T | P | C |
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|                      | 3 | - | - | 3 |
| 23BS2T01 - Chemistry |   |   |   |   |

### Course Objectives:

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- To introduce instrumental methods, molecular machines and switches.

**Course Outcomes:** At the end of the course, the students will be able to:

**CO1:** Compare the materials of construction for battery. (K3)

**CO2:** Explain the preparation, properties, and applications of the thermoplastics, the thermosetting & elastomers conducting polymers. (K2)

**CO3:** Explain the fundamentals of quantum mechanics and molecular orbital theory. (K2)

**CO4:** Apply the principle of Band diagrams in the application of conductors and semiconductors. (K3)

**CO5:** Summarize the concepts of Instrumental methods. (K2)

## UNIT - I

### Electrochemistry and Applications

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry-potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).

Primary cells—Zinc-air battery, Secondary cells—lithium-ion batteries—working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen fuel cell—working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

## UNIT - II

### Modern Engineering materials

Semiconductors—Introduction, basic concept, application Semiconductor preparation by distillation method and purification by Zone refining. Superconductors—Introduction basic concept, applications.

Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon nanotubes and Graphene nanotubes.

## UNIT - III

### Structure and Bonding Models:

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of  $\Psi$  and  $\Psi^2$ , molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of  $H_2$ ,  $O_2$ ,  $N_2$  and  $CO$ , calculation of bond order.

## UNIT - IV

### Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization with specific examples and mechanisms of polymer formation.

Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of –PVC, Teflon, Bakelite, Nylon-6,6.

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline,–mechanism of conduction and applications. Bio-Degradable polymers-PHBV.

## UNIT - V

### Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopies, fundamental modes and selection rules, Instrumentation.

### Text books:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

### Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. J.D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition, Wiley Publications, Feb. 2008
3. Textbook of Polymer Science, Fred W. Billmeyer Jr, 3rd Edition

| <b>II SEMESTER</b>   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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| <b>23BS2T04 - Differential Equations &amp; Vector Calculus</b> |          |          |          |          |

**Course Objectives:**

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

**Course Outcomes:** At the end of the course, the student will be able to

**CO1:** Solve the differential equations related to various engineering fields. (K3)

**CO2:** Identify solution methods for partial differential equations that model physical processes. (K2)

**CO3:** Interpret the physical meaning of different operators such as gradient, curl and divergence. (K2)

**CO4:** Estimate the work done against a field, circulation and flux using vector calculus. (K3)

**UNIT - I**

**Differential equations of first order and first degree**

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

**UNIT - II**

**Linear differential equations of higher order (Constant Coefficients)**

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems.

**UNIT - III**

**Partial Differential Equations**

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

**UNIT - IV**

**Vector differentiation**

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions Gradient, Directional derivative, del applied to vector point functions-Scalar Potential Function-Divergence- Solenoidal and Curl-Irrotational, vector identities.

**UNIT - V**

**Vector integration**

Line integral-circulation-work done, Surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), Volume integral, Divergence theorem (without proof) and related problems.

**Textbooks:**

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44<sup>th</sup> Edition

**Reference book:**

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10<sup>th</sup> Edition

| II SEMESTER  | L | T | P | C |
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| <b>23ME2T01 - Basic Civil &amp; Mechanical Engineering</b> |   |   |   |   |

**PART – A**  
**BASIC CIVIL ENGINEERING**

**Course Objectives:**

1. Get familiarized with the scope and importance of Civil Engineering sub-divisions.
2. Introduce the preliminary concepts of surveying.
3. Acquire preliminary knowledge on Transportation and its importance in nation's economy.
4. Get familiarized with the importance of quality, conveyance and storage of water.
5. Introduction to basic civil engineering materials and construction techniques.

**Course Outcomes:** On completion of the course, the student should be able to:

- CO1:** Understand various sub-divisions of Civil Engineering and to appreciate the role in ensuring better society. (K2)
- CO2:** Know the concepts of surveying and to understand the measurement of distances, angles and levels through surveying. (K1)
- CO3:** Realize the importance of Transportation in nation's economy and the engineering measures related to transportation. (K3)
- CO4:** Understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated. (K2)
- CO5:** Understand the basic characteristics of Civil Engineering Materials and attain knowledge on Prefabricated technology. (K2)

**UNIT I**

**Basics of Civil Engineering:** Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering – Hydraulics and Water Resources Engineering – Environmental Engineering – Scope of each discipline - Building Construction and Planning- Construction Materials- Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

**UNIT II**

**Surveying:** Objectives of Surveying – Horizontal Measurements – Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings- Contour mapping.

**UNIT III**

Transportation Engineering Importance of Transportation in Nation's economic development- Types of Highway Pavements – Flexible Pavements and Rigid Pavements – Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology– Rainwater Harvesting- Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

**Textbooks:**

1. Basic Civil Engineering, M.S.Palanisamy,, Tata Mcgraw Hill publications (India) Pvt.Ltd.Fourth Edition.
2. Introduction to Civil Engineering, S.S.Bhavikatti, New Agenternational Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi,Pearson Publications,2009, First Edition.

**ReferenceBooks:**

1. Surveying, Vol-I and Vol-II, S.K.Duggal, Tata McGrawHill Publishers 2019.FifthEdition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures –Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38<sup>th</sup> Edition.
4. Highway Engineering, S.K.Khanna, C.E.G.Justoand Veeraraghavan, Nemchand and Brothers Publications 2019. 10<sup>th</sup> Edition.
5. Indian Standard DRINKINGWATER—SPECIFICATION IS10500-2012.

**PART – B**  
**BASIC MECHANICAL ENGINEERING**

**Course Objectives:**

The students after completing the course are expected to

1. Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
2. Explain different engineering materials and different manufacturing processes.
3. Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

**Course Outcomes:** On completion of the course, the student should be able to

**CO1:** Understand the different manufacturing processes.(K2)

**CO2:** Explain the basics of thermal engineering and its applications.(K1)

**CO3:** Describe the working of different mechanical power transmission systems and power plants.(K2)

**CO4:** Describe the basics of robotics and its applications. (K2)

**UNIT I**

**Introduction to Mechanical Engineering:** Role of Mechanical Engineering in Industries and Society-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Engineering Materials: Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

**UNIT II**

**Manufacturing Processes:** Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering: Working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

### UNIT III

**Power plants:** Working principle of Steam, Diesel, Hydro, Nuclear power plants. Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

#### Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
2. A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

#### Reference Books:

1. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.
2. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
3. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
4. AppuuKuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I

| II SEMESTER                | L | T | P | C |
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| 23CS2T01 - Data Structures |   |   |   |   |

**Course Objectives:**

- To provide the knowledge of basic datastructures and their implementations.
- To understand importance of datastructures in context of writing efficient programs.
- To develop skills to apply appropriated at a structures in problem solving.

**CourseOutcomes:** At the end of the course, Student will be able to

**CO1:** Acquire the basic concepts of data structures in organizing and accessing data efficiently in algorithms. (K2)

**CO2:** Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation. (K3)

**CO3:** Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems.(K3)

**CO4:** Apply queue-based algorithms for efficient task scheduling and breadth-first traversal ingraphs and distinguish between dequeues and priority queues, and apply them appropriately to solved at a management challenges.(K4)

**CO5:** Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees.(K3)

**CO6:** Design hash-based solutions for specific problems.(K2)

**UNIT - I**

**Introduction to Data Structures:** Definition and classification of data structures,Abstract datatypes(ADTs) and their implementation.Overview of time and space complexity analysis.Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selectionsort,InsertionSort,QuickSort and MergeSort.Timecomplexity analysis for sorting techniques.

**UNIT - II**

**LinkedLists:** Singly linked lists: representation and operations, doubly linked lists and circular linked lists,Comparing arraysand linked lists,Applications of linked lists.

**UNIT - III**

**Stacks:** Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks: Arthematic expression conversions,expression evaluation,backtracking,reversing listand factorial calculation.

**UNIT - IV**

**Queues:** Introduction to queues: properties and operations, implementing queues using arraysand linked lists, circular queue and priority queue Applications of queues in breadth-firstsearch,scheduling.

**Dequeues:**Introductiontodeques(double-endedqueues),Operationsondequesandtheirapplications.

## UNIT - V

**Trees:** Introduction to Trees, properties of Trees, Binary Search Tree – Insertion, Deletion & Traversal

**Graphs:** Introduction to graphs, properties, representation, Traversal

**Hashing: Brief** introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing, Hashtables: basic implementation and operations, Applications of hashing in unique identifier generation, caching.

### Textbooks:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2<sup>nd</sup> Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008

### Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick

| <b>II SEMESTER</b>                          | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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| <b>23HS2L01 - Communicative English Lab</b> |          |          |          |          |

**Course Outcomes:**

**CO1:** Understand the different aspects of the English language proficiency with emphasis on LSRW skills.

**CO2:** Apply communication skills through various language learning activities.

**CO3:** Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and Speaking comprehension.

**CO4:** Evaluate and exhibit professionalism in participating in debates and group discussions.

**CO5:** Create effective Course Objectives

**List of Topics:**

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

**Suggested Software:**

- Walden Infotech
- Young India Films

**Reference Books:**

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. *Cambridge Academic English (B2)*. CUP, 2012.
4. J. Sethi& P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2<sup>nd</sup> Ed), Kindle, 2013

**Web Resources:**

**Spoken English:**

1. [www.esl-lab.com](http://www.esl-lab.com)
2. [www.englishmedialab.com](http://www.englishmedialab.com)
3. [www.englishinteractive.net](http://www.englishinteractive.net)
4. <https://www.britishcouncil.in/english/online>
5. <http://www.letstalkpodcast.com/>

| II SEMESTER              | L | T | P | C |
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| 23BS2L01 - Chemistry Lab |   |   |   |   |

### Course Objectives:

- Verify the fundamental concepts with experiments.

**Course Outcomes :** At the end of the course, the students will be able to

CO1: Determine the cell constant and conductance of solutions.

CO2: Prepare advanced polymer Bakelite materials.

CO3: Measure the strength of an acid present in secondary batteries.

CO4: Determine the redox potentials and emf.

CO5: Calculate strength of acid in Pb-Acid battery.

### List of Experiments:

1. Conductometric titration of strong acid vs. strong base
2. Conductometric titration of weak acid vs. strong base
3. Potentiometric titration of strong acid vs. strong base
4. Potentiometric titration of weak acid vs. strong base
5. Determination of cell constant and conductance of solutions
6. Potentiometry-determination of redox potentials and emf
7. Determination of Strength of an acid in Pb-Acid battery
8. Preparation of Bakelite
9. Preparation of nanomaterials by precipitation method
10. Estimation of Ferrous ion by Dichrometry

### Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar

| II SEMESTER                     | L | T | P | C   |
|---------------------------------|---|---|---|-----|
|                                 | - | - | 3 | 1.5 |
| 23ME2L01 - Engineering Workshop |   |   |   |     |

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

**CO1.** Measure voltage, current and power in an electrical circuit. (K3)

**CO2.** Measure of Resistance using Wheat stone bridge (K4)

**CO3.** Discover critical field resistance and critical speed of DC shunt generators. (K4)

**CO4.** Investigate the effect of reactive power and power factor in electrical loads. (K5)

#### Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
  - Provide some exercises so that hardware tools and instruments are learned to be used by the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
  - Provide some exercises so that measuring instruments are learned to be used by the students.
3. Components:
  - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
  - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

### PART A: ELECTRICAL ENGINEERING LAB

#### List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

**Reference Books:**

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

**Note:** Minimum Six Experiments to be performed.

**PART B: ELECTRONICS ENGINEERING LAB**

**Course Objectives:**

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

**Course Outcomes:** At the end of the course, the student will be able to CO1: Identify & testing of various electronic components.

CO2: Understand the usage of electronic measuring instruments.

CO3: Plot and discuss the characteristics of various electron devices. CO4: Explain the operation of a digital circuit.

**List of Experiments:**

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S – R, J-K & D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

**References:**

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021
2. R. P. Jain, Modern Digital Electronics, 4<sup>th</sup> Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits - Conventional Flow Version Pearson Education, 2009

**NOTE:** Minimum Six Experiments to be performed All the experiments shall be implemented using both Hardware and Software

| II SEMESTER                    | L | T | P | C   |
|--------------------------------|---|---|---|-----|
|                                | - | - | 3 | 1.5 |
| 23CS2L01 - Data Structures Lab |   |   |   |     |

**Course Objectives:**

The course aims to strengthen the ability of the students to identify and apply the suitable data structure for the given real-world problem. It enables them to gain knowledge in practical applications of data structures.

**Course Outcomes:** At the end of the course, Student will be able to

CO1: Acquire the basic concepts of data structures in organizing and accessing data efficiently in algorithms. (K2)

CO2: Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation. (K4)

CO3: Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems. (K3)

CO4: Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between deques and priority queues and apply them appropriately to solve data management challenges. (K3)

CO5: Design hash-based solutions for specific problems. (K4)

**List of Experiments:****Exercise-1: Array Manipulation**

- Write a program to reverse an array.
- C program to implement the Searching Techniques – Linear & Binary Search
- C program to implement Sorting Techniques – Bubble, Selection, Insertion Sort, Quick sort and Merge sort.

**Exercise-2: Linked List Implementation**

- Implement a singly linked list and perform insertion and deletion operations.
- Develop a program to reverse a linked list iteratively and recursively.
- Solve problems involving linked list traversal and manipulation.

**Exercise-3: Linked List Applications**

- Create a program to detect and remove duplicates from a linked list.
- Implement a linked list to represent polynomials and perform addition.
- Implement a double-ended queue (deque) with essential operations.

**Exercise-4: Double Linked List Implementation**

- Implement a doubly linked list and perform various operations to understand its properties and applications.
- Implement a circular linked list and perform insertion, deletion, and traversal.

**Exercise-5: Stack Operations**

- Implement a stack using arrays and linked lists.
- Write a program to evaluate a postfix expression using a stack.
- Implement a program to check for balanced parentheses using a stack.

### **Exercise-6: QueueOperations**

- i) Implement a queue using arrays and linked lists.
- ii) Develop a program to simulate a simple printer queue system.
- iii) Solve problems involving circular queues.

### **Exercise-7: Stack and Queue Applications**

- i) Use a stack to evaluate an infix expression and convert it to postfix.
- ii) Create a program to determine whether a given string is a palindrome or not.
- iii) Implement a stack or queue to perform comparison and check for symmetry.

### **Exercise-8: Binary Search Tree**

- i) Implementing a BST using a Linked List.
- ii) Traversing of BST.

### **Exercise-9: Hashing**

- i) Implement a hash table with collision resolution techniques.
- ii) Write a program to implement a simple cache using hashing.

### **Textbooks:**

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2<sup>nd</sup> Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Silicon Press, 2008

### **Reference Books:**

1. Algorithms and Data Structures: The Basic Tool box by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms by Robert Sedgewick.

| II SEMESTER                                     | L | T | P | C   |
|---|---|---|---|-----|
|   | - | - | 1 | 0.5 |
| 23BS1P01 - Health and Wellness, Yoga and Sports |   |   |   |     |

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

- CO1:** Understand the importance of yoga and sports for Physical fitness and sound health. (K1)
- CO2:** Demonstrate an understanding of health-related fitness components. (K2)
- CO3:** Compare and contrast various activities that help enhance their health. (K3)
- CO4:** Assess current personal fitness levels. (K2)
- CO5:** Develop Positive Personality, (K3)

### UNIT - I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

#### Activities:

- i)Organizing health awareness programmes in community ii)Preparation of health profile
- iii)Preparation of chart for balance diet for all age groups

### UNIT - II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

#### Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

### UNIT - III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

#### Activities:

- i)Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
- Practicing general and specific warm up, aerobics ii)Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

**Reference Books:**

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

**General Guidelines:**

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

**Evaluation Guidelines:**

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.

A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

| III SEMESTER                                     | L | T | P | C |
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|  | 3 | - | - | 3 |
| 23BS3T03 : DISCRETE MATHEMATICS AND GRAPH THEORY |   |   |   |   |

**Course Objectives:**

- To introduce the students to the topics and techniques of discrete methods and combinatorial reasoning.
- To introduce a wide variety of applications. The algorithmic approach to the solution of problems is fundamental in discrete mathematics, and this approach reinforces the close ties between this discipline and the area of computer science.

**Course Outcomes:** At the end of the course students will be able to

**CO1:** Comprehend mathematical principles and logic.(K3)

**CO2:** Apply the concepts and perform the basic operations related to sets, relations and Functions.(K3)

**CO3:** Apply counting principles and generating functions to formulate and solve complex Problems.(K3)

**CO4:** Apply fundamental concepts in graph theory.(K3)

**CO5:** Apply graph theory concepts in data structures and net work theory effectively.(K3)

**UNIT-I: Mathematical Logic:****[16 Hrs.]**

**Propositional Calculus:** Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof, **Predicate Calculus:** Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

**UNIT-II: Set Theory:****[16 Hrs.]**

**Sets:** Operations on Sets, Principle of Inclusion-Exclusion (without proof), Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams, **Functions:** Bijective, Composite, Inverse, Permutation, and Recursive Functions.

**UNIT-III: Combinatorics and Recurrence Relations:****[12 Hrs.]**

**Combinatorics:** Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems(without proof).

**Recurrence Relations:**

Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations.

**UNIT-IV: Graph Theory:**

**[12 Hrs.]**

Basic Concepts, Graph Theory and its Applications, Sub graphs, Graph Representations: Adjacency and Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs.

**Unit-V: Multi Graphs**

**[12 Hrs.]**

Multi graphs, Bipartite and Planar Graphs, Euler's Theorem, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Prim's and Kruskal's Algorithms, BFS and DFS Spanning Trees.

**TEXT BOOKS:**

1. Discrete Mathematical Structures with Applications to Computer Science, J.P.Tremblay and P.Manohar, Tata McGraw Hill.
- 2.Mathematical Foundation for Computer Science, S.Santha, E.V.Prasad, Cengage Publications.

**REFERENCE BOOKS:**

- 1.Discrete Mathematics for Computer Scientists and Mathematicians, J.L.Mott, A.Kandel and T.P.Baker, 2ndEdition, Prentice Hall of India.
- 2.Mathematical Foundation of Computer Science, Dr.J.Rajendra Prasad,T.Rama Rao,A.Madhana Mohana Rao,University Science Press.

| III SEMESTER   | L | T | P | C |
|--|---|---|---|---|
|  | 2 | 1 | - | 3 |
| <b>23HS3T01 : UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT</b> |   |   |   |   |

### Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

### Course Outcomes:

**CO1:** Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)

**CO2:** Identify one's self, and one's surroundings (family, society nature) (L1, L2)

**CO3:** Apply what they have learnt to their own self in different day-to-day settings in real life (L3)

**CO4:** Relate human values with human relationship and human society. (L4)

**CO5:** Justify the need for universal human values and harmonious existence (L5)

**CO6:** Develop as socially and ecologically responsible engineers (L3, L6)

### Course Topics:

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1- hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

**UNIT -I:**

Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility

(Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: self-exploration as the Process for Value Education

Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

**UNIT - II:**

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.

Lecture 9: The body as an Instrument of the self

Lecture 10: Understanding Harmony in the self

Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self

Lecture 11: Harmony of the self with the body

Lecture 12: Programme to ensure self-regulation and Health

Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

**UNIT – III:**

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 15: 'Respect' – as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in Human-to-Human Relationship

Lecture 17: Other Feelings, Justice in Human-to-Human Relationship

Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order

Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

#### **UNIT – IV:**

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

#### **UNIT - V:**

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values Lecture 24:

Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models- Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education PS1 Sharing about Oneself

PS2 Exploring Human Consciousness PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being PS4 Exploring the difference of Needs of self and body

PS5 Exploring Sources of Imagination in the self PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society PS7

Exploring the Feeling of Trust

PS8 Exploring the Feeling of Respect

PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature

PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order

## **Readings:**

### **Textbook and Teachers Manual**

a. The Textbook

R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

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

## **Reference Books:**

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

### **Mode of Conduct:**

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than "extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions

commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

**Online Resources:**

1. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf>
2. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf>
3. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf>
4. <https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%202023.pdf>
5. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf>
6. <https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf>
7. <https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf>
8. <https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385>
9. [https://onlinecourses.swayam2.ac.in/aic22\\_ge23/preview](https://onlinecourses.swayam2.ac.in/aic22_ge23/preview)

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| <b>III SEMESTER</b>                            | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>23CD3T01 : INTRODUCTION TO DATA SCIENCE</b> |          |          |          |          |

**COURSE OBJECTIVES:** From the course the student will learn

1. Knowledge and expertise to become a data scientist.
2. Essential concepts of statistics and machine learning that are vital for data science;
3. Significance of exploratory data analysis (EDA) in data science.
4. Critically evaluate data visualizations presented on the dashboards
5. Suitability and limitations of tools and techniques related to data science process

### **Course Outcomes:**

**CO1:** To Understand the data science process from defining goals to presenting findings.

**CO2:** Apply Python tools like sklearn for modeling and prediction in data science projects and implement techniques for efficiently handling and analyzing large datasets in data science.

**CO3:** Utilize NoSQL databases like Hadoop for distributed storage and processing in data science applications.

**CO4:** Use tools such as Neo4j for managing graph databases and Python libraries for text mining in data science projects.

**CO5:** Create interactive data visualizations and prototype applications for effective data presentation and analysis

### **UNIT - I:**

**[16 Hrs.]**

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science

**Data Science process:** Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them

### **UNIT - II:**

**[14Hrs.]**

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning

**Handling large data:** problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

**UNIT - III:**

**[15 Hrs.]**

**NoSQL movement for handling Bigdata:** Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling

**UNIT - IV:**

**[14 Hrs.]**

**Tools and Applications of Data Science:** Introducing **Neo4j** for dealing with graph databases, graph query language **Cypher**, Applications graph databases, Python libraries like **nlTK** and **SQLite** for handling Text mining and analytics, case study on classifying Reddit posts

**UNIT V:**

**[14 Hrs.]**

**Data Visualization and Prototype Application Development:** Data Visualization options, **Crossfilter**, the JavaScript **MapReduce** library, Creating an interactive dashboard with **dc.js**, Dashboard development tools.

Applying the Data Science process for real world problem solving scenarios as a detailed case study.

**Textbook:**

- 1) Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, “Introducing to Data Science using Python tools”, Manning Publications Co, Dreamtech press, 2016
- 2) Prateek Gupta, “Data Science with Jupyter” BPB publishers, 2019 for basics

**Reference Books:**

- 1) Joel Grus, “Data Science From Scratch”, OReilly, 2019
- 2) Doing Data Science: Straight Talk From The Frontline, 1 st Edition, Cathy O’Neil and Rachel Schutt, O’Reilly, 2013

| III SEMESTER                                     | L | T | P | C |
|--|---|---|---|---|
|  | 3 | - | - | 3 |
| 23CS3T02 : ADVANCED DATA STRUCTURES & ALGORITHMS |   |   |   |   |

### Course Objectives:

The main objectives of the course is to

- provide knowledge on advance data structures frequently used in Computer Sciencedomain
- Develop skills in algorithm design techniques popularly used
- Understand the use of various data structures in the algorithm design

### Course Outcomes:

**CO1:** Discover the performance of an algorithm using asymptotic notation. (K2)

**CO2:** Use divide and conquer technique to solve problems.(K3)

**CO3:** Understand greedy and dynamic programming techniques to solve efficient solutions for optimization problem.(K3)

**CO4:** Recognize problems suitable for back tracking, branch and bound solutions.(K1)

**CO5:** Understand the complexity classes NP-Hard and NP-Complete and solve related decision problems.(K2)

### UNIT-I:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.

AVL Trees – Creation, Insertion, Deletion operations and Applications

B-trees – Creation, Insertion, Deletion operations and Applications

### UNIT-II:

HeapTrees (PriorityQueues)–MinandMaxHeaps,OperationsandApplications

**Graphs**–Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications

### UNIT-III:

**Divide and Conquer:** The General Method, Quick Sort, Merge Sort, Strassen’s matrix multiplication.

**Greedy Method:** General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths

## UNIT-IV:

**Dynamic Programming:** General Method, All pairs shortest paths, Single Source Shortest Paths– General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem

**Backtracking:** General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem

## UNIT-V:

**Branch and Bound:** The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem.

**NP Hard and NP Complete Problems:** Basic Concepts, Cook's theorem NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP).

## Text Books:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press
2. Computer Algorithms/C++ Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran 2nd Edition University Press

## Reference Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson, McGrawHill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. Data Structures using C & C++: Langsam, Augenstein & Tanenbaum, Pearson, 1995
5. Algorithms + Data Structures & Programs:, N.Wirth, PHI
6. Fundamentals of Data Structures in C++: Horowitz Sahni & Mehta, Galgottia Pub.
7. Data structures in Java:, Thomas Standish, Pearson Education Asia

## Online Learning Resources:

1. [https://www.tutorialspoint.com/advanced\\_data\\_structures/index.asp](https://www.tutorialspoint.com/advanced_data_structures/index.asp)
2. <http://peterindia.net/Algorithms.html>
3. Abdul Bari, 1. Introduction to Algorithms (youtube.com)
4. <https://www.swarnandhra.ac.in/dsv>
5. [bit.ly/BRK\\_DSV](https://bit.ly/BRK_DSV)

| III SEMESTER                                  | L | T | P | C |
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| <b>23CS3T03 : DATABASE MANAGEMENT SYSTEMS</b> |   |   |   |   |

### Course Objectives:

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

### Course Outcomes:

**CO1:** Understand database systems, characteristics, architectures, and ER modeling. (K2)

**CO2:** Learn the relational model, constraints, and basic SQL operations. (K1)

**CO3:** Perform advanced SQL queries and manage relational databases. (K2)

**CO4:** Apply normalization techniques and understand functional dependencies. (K3)

**CO5:** Grasp transaction properties, concurrency control, recovery, and indexing methods (K2)

### UNIT I:

[14 Hrs]

**Introduction:** Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**Entity Relationship Model:** Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

**Unit II:**

**[13 Hrs]**

**Relational Model:** Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

**UNIT III:**

**[13 Hrs]**

**SQL:** Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion). Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub

queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non-updatable), relational set operations.

**UNIT IV:**

**[14 Hrs]**

**Schema Refinement (Normalization):** Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), MVD, Fourth normal form (4NF), Fifth Normal Form (5NF).

**UNIT V:**

**[12 Hrs]**

**Transaction Concept:** Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

**Introduction to Indexing Techniques:** B+ Trees, operations on B+ Trees, Hash Based Indexing:

### Text Books:

- 1) Database Management Systems, 3<sup>rd</sup> edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
- 2) Database System Concepts, 5<sup>th</sup> edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

### Reference Books:

1. Introduction to Database Systems, 8<sup>th</sup> edition, C J Date, Pearson.
2. Database Management System, 6<sup>th</sup> edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

### Web-Resources:

1. <https://nptel.ac.in/courses/106/105/106105175/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01275806667282022456\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview)

| III SEMESTER                       | L | T | P | C   |
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| <b>23CD3L01 : DATA SCIENCE LAB</b> |   |   |   |     |

### Course Objectives:

- The main objective of the course is to inculcate the basic understanding of DataScience and its practical implementation using Python.

### List of Experiments

- Creating a NumPy Array
  - Basic ndarray
  - Array of zeros
  - Array of ones
  - Random numbers in ndarray
  - An array of your choice
  - Imatrix in NumPy
  - Evenly spaced ndarray
- The Shape and Reshaping of NumPy Array
  - Dimensions of NumPy array
  - Shape of NumPy array
  - Size of NumPy array
  - Reshaping a NumPy array
  - Flattening a NumPy array
  - Transpose of a NumPy array
- Expanding and Squeezing a NumPy Array
  - Expanding a NumPy array
  - Squeezing a NumPy array
  - Sorting in NumPy Arrays
- Indexing and Slicing of NumPy Array
  - Slicing 1-D NumPy arrays
  - Slicing 2-D NumPy arrays
  - Slicing 3-D NumPy arrays
  - Negative slicing of NumPy arrays
- Stacking and Concatenating Numpy Arrays
  - Stacking ndarrays
  - Concatenating ndarrays
  - Broadcasting in Numpy Arrays
- Perform following operations using pandas
  - Creating dataframe
  - concat()
  - Setting conditions
  - Adding a new column

7. Perform following operations using pandas
  - a. Filling NaN with string
  - b. Sorting based on column values
  - c. groupby()
8. Read the following file formats using pandas
  - a. Text files
  - b. CSV files
  - c. Excel files
  - d. JSON files
9. Read the following file formats
  - a. Pickle files
  - b. Image files using PIL
  - c. Multiple files using Glob
  - d. Importing data from database
10. Demonstrate web scraping using python
11. Perform following preprocessing techniques on loan prediction dataset
  - a. Feature Scaling
  - b. Feature Standardization
  - c. Label Encoding
  - d. One Hot Encoding
12. Perform following visualizations using matplotlib
  - a. Bar Graph
  - b. Pie Chart
  - c. Box Plot
  - d. Histogram
  - e. Line Chart and Subplots
  - f. Scatter Plot
13. Getting started with NLTK, install NLTK using PIP
14. Python program to implement with Python Sci Kit-Learn & NLTK
15. Python program to implement with Python NLTK/Spicy/Py NLPI.

### Web References:

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/>
3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/>
4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-exploration-python/6>.
6. <https://www.nltk.org/book/ch01.html>

| III SEMESTER                                      | L | T | P | C   |
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| <b>23CS3L02 : DATABASE MANAGEMENT SYSTEMS LAB</b> |   |   |   |     |

### Course Objectives:

This Course will enable students to

- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers,

### Experiments covering the topics:

- DDL, DML, DCL commands
- Queries, nested queries, built-in functions,
- PL/SQL programming- control structures
- Procedures, Functions, Cursors, Triggers,
- Database connectivity- ODBC/JDBC

### Sample Experiments:

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to\_char, to\_number and to\_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next\_day, add\_months, last\_day, months\_between, least, greatest, trunc, round, to\_char, to\_date)
5.
  - i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
  - ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.

6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT -IN Exceptions, USE defined Exceptions, RAISE- APPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Create a table and perform the search operation on table using indexing and non-indexing techniques.
13. Write a Java program that connects to a database using JDBC
14. Write a Java program to connect to a database using JDBC and insert values into it
15. Write a Java program to connect to a database using JDBC and delete values from it

### Text Books/Suggested Reading:

1. Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007

| III SEMESTER  | L | T | P | C |
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| <b>23AM3S01 : PYTHON PROGRAMMING (Skill Enhancement Course)</b> |   |   |   |   |

## Course objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these

## Course Outcomes:

**CO1:** Understand the historical context and evolution of Python.

**CO2:** Develop problem-solving skills through hands-on exercises and projects involving functions, strings, and lists.

**CO3:** Apply built-in functions, methods, and constructors effectively to manipulate dictionaries, tuples, and sets.

**CO4:** Understand and implement OOP concepts such as classes, objects, inheritance, polymorphism, and encapsulation.

**CO5:** Apply Python's libraries and modules effectively to address real-world data science challenges.

## UNIT -I:

[9 Hrs]

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

**Parts of Python Programming Language:** Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

**Control Flow Statements:** if statement, if-else statement, if...elif...else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

## Sample Experiments:

- Write a program to find the largest element among three Numbers.
- Write a Program to display all prime numbers within an interval
- Write a program to swap two numbers without using a temporary variable.

4. Demonstrate the following Operators in Python with suitable examples.
  - i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators
  - v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

## UNIT -II:

[8 Hrs]

**Functions:** Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, \*args and \*\*kwargs, Command Line Arguments. **Strings:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

**Lists:** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

### Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list:
  - i. Addition ii. Insertion iii. slicing
6. Write a program to perform any 5 built-in functions by taking any list.

## UNIT - III:

[6 Hrs]

**Dictionaries:** Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

**Tuples and Sets:** Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

### Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.
4. Write a program to add a new key-value pair to an existing dictionary.
5. Write a program to sum all the items in a given dictionary.

#### UNIT - IV:

[6 Hrs]

**Files:** Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

**Object-Oriented Programming:** Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

#### Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Python program to print each line of a file in reverse order.
3. Python program to compute the number of characters, words and lines in a file.
4. Write a program to create, display, append, insert and reverse the order of the items in the array.
5. Write a program to add, transpose and multiply two matrices.
6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

#### UNIT-V:

[6 Hrs]

**Introduction to Data Science:** Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

#### Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
  - a) Apply head () function to the pandas data frame
  - b) Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

### Reference Books:

1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2<sup>nd</sup> Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

### Online Learning Resources/Virtual Labs:

1. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
2. <https://www.coursera.org/learn/python?specialization=python#syllabus>

| III SEMESTER                     | L | T | P | C |
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| 23BS3M01 : ENVIRONMENTAL SCIENCE |   |   |   |   |

### Course Objectives:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

### Course Outcomes:

- CO1:** Grasp multidisciplinary nature of environmental studies and various renewable and non-renewable resources. (K2)
- CO2:** Understand flow and bio-geo-chemical cycles and ecological pyramids. (K2)
- CO3:** Understand various causes of pollution and solid waste management and related preventive measures. (K2)
- CO4:** About the rain water harvesting, watershed management, ozone layer depletion and waste land reclamation. (K1)
- CO5:** Causes of population explosion, value education and welfare programmes. (K2)

### UNIT- I :

[8 Hrs]

Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

## **UNIT– II :**

**[8 Hrs]**

Ecosystems: Concept to an ecosystem.–Structure and function of an ecosystem– Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession –Food chains, food webs and ecological pyramids–Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation: Introduction Definition: genetic, species and ecosystem diversity–Bio-geographical classification of India–Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts– Endangered and endemic species of India –Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

## **UNIT– III :**

**[8 Hrs]**

Environmental Pollution: Definition, Cause, effects and control measures of:

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

## **UNIT–IV :**

**[8 Hrs]**

Social Issues and the Environment: From Unsustainable to Sustainable development– Urban problems related to energy – Water conservation, rain water harvesting, watershed management –Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions–Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act–Wild life Protection Act–Forest Conservation Act–Issues involved in enforcement of environment legislation–Public awareness.

## **UNIT–V :**

**[8 Hrs]**

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education–HIV/AIDS–Women and Child Welfare–Role of information Technology in Environment and human health–Case studies. Field Work: Visit to a local area to document environmental assets River/ forest grassland/ hill/ mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds–river, hills, etc..

### **Text books:**

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson Education
3. S. Azeemunnisa, “Environmental Studies” Academic Publishing Company
4. K. Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

### **Reference Books:**

1. Deeksha Dave and E. Sai Baba Reddy, “Text book of Environmental Science”, Cengage Publications.
2. M. Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J. P. Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private limited
5. G. R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science”, Prentice Hall of India Private limited.

| IV SEMESTER                        | L | T | P | C |
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| 23BS4T03 : OPTIMIZATION TECHNIQUES |   |   |   |   |

**Course Objectives:**

1. To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
2. To state single variable and multi variable optimization problems, without and with constraints.
3. To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
4. To state transportation and assignment problem as a linear programming problem to determine Simplex method.
5. To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.

**Course Outcomes:** At the end of the course, student will be able to

**CO1:** State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem. (K2)

**CO2:** Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution. (K3)

**CO3:** Apply and Solve transportation and assignment problem by using Linear programming Simplex method. (K3)

**CO4:** Apply gradient and non-gradient methods to nonlinear optimization problems and use Interior or exterior penalty functions for the constraints to derive the optimal solutions. (K3)

**CO5:** Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution. (K3)

**UNIT -I: Introduction and Classical Optimization Techniques:**

Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.

**Classical Optimization Techniques:** Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, multivariable Optimization with inequality constraints, Kuhn – Tucker conditions

**UNIT -II: Linear Programming :**

Standard form of a linear programming problem, geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm.

**UNIT -III: Transportation Problem:**

Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method, testing for optimality of balanced transportation problems, Special cases in transportation problem.

**UNIT -IV: Nonlinear Programming:**

Unconstrained cases, One – dimensional minimization methods: Classification, Fibonacci method, Univariate method, steepest descent method. Constrained cases– Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method, Basic approaches of Interior and Exterior penalty function methods,

**UNIT -V: Dynamic Programming:**

Dynamic programming multistage decision processes, types, concept of sub optimization and the principle of optimality, computational procedure in dynamic programming, examples illustrating the calculus method of solution, examples illustrating the tabular method of solution.

**Textbooks:**

1. “Engineering optimization: Theory and practice”, S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. “Introductory Operations Research”, H.S. Kasene& K.D. Kumar, Springer (India), Pvt.LTd.

**Reference Books:**

1. “Optimization Methods in Operations Research and systems Analysis”, by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research, Dr.S.D.Sharma, Kedarnath, Ramnath& Co

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| <b>23BS4T03 : STATISTICAL METHODS FOR DATA SCIENCE</b> |          |          |          |          |

**Course Objectives:**

- This course aims at providing knowledge on basic concepts of Statistics, Estimation and testing of hypotheses for large and small samples.

**Course Outcomes:** At the end of the course, the student will be able to

**CO1:** Analyze data and draw conclusion about collection of data and fitting of distributions. (K4)

**CO2:** Analyzing the testing of hypothesis for Large and Small samples. (K4)

**CO3:** Develop skills in problem solving of the regression analysis. (K3)

**CO4:** Understanding the significance of Time Series data in various fields. (K2)

**CO5:** Understanding the classification using Logistic Regression. (K2)

**UNIT-I: Data Visualization and Distributions****[14 Hrs]**

**Data Visualization Techniques:** Introduction to Statistical methods-Exploratory Data Analysis-Charts (Line,Pie,Bar); Plots (Bubble, Scatter); Maps (Heat, Dot Distribution); Diagrams (Trees and Matrices)- Principal Components Analysis.

Introduction to Data Distributions - Probability Distributions – discrete (binomial, Poisson), Continuous Distributions (Normal, exponential).

**UNIT-II: Hypothesis Testing****[12 Hrs]**

Introduction to Parametric Estimation-Parametric Confidence Intervals – Choosing a Statistic-Hypothesis Testing - Parametric test: the T-test-Applications to Hypothesis Tests-Pair wise comparisons.

**UNIT-III: Linear Regression and Multiple Regression****[16 Hrs]**

**Regression:** Linear Regression, Curvilinear Regression: Exponential Regression-Polynomial Regression-Power Model. Practical Examples - The nature of the 'relationship' - Multiple Linear Regression – Important measurements of the regression estimate - Multiple Regression with Categorical Explanatory Variables-Inference in Multiple Regression-Variable Selection.

**UNIT-IV: Time Series**

**[16 Hrs]**

**Time series:** Significance of Time series analysis, Components of Time series, Secular trend: Graphic method, Semi-average method, Method of moving averages, Method of least squares: straight line and non-linear trends, Logarithmic methods–Exponential trends, Growth curves, Seasonal Variations: Method of simple averages, Ratio-to-trend method, ratio-to-moving average method, Link relative method.

**UNIT-V: Logistic Regression**

**[12 Hrs]**

The classification problem – Logistic Regression Setup-Interpreting the Results-Comparing Models- Classification Using Logistic Regression.

**Textbooks:**

1. Elizabeth Purdom, "Statistical methods for Data science"
2. K. Murugesan, P. Gurusamy, "Probability, Statistics and Random Processes"

**Reference Books:**

1. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference–Testing of Hypotheses, Prentice Hall of India, 2014.
2. Robert V Hogg, Elliot A Tannis and Dale L. Zimmerman, Probability and Statistical Inference, 9<sup>th</sup> edition, Pearson publishers, 2013.
3. Chris Chatfield, "The analysis of time series an introduction," 5<sup>th</sup> edition, Chapman & Hall/CRC.
4. Peter J. Brockwell, Richard A. Davis, "Introduction to Time series and Forecasting," Second edition, Springer.

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| <b>IV SEMESTER</b>                      | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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| <b>23AM4T01 : COMPUTER ORGANIZATION</b> |          |          |          |          |

|   |   |            |
|---|---|------------|
| <b>Course Objectives:</b> Students are expected to learn                            |   |            |
| 1.  | Principles and the Implementation of Computer Arithmetic  |            |
| 2.  | Operation of CPUs including RTL, ALU, Instruction Cycle, and Busses   |            |
| 3.  | Functionality of central processing unit and control units  |            |
| 4.  | Memory System and I/O Organization  |            |
| <b>Course Outcomes:</b> After completion of the course, the student will be able to |   |            |
| <b>S.No</b>   | <b>Outcome</b>  | <b>K L</b> |
| CO1   | Identify the basic structure of computer organization   | K3         |
| CO2   | Demonstrate functional components and micro operations in a basic computer system.  | K2         |
| CO3   | Demonstrate various instructions and arithmetic operations  | K3         |
| CO4   | Illustrate knowledge of functional components on central processing unit and various control units.   | K2         |
| CO5   | Determine different memory components in a computer for better memory organization  | K3         |
| CO6   | Explain different ways of communication with I/O devices and standard I/O interface   | K2         |
| <b>SYLLABUS</b>   |   |            |
| <b>UNIT-I<br/>(10 Hrs)</b>  | <b>Basic Structure of Computers:</b> Computer Types, Functional units, Basic operational concepts, Bus structures.<br><b>Register Transfer and Micro operations:</b> Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit.   |            |
| <b>UNIT-II<br/>(08 Hrs)</b>   | <b>Basic Computer Organization and Design:</b> Instruction Codes, Computer Register, Computer Instructions, Instruction Cycle, Memory – Reference Instructions. Input – Output and Interrupt, Complete Computer Description<br><b>Computer Arithmetic:</b> Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations |            |
| <b>UNIT-III<br/>(10 Hrs)</b>  | <b>Central Processing Unit:</b> General Register Organization, STACK Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Execution of a Complete Instruction, Multiple-Bus Organization,<br><b>Microprogrammed Control:</b> Control Memory, Address Sequencing, Micro Program example, Hardwired Control and Micro programmed Control.   |            |

|                             |  |
|-----------------------------|--|
| <b>UNIT-IV<br/>(10 Hrs)</b> | <b>The Memory Organization:</b> Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Requirements, Secondary Storage.  |
| <b>UNIT-V<br/>(12 Hrs.)</b> | <b>Input / Output Organization:</b> Accessing I/O Devices, Interrupts, Processor Examples, modes of transfers, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces. |
|                             |  |
| <b>Text Books:</b>          |  |
| 1.                          | Computer System Architecture, M. M. Mano:3rd ed., Prentice Hall of India, New Delhi, 1993  |
| 2.                          | Computer Organization &Architecture, Pynabananda Chskraborty, 1 <sup>st</sup> Edition, Chapman and Hallkrc,2020.   |
| 3.                          | Computer Organization, Carl Hamacher, ZvonkoVranesic, SafwatZaky, 5/e, McGraw Hill,2002.   |
|                             |  |
| <b>Reference Books:</b>     |  |
| 1.                          | Computer Organization and Architecture, William Stallings, 6/e, Pearson,2006.  |
| 2.                          | Structured Computer Organization, Andrew S. Tanenbaum, 4/e, Pearson,2005.  |
| 3.                          | Fundamentals of Computer Organization and Design, Sivarama P. Dandamudi, Springer, 2006.   |
|                             |  |
| <b>e-Resources</b>          |  |
| 1.                          | <a href="https://nptel.ac.in/courses/106/105/106105163/">https://nptel.ac.in/courses/106/105/106105163/</a>  |
| 2.                          | <a href="http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf">http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf</a>  |

|                                    |          |          |          |          |
|------------------------------------|----------|----------|----------|----------|
| <b>IV SEMESTER</b>                 | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                    | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>23CD4T01 : DATA ENGINEERING</b> |          |          |          |          |

### Course Objectives:

- Explain basic concepts of Data Engineering
- Discuss about Data Engineering Life Cycle
- How to design Good Data Architecture

### Course Outcomes: At the end of the course, student will be able to

**CO1:** Understand the definition, life cycle, skills, roles, and responsibilities of data engineering, and differentiate it from data science. (K1)

**CO2:** Describe the data engineering life cycle stages, including generation, storage, ingestion, transformation, and serving, and recognize key undercurrents like security and data management. (K2)

**CO3:** Design robust data architectures and identify various data generation sources, including files, APIs, databases, and logs, along with their practical details. (K2)

**CO4:** Understand different data storage systems and abstractions, and key considerations for data ingestion, including batch and stream ingestion methods. (K2)

**CO5:** Explain query processing, data modeling, and transformation techniques, and methods for serving data for analytics, machine learning, and reverse ETL. (K3)

### UNIT - I:

**[14Hrs]**

**Introduction to Data Engineering:** Definition, Data Engineering Life Cycle, Evolution of Data Engineer, Data Engineering Versus Data Science, Data Engineering Skills and Activities,

Data Maturity, Data Maturity Model, Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, Data Engineers and Other Technical Roles.

### UNIT - II:

**[12 Hrs]**

**Data Engineering Life Cycle:** Data Life Cycle Versus Data Engineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data.

**Major undercurrents across the Data Engineering Life Cycle:** Security, Data Management, DataOps, Data Architecture, Orchestration, Software Engineering.

### **UNIT - III:**

**[10 Hrs]**

**Designing Good Data Architecture:** Enterprise Architecture, Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts.

**Data Generation in Source Systems:** Sources of Data, Files and Unstructured Data, APIs, Application Databases (OLTP), OLAP, Change Data Capture, Logs, Database Logs, CRUD, Source System Practical Details.

### **UNIT - IV:**

**[12 Hrs]**

**Storage:** Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lakehouse.

**Ingestion:** Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data

### **UNIT - V:**

**[12 Hrs]**

**Queries, Modeling and Transformation:** Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modelling, Modeling Streaming Data, Transformations, Streaming Transformations and Processing.

**Serving Data for Analytics, Machine Learning and Reverse ETL:** General Considerations for serving Data, Business Analytics, Operational Analytics, Embedded Analytics, Ways to serve data for analytics and ML, Reverse ETL.

#### **Text Books:**

1. Joe Reis, Matt Housley, Fundamentals of Data Engineering, O'Reilly Media, Inc., June 2022, ISBN: 9781098108304

#### **Reference Books:**

1. Paul Crickard , Data Engineering with Python, Packt Publishing, October 2020.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley, 3rd Edition, 2013
3. James Densmore, Data Pipelines Pocket Reference: Moving and Processing Data for Analytics, O'Reilly Media, 1st Edition, 2021

| IV SEMESTER  | L | T | P | C |
|--|---|---|---|---|
|  | 3 | - | - | 3 |
| <b>23CS4T02 : OBJECT-ORIENTED PROGRAMMING THROUGH JAVA</b> |   |   |   |   |

**Course Objectives:** The learning objectives of this course are to:

- identify Java language components and how they work together in applications
- learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- understand how to design applications with threads in Java
- understand how to use Java APIs for program development

### **Course Outcomes:**

**CO1:** Identify and utilize Java language components effectively in applications. (K1)

**CO2:** Implement object-oriented programming principles using Java. (K2)

**CO3:** Extend Java classes with inheritance and handle exceptions in applications (K3)

**CO4:** Design multi-threaded applications in Java. (K4)

**CO5:** Use Java APIs for program development and database connectivity. (K3)

### **UNIT I:**

**Object Oriented Programming:** Basic concepts: Object, Class, Abstraction, Encapsulation, Inheritance, Polymorphism, Dynamic binding and Message passing. Program Structure in Java: Introduction, Elements or Tokens in Java, Command Line Arguments, User Input to Programs.

**Data Types, Variables, and Operators:** Introduction, Data Types in Java, Declaration of Variables, Type Casting, Scope of Variable, Static Variables and Methods,

**Introduction to Operators,** Types of operators, Precedence and Associativity of Operators,

**Control Statements:** Introduction, if Expression, Nested if Expressions, if-else Expressions, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each Loop, Break Statement, Continue Statement.

## UNIT II:

**Classes and Objects:** Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

**Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

## UNIT III:

**Arrays:** Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Multidimensional arrays.

**Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

**Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

## UNIT IV:

**Packages and Java Library:** Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class.

**Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

## UNIT V:

**String Handling in Java:** Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

**Multithreaded Programming:** Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of NewThreads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

**Java Database Connectivity:** Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface

### **Text Books:**

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4<sup>th</sup> Edition, Pearson.

### **References Books:**

1. The complete Reference Java, 11<sup>th</sup>edition, Herbert Schildt,TMH
2. Introduction to Java programming, 7<sup>th</sup> Edition, Y Daniel Liang, Pearson

### **Online Resources:**

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012880464547618816347\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview)

| IV SEMESTER                     | L | T | P | C   |
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| 23CD4L01 : DATA ENGINEERING LAB |   |   |   |     |

### Course Objective:

- The main objective of this course is to teach how build data engineering infrastructure and data pipelines.

**Course Outcomes:** At the end of the course student will be able to:

- CO1: Build our Data Engineering Infrastructure (K2)
- CO2: Demonstrate Reading and Writing files (K1)
- CO3: Build Data Pipelines and integrate with Dashboard (K2)
- CO4: Deploy the Data Pipeline in production (K3)

### Experiments:

- Installing and configuring Apache NiFi, Apache Airflow
- Installing and configuring Elasticsearch, Kibana, PostgreSQL, pgAdmin 4
- Reading and Writing files
  - Reading and writing files in Python
  - Processing files in Airflow
  - NiFi processors for handling files
  - Reading and writing data to databases in Python
  - Databases in Airflow
  - Database processors in NiFi
- Working with Databases
  - Inserting and extracting relational data in Python
  - Inserting and extracting NoSQL database data in Python
  - Building database pipelines in Airflow
  - Building database pipelines in NiFi
- Cleaning, Transforming and Enriching Data
  - Performing exploratory data analysis in Python
  - Handling common data issues using pandas
  - Cleaning data using Airflow
- Building the Data Pipeline
- Building a Kibana Dash Board
- Perform the following operations
  - Staging and validating data
  - Building idempotent data pipelines
  - Building atomic data pipelines

9. Version Control with the NiFi Registry
  - a. Installing and configuring the NiFi Registry
  - b. Using the Registry in NiFi
  - c. Versioning your data pipelines
  - d. Using git-persistence with the NiFi Registry
10. Monitoring Data Pipelines
  - a. Monitoring NiFi in the GUI
  - b. Monitoring NiFi using processors
  - c. Monitoring NiFi with Python and the REST API
11. Deploying Data Pipelines
  - a. Finalizing your data pipelines for production
  - b. Using the NiFi variable registry
  - c. Deploying your data pipelines
12. Building a Production Data Pipeline
  - a. Creating a test and production environment
  - b. Building a production data pipeline
  - c. Deploying a data pipeline in production

## Reference Books:

1. Paul Crickard , Data Engineering with Python, Packt Publishing, October 2020.

| IV SEMESTER  | L | T | P | C   |
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| <b>23CS4L02 : OBJECT-ORIENTED PROGRAMMING THROUGH<br/>JAVA LAB</b> |   |   |   |     |

**Course Objectives:** The aim of this course is to

- Practice object oriented programming in the Java programming language
- implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrate inheritance, Exception handling mechanism, JDBC connectivity
- Construct Threads, Event Handling, implement packages, Java FX GUI

**Experiments covering the Topics:**

- Object Oriented Programming fundamentals- data types, control structures
- Classes, methods, objects, Inheritance, polymorphism,
- Exception handling, Threads, Packages, Interfaces
- Files, I/O streams, JavaFX GUI

**Sample Experiments:**

**Exercise – 1:**

- Write a JAVA program to display default value of all primitive data type of JAVA
- Write a java program that display the roots of a quadratic equation  $ax^2+bx=0$ . Calculate the discriminate D and basing on value of D, describe the nature of root.

**Exercise - 2**

- Write a JAVA program using StringBuffer to delete, remove character.
- Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.

**Exercise - 3**

- Write a JAVA program implement method overloading.
- Write a JAVA program to implement constructor.
- Write a JAVA program to implement constructor overloading.

**Exercise - 4**

- Write a JAVA program to implement Single Inheritance
- Write a JAVA program to implement multi level Inheritance
- Write a JAVA program for abstract class to find areas of different shapes

### Exercise - 5

- a) Write a JAVA program give example for “super” keyword.
- b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?
- c) Write a JAVA program that implements Runtime polymorphism

### Exercise - 6

- a) Write a JAVA program that describes exception handling mechanism
- b) Write a JAVA program Illustrating Multiple catch clauses
  - Write a JAVA program for creation of Java Built-in Exceptions
  - Write a JAVA program for creation of User Defined Exception

### Exercise - 7

- a) Write a JAVA program that creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds, (Repeat the same by implementing Runnable)
- b) Write a program illustrating **is Alive** and **join ()**
- c) Write a Program illustrating Daemon Threads.

### Exercise – 8

- a) Write a java program that connects to a database using JDBC
- b) Write a java program to connect to a database using JDBC and insert values into it.
- c) Write a java program to connect to a database using JDBC and delete values from it

### Online Learning Resources:

1. <https://www.javatpoint.com/java-tutorial>
2. <https://mkyong.com/tutorials/java-8-tutorials/>

| V SEMESTER   | L | T | P | C |
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| <b>23CD4S01 : DATA VISUALIZATION USING POWER BI</b><br><b>(SKILL DEVELOPMENT COURSE)</b> |   |   |   |   |

**Course objectives:**

1. Understand the Importance of data Visualization for business intelligence and decision making.
2. Learn different approaches to understand the importance of visual perception.
3. Learn different data visualization techniques and tools.
4. Gain knowledge of effective data visuals to solve workplace problems.

**Course outcomes:**

CO1: Design the experiment to create basic charts and graphs using Power BI. (K2)

CO2: Develop the solution for the given real world problem. (K3)

CO3: Analyze the results and produce substantial written documentation. (K3)

**List Of Experiments:**

**1.Introducing Power BI** –Components and the flow of work. Power BI Desktop Interface-The Report has five main areas.

**2.Querying Data from CSV** - Query Editor, Connecting the data from the Excel Source, Clean, Transform the data.

**3.Creating Reports & Visualizations** - Different types of charts, Formatting charts with Title, Colors.

**4.Dashboards** - Filters in Power BI, Formatting dashboards.

**5.Analysis of revenue in sales dataset:**

- i) Create a choropleth map (fill the map) to spot the special trends to show the state which has the highest revenue.
- ii) Create a line chart to show the revenue based on the month of the year.
- iii) Create a bin of size 10 for the age measure to create a new dimension to show the revenue.

**6. What insights can be drawn from the revenue in the sales dataset?**

- i) Create a donut chart view to show the percentage of revenue per region by creating zero access in the calculated field.
- ii) Create a butterfly chart by reversing the bar chart to compare female & male revenue based on product category.
- iii) Create a calculated field to show the average revenue per state & display profitable & non-profitable state.
- iv) Build a dashboard.

### **7. Analysis of GDP dataset:**

- i) Visualize the countries data given in the dataset with respect to latitude and longitude along with country name using symbol maps.
- ii) Create a bar graph to compare GDP of Belgium between 2006 – 2026.
- iii) Using pie chart, visualize the GDP of India, Nepal, Romania, South Asia, Singapore by the year 2010.

### **8. What patterns can be identified in the GDP data over time?**

- i) Visualize the countries Bhutan & Costa Rica competing in terms of GDP.
- ii) Create a scatter plot or circle views of GDP of Mexico, Algeria, Fiji, Estonia from 2004 to 2006.
- iii) Build an interactive dashboard.

### **9. Analysis of HR Dataset:**

- i) Create KPI to show employee count, attrition count, attrition rate, attrition count, active employees, and average age.
- ii) Create a Lollipop Chart to show the attrition rate based on gender category.
- iii) Create a pie chart to show the attrition percentage based on Department Category- Drag department into colours and change automatic to pie. Entire view, Drag attrition count to angle. Label attrition count, change to percent, add total also, edit label.

### **10. What key factors can be identified in the HR dataset regarding employee performance?**

- i) Create a bar chart to display the number of employees by Age group.
- ii) Create a highlight table to show the Job Satisfaction Rating for each job role based on employee count.
- iii) Create a horizontal bar chart to show the attrition count for each Education field Education field wise attrition – drag education field to rows, sum attrition count to col.
- iv) Create multiple donut chart to show the Attrition Rate by Gender for different Age group.

### **11. Analysis of Amazon Prime Dataset:**

- i) Create a Donut chart to show the percentage of movie and tv shows.
- ii) Create a area chart to shows by release year and type.
- iii) Create a horizontal bar chart to show Top 10 genre.

### **12. What insights can we gain from the Amazon Prime dataset?**

- i) Create a map to display total shows by country.
- ii) Create a text sheet to show the description of any movie/movies.
- iii) Build an interactive Dashboard.

### **Reference Books:**

1. Microsoft Power BI Dashboards Step by Step by Errin O'Connor, 2019 by Pearson Education, Inc
2. Information Dashboard Design: Displaying Data for At-a-glance Monitoring” by Stephen Few.

### **Online Learning Resources:**

3. <https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-home.htm>
4. [https://www.tutorialspoint.com/power\\_bi/index.htm](https://www.tutorialspoint.com/power_bi/index.htm)
5. <https://www.simplilearn.com/tutorials/power-bi-tutorial/power-bi-vs-tableau>

| IV SEMESTER  | L | T | P | C |
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| <b>23CD4Z01 : DESIGN THINKING &amp; INNOVATION</b> |   |   |   |   |

**Course Objectives:** The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

**Course Outcomes:**

| COs | Statements  | Blooms Level |
|-----|---|--------------|
| CO1 | Define the concepts related to design thinking.                               | K1           |
| CO2 | Explain the fundamentals of Design Thinking and innovation.                   | K2           |
| CO3 | Apply the design thinking techniques for solving problems in various sectors. | K3           |
| CO4 | Analyse to work in a multidisciplinary environment.                           | K4           |
| CO5 | Evaluate the value of creativity.   | K5           |

### **UNIT – I Introduction to Design Thinking**

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

### **UNIT - II Design Thinking Process**

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

**Activity:** Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

### **UNIT - III Innovation**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

**Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

#### **UNIT - IV      Product Design**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

**Activity:** Importance of modeling, how to set specifications, Explaining their own product design.

#### **UNIT – V      Design Thinking in Business Processes**

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

**Activity:** How to market our own product, about maintenance, Reliability and plan for startup.

#### **Text Books:**

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

#### **Reference Books:**

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e,Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

#### **Online Learning Resources:**

- <https://nptel.ac.in/courses/110/106/110106124/>
- <https://nptel.ac.in/courses/109/104/109104109/>
- [https://swayam.gov.in/nd1\\_noc19\\_mg60/preview](https://swayam.gov.in/nd1_noc19_mg60/preview)
- [https://onlinecourses.nptel.ac.in/noc22\\_de16/preview](https://onlinecourses.nptel.ac.in/noc22_de16/preview)