**MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)**
**B.Tech in Mechanical Engineering (Mechatronics)**
Scheme of Instruction and Examination
**(Choice Based Credit System)**
Applicable from the Academic Year 2022-23

## I SEMESTER

| S.No | Course Code | Course Title | Instruction | | | Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Hours Per Week | | | Max. Marks | | Duration of SEE in Hours | |
| | | | L | T | P/D | CIE | SEE | | |
| 1. | MA101BS | Matrices and Calculus | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 2. | PH101BS | Applied Physics | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 3. | CS102ES | C Programming and Data Structures | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 4. | EN101HS | English for Skill Enhancement | 2 | 0 | 0 | 40 | 60 | 3 | 2 |
| 5. | PH151BS | Applied Physics Laboratory | 0 | 0 | 3 | 40 | 60 | 3 | 1.5 |
| 6. | CS152ES | C Programming and Data Structures Laboratory | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 7. | EN151HS | English Language and Communication Skills Laboratory | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 8. | MT151PC | Elements of Mechatronics Engineering | 0 | 0 | 2 | 50 | - | - | 1 |
| 9. | ME151ES | Engineering Workshop | 0 | 1 | 3 | 40 | 60 | 3 | 2.5 |
| 10. | - | Induction Programme | - | - | - | - | - | - | - |
| **Total Hours/Marks/Credits** | | | **11** | **3** | **12** | **370** | **480** | **-** | **20** |

## II SEMESTER

| S.No | Course Code | Course Title | Instruction | | | Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Hours Per Week | | | Max. Marks | | Duration of SEE in Hours | |
| | | | L | T | P/D | CIE | SEE | | |
| 1. | MA201BS | Ordinary Differential Equations and Vector Calculus | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 2. | CH201BS | Engineering Chemistry | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 3. | ME201ES | Engineering Graphics | 1 | 0 | 4 | 40 | 60 | 3 | 3 |
| 4. | ME202ES | Engineering Mechanics | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 5. | MM201ES | Engineering Materials | 2 | 0 | 0 | 40 | 60 | 3 | 2 |
| 6. | CH251BS | Engineering Chemistry Laboratory | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 7. | CS251ES | Python Programming Laboratory | 0 | 1 | 2 | 40 | 60 | 3 | 2 |
| 8. | MM251ES | Fuels & Lubricants Laboratory | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 9. | MC201BS | Environmental Science | 3 | 0 | 0 | 40 | 60 | 3 | 0 |
| **Total Hours/Marks/Credits** | | | **15** | **3** | **10** | **360** | **540** | **-** | **20** |

L: Lecture T: Tutorial D: Drawing P: Practical CIE - Continuous Internal Evaluation SEE - Semester End Examination

**III Semester**

| S.No | CourseCode | Course Title | Instruction | | | Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Hours Per Week | | | Max. Marks | | Duration of SEE in Hours | |
| | | | L | T | P/D | CIE | SEE | | |
| 1 | EC332PC | Electronic Devices and Circuits | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 2 | MM331ES | Material Science and Metallurgy | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 3 | ME301PC | Mechanics of Solids | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 4 | MT301PC | Thermal Science | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 5 | MT302PC | Fluid Mechanics and Heat Transfer | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 6 | MC301HS | Constitution of India | 3 | 0 | 0 | 40 | 60 | 3 | 0 |
| 7 | EC362PC | Electronic Devices and Circuits Lab | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 8 | MM361ES | Metallurgy & Mechanics of Solids Lab | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 9 | MT351PC | Fluid Mechanics and Heat Transfer Lab | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| **Total Hours/Marks/Credits** | | | **18** | **2** | **6** | **360** | **540** | | **20** |

**IV Semester**

| S.No | Course Code | Course Title | Instruction | | | Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Hours Per Week | | | Max. Marks | | Duration of SEE in Hours | |
| | | | L | T | P/D | CIE | SEE | | |
| 1 | MA403BS | Probability, Statistics & Complex Variables | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 2 | EC432PC | Switching Theory and Logic Design | 3 | 1 | 0 | 40 | 60 | 3 | 4 |
| 3 | EE432ES | Electrical Engineering | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 4 | ME401PC | Kinematics of Machinery | 3 | 0 | 0 | 40 | 60 | 3 | 3 |
| 5 | MT401PC | Machine Drawing and Computer Aided Graphics | 0 | 0 | 4 | 40 | 60 | 3 | 2 |
| 6 | EE462ES | Electrical Engineering Lab. | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 7 | MT451PC | Thermal Science Lab. | 0 | 0 | 2 | 40 | 60 | 3 | 1 |
| 8 | MT452PC | Real-Time Research Project/ Field-based Project | 0 | 0 | 4 | 50 | - | | 2 |
| 9 | MC451HS | Gender Sensitization Lab. | 0 | 0 | 2 | 50 | 50 | 3 | 0 |
| **Total Hours/Marks/Credits** | | | **12** | **2** | **14** | **380** | **470** | | **20** |

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# B.Tech. in Mechanical Engineering (Mechatronics)
## I Semester Syllabus
## MA101BS: MATRICES AND CALCULUS
## (Common to all Branches)

**Course Objectives**

- Types of matrices and their properties, concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations
- Concept of eigen values and eigen vectors and to reduce the quadratic form to canonical form.
- Geometrical approach to the mean value theorems and their application to the mathematical
- problems, evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative, finding maxima and minima of function of two and three variables.
- Evaluation of multiple integrals and their applications.

**Course Outcomes**

- Write the matrix representation of a set of linear equations and to analyse the solution of thesystem of equations.
- Find the Eigen values and Eigen vectors, reduce the quadratic form to canonical form using orthogonal transformations.
- Solve the applications on the mean value theorems, evaluate the improper integrals using Beta and Gamma functions.
- Find the extreme values of functions of two variables with and without constraints.
- Evaluate the multiple integrals and apply the concept to find areas, volumes.

### UNIT-I: Matrices

Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss- Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations, LU Decomposition method, Gauss elimination method and Gauss Seidel Iteration Method.

### UNIT-II: Eigen values and Eigen vectors

Linear Transformation and Orthogonal Transformation: Eigen values, Eigen vectors, properties of Symmetric, Skew Symmetric, Orthogonal, Unitary, Hermitian and Skew Hermitian matrices with reference to Eigen values and Eigen vectors 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 and applications, Cauchy's Mean value Theorem, Taylor's Series. Definition of Improper Integral: Beta and Gamma functions and their applications.

### UNIT-IV: Multivariable Calculus (Partial Differentiation and applications)

Definitions of Limit and continuity, Partial Differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence and independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

**UNIT-V: Multivariable Calculus (Integration)**

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

**Suggested Readings:**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications,5th Editon, 2016.

**Reference Books:**

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2008.
4. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and CompanyLimited, New Delhi.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**I Semester Syllabus**
**PH101BS: APPLIED PHYSICS**

**Course Objectives:** The objectives of this course for the student are to:

- Understand the basic principles of quantum physics.
- Understand the underlying mechanism involved in construction and working principles of various semiconductor devices.
- Study the fundamental concepts related to the dielectric and magnetic materials.
- Identify the importance of nanoscale, quantum confinement and various fabrication techniques.
- Study the characteristics of lasers and optical fibres.

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

- Understand physical world from fundamental point of view by the concepts of Quantum mechanics and visualize the difference between conductor, semiconductor and an insulator by classification of solids.
- Identify the role of semiconductor devices in science and engineering Applications.
- Explore the fundamental properties of dielectric and magnetic materials for their applications.
- Appreciate the features and applications of Nanomaterials.

**UNIT - I: QUANTUM PHYSICS**

Blackbody radiation – Planck's radiation law - Wein's law, Rayleigh-Jean's law - Photoelectric effect – de Broglie's Hypothesis, Davisson and Germer's experiment – Heisenberg uncertainty principle with an illustration - Non-existence of electrons in nucleus - Time independent Schrodinger wave equation - Born interpretation of the wave function - Particle in one dimensional potential box.

**UNIT - II: SEMICONDUCTORS AND DEVICES**

Intrinsic and extrinsic semiconductors – Hall effect - Direct and indirect band gap semiconductors - Construction, principle of operation and characteristics of P-N Junction diode, Zener diode and Bipolar Junction Transistor (BJT) – LED, PIN diode, Avalanche Photo Diode (APD) and Solar cells: structure, materials, working principle and characteristics.

**UNIT - III: DIELECTRIC AND MAGNETIC MATERIALS**

Dielectric Materials: Types of polarizations – Electronic & Ionic polarizabilities - Internal field in Dielectrics and Clausius-Mossotti Relation – Ferroelectric - Piezoelectric and Pyroelectric materials – Applications: liquid crystal displays (LCD) and crystal oscillators.

Magnetic Materials: Origin of magnetic moment - Classification of Magnetic materials - Weiss theory of ferromagnetism – Hysteresis curve – Soft and Hard magnetic materials – Applications: Bubble memory devices, magnetic field sensors.

**UNIT - IV: NANOTECHNOLOGY**

Nanoscale – Properties of Nanomaterials - Surface to volume ratio - Quantum confinement – Top-down fabrication: ball milling - Bottom-up fabrication: sol-gel, Physical Vapor Deposition (PVD) and Chemical Vapor Deposition (CVD) - Characterization techniques: XRD, SEM & TEM - Applications of nanomaterials.

**UNIT - V: LASERS AND FIBER OPTICS**

Lasers: Characteristics - Spontaneous and Stimulated emissions – Einstein coefficients - Population Inversion - Pumping mechanisms - Ruby laser, Nd:YAG laser, He-Ne laser, $CO_2$ laser, Semiconductor laser - Applications of lasers.
Fiber Optics: Introduction to optical fibers - Advantages of optical Fibers over conventional communications – Principle of light transmission through optical fiber - Structure of optical fiber - Acceptance angle and Numerical aperture - Classification of optical fibers: Step index and Graded index fibers – Attenuation mechanism in optical fibers – Block diagram of optical fiber communication system - applications.

**TEXT BOOKS:**

1. M. N. Avadhanulu, P.G. Kshirsagar & T. V. S. Arun Murthy "A Text book of Engineering Physics"- S. Chand Publications, 11th Edition 2019.
2. Engineering Physics by Shatendra Sharma and Jyotsna Sharma, Pearson Publication,2019
3. Semiconductor Physics and Devices- Basic Principle – Donald A, Neamen, Mc Graw Hill, 4th Edition,2021.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2nd Edition,2022.
5. Essentials of Nanoscience & Nanotechnology by Narasimha Reddy Katta, Typical Creatives NANO DIGEST, 1st Edition, 2021.

**REFERENCE BOOKS:**

1. Quantum Physics, H.C. Verma, TBS Publication, 2nd Edition 2012.
2. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons,11th Edition, 2018.
3. Introduction to Solid State Physics, Charles Kittel, Wiley Eastern, 2019.
4. Elementary Solid State Physics, S.L. Gupta and V. Kumar, Pragathi Prakashan, 2019.
5. A.K. Bhandhopadhya – Nano Materials, New Age International, 1st Edition, 2007.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**I Semester Syllabus**

**CS102ES: C PROGRAMMING AND DATA STRUCTURES**

**(Common to Civil, ECE, EEE, Mechanical, Mechatronics and MMT)**

**Course Objectives:** Introduce the importance of programming, C language constructs, programdevelopment, data structures, searching and sorting.

**Course Outcomes:**

1. Understand the various steps in Program development.
2. Explore the basic concepts in C Programming Language.
3. Develop modular and readable C Programs
4. Understand the basic concepts such as Abstract Data Types, Linear and Non-Linear Data structures.
5. Apply data structures such as stacks, queues in problem solving
6. To understand and analyze various searching and sorting algorithms.

**UNIT – I**

**Introduction to Computers** – Computer Systems, Computing Environments, Computer Languages,Creating and running programs, Software Development
**Introduction to C Language** – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output
**Structure of a C Program** – Operators, Bit-wise operators, Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Statements.

**UNIT – II**

**Statements** – if and switch statements, Repetition statements – while, for, do-while statements, Loopexamples, other statements related to looping – break, continue, go to, Recursion.
**Designing Structured Programs**- Functions, basics, user defined functions, inter function communication, standard functions.
**Arrays** – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays.

**UNIT – III**

**Pointers** – Introduction, Pointers for inter function communication, pointers to pointers, compatibility, **Pointer Applications** – Passing an array to a function, Memory allocation functions, array of pointers **Strings** – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulationfunctions, string / data conversion.

**UNIT – IV**

**Derived types** – The Typedef, enumerated types, Structures – Declaration, definition and initializationof structures, accessing structures, operations on structures, complex structures. Unions – Referencing unions, initializers, unions and structures.

**Input and Output** – Text vs Binary streams, standard library functions for files, converting file types, File programs – copy, merge files.

**UNIT – V**

**Sorting-** selection sort, bubble sort, insertion sort,

**Searching-**linear and binary search methods.

**Data Structures** – Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

**TEXT BOOKS:**

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

**REFERENCE BOOKS:**

1. C & Data structures – P. Padmanabham, 3rd Edition, B.S. Publications.
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3 Programming in C – Stephen G. Kochan, III Edition, Pearson Education.
4. C for Engineers and Scientists, H. Cheng, McGraw-Hill International Edition
5. Data Structures using C – A. M. Tanenbaum, Y. Langsam, and M.J. Augenstein, Pearson Education / PHI
6. C Programming & Data Structures, E. Balagurusamy, TMH.
7. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press
8. C & Data structures – E V Prasad and N B Venkateswarlu, S. Chand & Co.

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## B.Tech. in Mechanical Engineering (Mechatronics)
## B. Tech. I Semester
## EN101HS: English for Skill Enhancement
## (Common to CE, ME, MCT, MME & ECE)

**Course Objectives**: This course will enable the students to:

- Improve the language proficiency in English with an emphasis on Vocabulary and improve their functional grammar.
- Enhance their Reading and Writing skills.
- Develop study skills and communication skills in various professional situations.
- Train in effective reading techniques for better comprehension of texts of various domains.
- Equip them to study Engineering subjects more effectively and critically using the theoretical and practical components of the syllabus.

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

- Choose appropriate vocabulary and sentence structures for their oral and written Communication.
- Demonstrate their understanding of the rules of functional grammar.
- Develop comprehension skills from the known and unknown passages.
- Take an active part in drafting paragraphs, letters, essays, abstracts, précis and reports in various contexts.
- Acquire basic proficiency in reading and writing modules of English.

**UNIT – I**

Chapter entitled '**Toasted English' by R. K. Narayan** from **"English: Language, Context and Culture"** published by Orient BlackSwan, Hyderabad.

**Vocabulary**: The Concept of Word Formation -The Use of Prefixes and Suffixes - Acquaintance with Prefixes and Suffixes from Foreign Languages to form Derivatives - Synonyms and Antonyms

**Grammar:** Identifying Common Errors in Writing with Reference to Articles and Prepositions.

**Reading:** Reading and Its Importance- Techniques for Effective Reading.

**Writing:** Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

**UNIT – II**

Chapter entitled **'Appro JRD' by Sudha Murthy** from **"English: Language, Context and Culture" published** by Orient BlackSwan, Hyderabad.

**Vocabulary:** Words Often Misspelt - Homophones, Homonyms and Homographs

**Grammar:** Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

**Reading:** Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice

**Writing:** Nature and Style of Writing- Defining /Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence.

**UNIT – III**

Chapter entitled **'Lessons from Online Learning' by F. Haider Alvi, Deborah Hurst et al** from **"English: Language, Context and Culture"** published by Orient BlackSwan, Hyderabad.

**Vocabulary**: Words Often Confused - Words from Foreign Languages and their Use in English.
**Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.
**Reading:** Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice – Barriers to Effective Reading.

**Writing:** Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/Resume.

**UNIT – IV**

Chapter entitled **'Art and Literature' by Abdul Kalam** from **"English: Language, Context and Culture"** published by Orient BlackSwan, Hyderabad.

**Vocabulary:** Standard Abbreviations in English – Idioms and Phrases
**Grammar:** Redundancies and Clichés in Oral and Written Communication.
**Reading:** Effective Steps to Reading - Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice
**Writing:** Writing Practices- Essay Writing-Writing Introduction and Conclusion -Précis Writing.

**UNIT – V**

Chapter entitled **'Go, Kiss the World' by Subroto Bagchi** from **"English: Language, Context and Culture"** published by Orient BlackSwan, Hyderabad.

**Vocabulary**: Technical Vocabulary and their Usage
**Grammar:** Common Errors in English (Covering all the other aspects of grammar which were not covered in the previous units)
**Reading:** Reading Comprehension-Exercises for Practice
**Writing:** Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

**Note: Listening and Speaking Skills which are given under Unit-6 in AICTE Model Curriculum are covered in the syllabus of ELCS Lab Course.**

- **Note:** **1**. As the syllabus of English given in AICTE Model Curriculum-2018 for B.Tech First Year is **Open-ended**, besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.

- **Note**: **2**. Based on the recommendations of NEP2020, teachers are requested to be flexible to ad opt Blended Learning in dealing with the course contents .They are advised to teach 40 percent of each topic from the syllabus in blended mode.

**TEXTBOOK:**

1. "English: Language, Context and Culture" by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

**REFERENCE BOOKS:**

1. Liss and Davis (2010) Effective Academic Writing, Oxford University Press.
2. Richards, Jack C. (2022) Interchange Series. Introduction, 1, 2, 3. Cambridge University Press
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of Functional Language, Grammar and Vocabulary. (2nd ed.,). Sage Publications India Pvt. Ltd.
5. Wiley (2019). Technical Communication. Wiley India Pvt. Ltd, Rupa Publications.
6. Vishwamohan, Aysha. (2013). English for Technical Communication for Engineering Students. Mc Graw-Hill Education India Pvt. Ltd.
7. Swan, Michael. (2016). Practical English Usage. Oxford University Press. Fourth Edition
8. Green, David (2015). Contemporary English Grammar Structure And Composition, Trinity Press (Imprint of Laxmi Publication Pvt Ltd)

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**I Semester Syllabus**

## PH151BS: APPLIED PHYSICS LABORATORY

**(Common to all branches)**

**Course Objectives:** The objectives of this course for the student to

- Capable of handling instruments related to the Hall effect and photoelectric effect experiments and their measurements.
- Understand the characteristics of various devices such as PN junction diode, Zener diode, LED, solar cell, lasers and optical fiber and measurement of energy gap and resistivity of semiconductor materials.
- Able to measure the time constant of RC circuits.
- Study the variation of magnetic field along the axis of current carrying coil.
- Understanding the method of least squares fitting.

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

- Know the determination of the Planck's constant using Photo electric effect and identify the material whether it is n-type or p-type by Hall experiment.
- Appreciate quantum physics in semiconductor devices and optoelectronics.
- Gain the knowledge of applications of RC circuits.
- Understand the effect of magnetic field in different current carrying coils.
- Carried out data analysis.

**LIST OF EXPERIMENTS:**

1. Determination of work function and Planck's constant using photoelectric effect.
2. Determination of Hall co-efficient and carrier concentration of a given semiconductor.
3. Characteristics of series and parallel LCR circuits.
4. V-I characteristics of a p-n junction diode and Zener diode
5. V-I and P-I characteristics of light emitting diode (LED)
6. V-I Characteristics of solar cell
7. Determination of Energy gap of a semiconductor.
8. Determination of Acceptance Angle and Numerical Aperture of an optical fiber.
9. V-I characteristics of Laser diode.
10. Understanding the method of least squares – torsional pendulum as an example.
11. Determination of time constant using RC circuits
12. Determination of magnetic field of induction using Steewart-Gee's apparatus

***Note:*** *Any 8 experiments are to be performed.*

**REFERENCE BOOK:**

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

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## B.Tech. in Mechanical Engineering (Mechatronics)
## I Semester Syllabus

### CS152ES : C PROGRAMMING AND DATA STRUCTURES LABORATORY

**(Common to Civil ,ECE,EEE, Mechanical, Mechatronics and MMT)**

**Course Objectives:** Introduce the importance of programming, C language constructs, programdevelopment, data structures, searching and sorting.

**Course Outcomes:**

- Develop modular and readable C Programs
- Solve problems using strings, functions
- Handle data in files
- Implement stacks, queues using arrays, linked lists.
- To understand and analyze various searching and sorting algorithms

**List of Experiments:**

1. Write a C program to find the sum of individual digits of a positive integer.
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Writea C program to generate the first n terms of the sequence.
3. Write a C program to generate all the prime numbers between 1 and n, where n is a valuesupplied by the user.
4. Write a C program to find the roots of a quadratic equation.
5. Write a C program to find the factorial of a given integer.
6. Write a C program to find the GCD (greatest common divisor) of two given integers.
7. Write a C program to solve Towers of Hanoi problem.
8. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and useSwitch Statement)
9. Write a C program to find both the largest and smallest number in a list of integers.
10. Write a C program that uses functions to perform the following:
    i) Addition of Two Matrices
    ii) Multiplication of Two Matrices
11. Write a C program that uses functions to perform the following operations:
    i) To insert a sub-string in to a given main string from a given position.
    ii) To delete n Characters from a given position in a given string.
12. Write a C program to determine if the given string is a palindrome or not
13. Write a C program that displays the position or index in the string S where the string T begins,or – 1 if S doesn't contain T.
14. Write a C program to count the lines, words and characters in a given text.
15. Write a C program to generate Pascal's triangle.
16. Write a C program to construct a pyramid of numbers.
17. Write a C program that uses functions to perform the following operations:
    i) Reading a complex number
    ii) Writing a complex number
    iii) Addition of two complex numbers
    iv) Multiplication of two complex numbers
    (Note: represent complex number using a structure.)

18.
   i) Write a C program which copies one file to another.
   ii) Write a C program to reverse the first n characters in a file.(Note: The file name and n are specified on the command line.)

19.
   i. Write a C program to display the contents of a file.
   ii. Write a C program to merge two files into a third file (i.e., the contents of the first filefollowed by those of the second are put in the third file)

20. Write a C program that uses functions to perform the following operations on singly linkedlist.:
   i) Creation ii) Insertion iii) Deletion iv) Traversal

21. Write C programs that implement stack (its operations) using
   i) Arrays ii) Pointers

22. Write C programs that implement Queue (its operations) using
   i) Arrays ii) Pointers

23. Write a C program that implements the following sorting methods to sort a given list ofintegers in ascending order i) Bubble sort ii) Selection sortiii)Insertion sort

24. Write C programs that use both recursive and non recursive functions to perform the followingsearching operations for a Key value in a given list of integers:
   i) Linear search ii) Binary search

**TEXT BOOKS:**

1. C Programming & Data Structures, B.A. Forouzan and R. F. Gilberg, Third Edition, CengageLearning.
2. Let us C, Yeswanth Kanitkar
3. C Programming, Balaguruswamy.

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## B.Tech. in Mechanical Engineering (Mechatronics)
## B. Tech. I Semester
## EN151HS: English Language and Communication Skills Laboratory
## (Common to CE, ME, MCT, MME & ECE)

The **English Language and Communication Skills (ELCS) Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

**Course Objectives**:

This course aims:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize mother tongue interference
- To train students to use language appropriately for public speaking, group discussions
- and interviews.

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

- Understand the nuances of English language through audio- visual experience and group Activities.
- Demonstrate their understanding of exact pronunciation of speech sounds.
- Acquire fluency in their language and neutralize their accent for intelligibility without Mother Tongue Interference (MTI).
- Speak with clarity and confidence which in turn enhances their employability skills.
- Develops their ability in presenting, arguing, summarizing and leading various communicative activities.

**Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:**
**a. Computer Assisted Language Learning (CALL) Lab**

**b. Interactive Communication Skills (ICS) Lab**

**Listening Skills:**
Objectives
1. To enable students develop their listening skills so that they may appreciate the role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.
• Listening for general content
• Listening to fill up information
• Intensive listening
• Listening for specific information

**Speaking Skills:**
Objectives
1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional Contexts

• Oral practice
• Describing objects/situations/people
• Role play – Individual/Group activities
• Just A Minute (JAM) Sessions

The following course content is prescribed for the **English Language and Communication Skills Lab**.

**Exercise – I**
**CALL Lab**:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening.
Practice: Introduction to Speech Sounds – Vowels and Consonants – Minimal Pairs-
Consonant Clusters- Past Tense Marker and Plural Marker- Testing Exercises
**ICS Lab**:
Understand: Spoken vs. Written language- Formal and Informal English.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

**Exercise – II**
**CALL Lab:**
Understand: Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Stress pattern in sentences – Intonation.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Stress pattern in sentences – Intonation - Testing Exercises
**ICS Lab:**
Understand: Features of Good Conversation – Strategies for Effective Communication.
Practice: Situational Dialogues – Role Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

**Exercise - III**
**CALL Lab:**
Understand: Errors in Pronunciation-Neutralising Mother Tongue Interference (MTI).
Practice: Common Indian Variants in Pronunciation – Differences between British and American Pronunciation -Testing Exercises
**ICS Lab:**
Understand: Descriptions- Narrations- Giving Directions and Guidelines – Blog Writing
Practice: Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

**Exercise – IV**
**CALL Lab:**
Understand: Listening for General Details.
Practice: Listening Comprehension Tests - Testing Exercises
**ICS Lab:**
Understand: Public Speaking – Exposure to Structured Talks - Non-verbal Communication-
Presentation Skills.
Practice: Making a Short Speech – Extempore- Making a Presentation.

**Exercise – V**
**CALL Lab:**
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests -Testing Exercises
**ICS Lab:**
Understand: Group Discussion – Introduction to Interview Skills
Practice: Group Discussion – Mock Interviews

**Minimum Requirement of infrastructural facilities for ELCS Lab:**

**1. Computer Assisted Language Learning (CALL) Lab:**
**The Computer Assisted Language Learning Lab** has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

**System Requirement (Hardware component):**
Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration

ii) High Fidelity Headphones

**2. Interactive Communication Skills (ICS) Lab:**
**The Interactive Communication Skills Lab:** A Spacious room with movable chairs and audiovisual aids with a Public Address System, a T. V. or LCD, a digital stereo –audio & video system and camcorder etc.
**Source of Material (Master Copy):**
- Exercises in Spoken English. Part 1, 2, 3. CIEFL and Oxford University Press

**Note:** Teachers are requested to make use of the master copy and get it tailor-made to suit the contents of the syllabus.

**Suggested Software:**
- Cambridge Advanced Learners' English Dictionary with CD.
- Grammar Made Easy by Darling Kindersley.
- Punctuation Made Easy by Darling Kindersley.
- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
- Digital All
- Orell Digital Language Lab (Licensed Version)

**REFERENCE BOOKS:**
1. Kumar, Rajesh (2022). English Language Communication Skills – Lab Manual cum Workbook. Cengage Learning India Pvt. Ltd.
2. Shobha, KN & Rayen, J. Lourdes. (2019). Communicative English – A workbook. Cambridge University Press
3. Kumar, Sanjay & Lata, Pushp. (2019). Communication Skills: A Workbook. Oxford University Press
4. Board of Editors. (2016). ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities. Orient Black Swan Pvt. Ltd.
5. Mishra, Veerendra et al. (2020). English Language Skills: A Practical Approach. Cambridge University Press.
6. Central Institute of English (2005). Exercises in Spoken English Vol. 1, 2 & 3, Oxford India, Hyderabad

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**I Semester Syllabus**
**MT151PC: ELEMENTS OF MECHATRONICS ENGINEERING**

**Course Objectives:** The objectives of this course are to

- Make the student to experimentally measure the common geometric properties like length, diameter, flatness, curvature, volume and moment of inertia etc.
- Give a practical knowledge to evaluate the friction between surfaces and also to evaluate thenatural frequency of the system.
- Correlate between theory and experimental results, directly observe the proof of principlesand theories through practical knowledge
- Introduce students to the basic concepts of manufacturing through the demonstration of various processes.
- Understand the commonly used mechanical components like gear box, working of boilers and IC engine etc.

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

- Understand the operation, usage and applications of different measuring instrumentsand tools.
- Examine the different characteristics of instruments like accuracy, precision etc
- Prepare simple composite components and joining different materials using solderingprocess.
- Identify tools & learn practically the process of turning, milling, grinding on mild steelpieces.
- Understand the basic components of IC engine, Gear box and boiler

**List of Experiments to be performed:**

1. To measure diameter of a given wire and sphere, thickness of a given sheet.
2. Determination of flatness of the surface plate using straight edge and sprit level.
3. Determination of time period and natural frequency of simple and compound pendulum.
4. Study of various modes of heat transfer.
5. Study of architecture and working of a PLC
6. Study of basic operation of pick and place robot
7. Study of working of hydraulic and pneumatic actuators
8. Study of CNC Lathe & Milling Machines
9. Study of electronic circuit components of Resistor, Inductor, Capacitor, Diode and Transistors etc.,
10. finding color code of resistor and values of capacitors
11. Study the CRO and measure the frequency and phase of the given signal.
12. Identify various Digital and Analog ICs.

**Note:** Perform any 10 out of the 12 Exercises.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**I Semester Syllabus**
**ME151ES: ENGINEERING WORKSHOP**

**Pre-requisites**: Practical skill

**Course Objectives**: At the end of this course students are expected to

- Study of different hand operated power tools, uses and their demonstration.
- Gain a good basic working knowledge required for the production of various engineering products.
- Provide hands on experience about use of different engineering materials, tools, equipment and processes those are common in the engineering field.
- Study commonly used Engineering trades like carpentry, fitting, tin smithy, foundry, house wiring, plumbing & black smithy and practical exposure to these trades.
- Study of various machining operations.

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

- Practice on various workshop trades including plumbing, fitting, carpentry, foundry, house wiring, tin smithy, black smithy and welding by using different tools.
- Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring and chiseling.
- Apply basic electrical engineering knowledge for house wiring practice.
- Implement the knowledge of basic workshop processes under safety norms.
- Understand different metal joining techniques using arc welding process.

**1. TRADES FOR EXERCISES:**

**At least two exercises from each trade:**

I. Carpentry – (Bridle Joint, Half - Lap Joint, Mortise & Tenon Joint)
II. Fitting – ( L- fit, V-Fit & Dovetail Fit)
III. Tin-Smithy – (Square Tin, Rectangular scoop & Rectangular tray)
IV. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern)
V. Welding Practice – (Arc Welding- Lap Joint, Butt Joint & T Joint)
VI. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)
VII. Black Smithy – (Oval shape, S – Hook & Fan Hook )

**2. TRADES FOR DEMONSTRATION & EXPOSURE:**

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools used in construction and Wood Working operations.

**Text Books**:
1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal / Anuradha.

**Reference Books**:
1. Work shop Manual - P. Kannaiah/ K. L. Narayana/ SciTech
2. Workshop Manual / Venkat Reddy/ BSP

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## B.Tech. in Mechanical Engineering (Mechatronics)
## II Semester Syllabus
## MA201BS: Ordinary Differential Equations and Vector Calculus
## (Common to all Branches)

**Course Objectives**

- Methods of solving the differential equations of first order.
- Methods of solving the differential equations of higher order.
- Concept, properties of Laplace transforms, solving ordinary differential equations using Laplace transforms techniques.
- The physical quantities involved in engineering field related to vector valued functions.
- The basic properties of vector valued functions and their applications to line, surface andvolume integrals.

**Course Outcomes**

- Identify whether the given differential equation of first order is exact or not.
- Solve higher differential equation and apply the concept of differential equation to real world problems.
- Use the Laplace transforms techniques for solving ordinary differential equations.
- To analyse the physical quantities involved in engineering field related to vector valued functions.
- Evaluate the line, surface and volume integrals and converting them from one to another.

### UNIT-I: First Order Ordinary Differential Equations

Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling, Law of natural growth and decay.

### UNIT-II: Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}$, sin $ax$, cos $ax$, polynomials in $x$, $e^{ax}V(x)$ and $x\,V(x)$, method of variation of parameters, Equations reducible to linear ordinary differential equations with constant coefficients: Legendre's equation, Cauchy-Euler equation. Applications: Electric Circuits.

### UNIT-III: Laplace transforms

Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by 't', Laplace transforms of derivatives and integrals of function, Evaluation of integrals by Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform by different methods, Convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

### UNIT-IV: Vector Differentiation

Vector point functions and scalar point functions, Gradient, Divergence and Curl, Directional derivatives, Tangent plane and normal line, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

### UNIT-V: Vector Integration

Line, Surface and Volume Integrals, Theorems of Green, Gauss and Stokes (without proofs) and their applications.

**Suggested Readings:**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications,5th Edition, 2016.

**Reference Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,2002.
3. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and CompanyLimited, New Delhi.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2008.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**II Semester Syllabus**

## CH201BS: Engineering Chemistry

(Common to all branches)

**Course Objectives:**

To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer:

- To understand water quality for industrial and domestic usage, softening methods and related problems.
- To acquire the knowledge of Battery technology, corrosion and corrosion controlling techniques which are essential for the Engineers and applications in industries.
- To understand the preparation, properties and applications of polymeric materials.
- To get exposed to qualitative and quantitative parameters of fuels and to develop understanding of the combustion process.
- To understand the application of smart materials, lubricants, refractories and cement.

**Course Outcomes:**

After completing the course , the student will be able to acquire:

- Knowledge on the disadvantages of hard water for domestic and industrial purposes. The techniques of softening of hard water and treatment of potable water.
- Knowledge on storage of electrical energy in batteries, construction of batteries and fuel cells. Mechanism of corrosion of metals and alloys and corrosion control methods.
- Knowledge on the Preparation, properties and application of polymeric materials.
- Knowledge about the fuels, techniques of analysis for quality parameters of fuels, their combustion process and applications.
- Knowledge pertaining to the applications of smart materials, lubricants, refractories and cement.

### UNIT - I: Water and its treatment

Introduction to hardness of water – Expression of hardness, Units and related numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and breakpoint chlorination.

Boiler troubles: Sludge, Scale, Boiler corrosion and Caustic embrittlement. Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning - Colloidal conditioning. External treatment methods - Softening of water by ion- exchange processes. Desalination of water – Reverse osmosis.

### UNIT – II Battery Chemistry & Corrosion

Introduction - Classification of batteries - primary, secondary and reserve batteries with examples. Basic requirements for commercial batteries. Construction, working and applications of Zn-air and Lithium ion battery, Applications of Li-ion battery. Fuel Cells - Differences between battery and a fuel cell, Construction and applications of Methanol Oxygen fuel cell and Solid oxide fuel cell. Solar cells - Introduction and applications of Solar cells.

**Corrosion:** Causes and effects of corrosion – Theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion. Types of corrosion: Galvanic, Water-line and Pitting corrosion. Factors affecting rate of corrosion. Corrosion control methods: Cathodic protection – Sacrificial anode and impressed current methods. Application of Metallic coatings - Electroplating

## UNIT - III: Polymeric materials

Definition – Classification of polymers with examples – Types of polymerization – Addition and condensation polymerization with examples.

**Plastics:** Definition and characteristics - Thermoplastic and thermosetting plastics, Preparation, Properties and Engineering applications of PVC, Teflon and Bakelite.

**Fibers:** Preparation, Properties and Engineering applications of Nylon 6:6, and Terylene

**Elastomers:** Characteristics – Preparation – Properties and Applications of Buna-S, Butyl and Thiokolrubber.

**Conducting polymers:** Characteristics and Classification with examples - Mechanism of conduction in trans-polyacetylene and Applications of conducting polymers.

**Biodegradable polymers:** Concept and advantages - Polylactic acid and Polyvinyl alcohol and their applications.

## UNIT - IV: Energy Sources

Introduction, Calorific value of fuel – HCV, LCV- Dulong's formula. Classification - solid fuels: Coal – Analysis of coal – Proximate and ultimate analysis and their significance. Liquid fuels – Petroleum and its refining, Cracking types – Moving bed catalytic cracking. Knocking – Octane and Cetane rating. Synthetic petrol - Fischer-Tropsch's process. Gaseous fuels – Composition and uses of Natural gas, LPG and CNG. Biodiesel – Transesterification, advantages.

## UNIT - V: Engineering Materials

**Smart materials and their engineering applications**

Shape memory materials - Poly L- Lactic acid. Thermoresponse materials - Polyacryl amides, Poly vinylamides

**Lubricants:** Classification of lubricants with examples - Characteristics of a good lubricant. Properties of lubricants: Viscosity, Cloud point,Pour point, Flash point and Fire point.

**Refractories:** Definition, Classification, Characteristics of a good refractory. Application of refractories.

**Cement:** Portland cement - its composition, Setting and hardening

## TEXT BOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010
2. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, 2016
3. A textbook of Engineering Chemistry by M. Thirumala Chary, E. Laxminarayana and K. Shashikala, Pearson Publications, 2021.
4. Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley Publications.

## REFERENCE BOOKS:

1. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi (2011)

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**II Semester Syllabus**
**ME201ES: ENGINEERING GRAPHICS**

## Course Objectives:

- Recognize the standards of engineering graphics, learn to generate Geometric Constructions, Conic Sections and construct Engineering Scales.
- Understand the procedure to develop Orthographic projections of points, lines and planes.
- Learn the procedure to develop projection of solids and objects.
- Understand the procedure to generate the Sections and developments of Solids.
- Learn the procedure to develop Isometric projections, convert Orthographic views to Isometric views and vice versa using Graphics Instruments and AutoCAD.

## Course Outcomes:

- Apply the fundamental principles of Engineering Graphics to create engineering drawings of various geometric constructions, conic sections and engineering scales adhering to BIS Standards.
- Generate Orthographic projections; Front View, top view and side views of points and lines.
- Draw the Orthographic projections of planes and solids
- Understand the Sections of solids and developments of surfaces.
- Develop Isometric projection convert Orthographic views to Isometric views and vice versa for practical engineering problems using AutoCAD.

**UNIT – I**

**Introduction to Engineering Graphics:** Principles of Engineering Graphics and their Significance, Scales – Plain & Diagonal, Conic Sections-ellipse, parabola, hyperbola and Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid. Introduction to Auto CAD software – Commands.

**UNIT- II**

**Orthographic Projections:** Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures.

**UNIT – III**

Projections of Regular Solids inclined to one plane, Sections and Sectional views of Right Regular Solids –Prism, Cylinder, Pyramid, and Cone

**UNIT – IV**

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone. Intersection of solids – cylinder vs cylinder.

**UNIT – V**

**Isometric Projections:** Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Projection of solids. Conversionof Isometric Views to Orthographic Views and Vice-versa –Conventions.
Free hands Sketches of 2D, creation of 2D sketches. conversion of Isometric views to orthographic views using Auto CAD.

**TEXT BOOKS:**

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing, Basant Agrawal and C M Agrawal, Third Edition McGraw Hill
3. Engineering Drawing and graphics Using AutoCAD Third Edition, T. Jeyapoovan, Vikas: S.Chand and company Ltd.

**REFERENCE BOOKS:**

1. Engineering Graphics and Design, WILEY, Edition 2020
2. Engineering Drawing, M. B. Shah, B.C. Rane / Pearson.
3. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford
4. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers

**Note: - Internal and External examinations are conducted in conventional mode.**

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**II Semester Syllabus**
**ME202ES: ENGINEERING MECHANICS**

**Course Objectives:** The objectives of this course are to

- Explain the resolution of forces, compute the resultant of system of forces and solve problems using equations of equilibrium.
- Perform analysis of forces acting on bodies lying on rough surfaces.
- Locate the centroid and compute the area moment of inertia of standard and composite sections
- Locate centre of gravity and compute the mass moment of inertia of standard and composite bodies.
- Explain kinematics and kinetics of particles, curvilinear motion and rotation of rigid bodies.

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

- Determine resultant of forces acting on a body and analyze equilibrium of a body subjected to system of forces.
- Solve problem of bodies subjected to friction.
- Find the location of centroid and calculate area moment of inertia of a given section.
- Find the centre of gravity and calculate the mass moment of inertia of given body.
- Solve problems using kinematic equations and also solve problems using principles of kinetics such as work-energy principle, Impulse-momentum principle

**UNIT-I**

**Introduction to Engineering Mechanics** - Basic concepts, System of Forces, Moment of Forces and its Application; Resultant of Force System, Free body diagrams, Equilibrium of System of Forces, Equations of Equilibrium of Coplanar Concurrent Force System; Spatial Systems - Components in Space, Resultant; Static Indeterminacy.

**UNIT-II**

**Friction:** Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Wedge Friction, Screw jack;

**UNIT-III**

**Centroid** of Lines and Areas from first principles; Centroid of composite sections;
**Centre of Gravity** of simple bodies and composite bodies; Theorems of Pappus.

**UNIT-IV**

**Moment of Inertia –** Definition; Theorems of moment of inertia; Area Moment of inertia of plane sections from first principles, Area Moment of inertia of composite sections;
**Mass Moment of Inertia -** Transfer Formula, Mass moment of inertia of simple bodies and composite bodies.

**UNIT-V**

**Kinematics -** Rectilinear motion; Plane curvilinear motion;

**Kinetics -** D'Alembert's principle - its applications in translation and motion of connected bodies; Work Energy principle - its application in motion of connected bodies; Impulse-momentum principle.

**TEXT BOOKS:**

1. K.Vijay Kumar Reddy and J.Suresh Kumar, Singer's Engineering Mechanics – Statics and Dynamics, BS Publications, 2011.
2. Irving H. Shames and G. Krishna Mohan Rao, Engineering Mechanics, Pearson Education, 2005.

**REFERENCE BOOKS:**

1. Timoshenko S.P and Young D.H., Engineering Mechanics, McGraw Hill International Edition, 1983.
2. Beer F.P & Johnston E.R Jr. Vector, Mechanics for Engineers, Tata McGraw Hill, 2004.
3. Hibbeler R.C & Ashok Gupta, Engineering Mechanics, Pearson Education, 2010.
4. Tayal A.K., Engineering Mechanics – Statics & Dynamics, Umesh Publications, 2011.
5. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, 2008.
6. Nelson A, Engineering Mechanics - Statics and Dynamics, McGraw Hill Education, 2017.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**II Semester Syllabus**
**MM201ES: ENGINEERING MATERIALS**
**(Common to Mechanical & MCT)**

**Course Objectives:**

The objectives of this course are to

- Provide basic understanding of engineering materials, their structure, classification and usage.
- Introduce the testing methods for various material properties and ASTM standards used in testing.
- Understand the various materials used in mechanical engineering like metals, ceramics, polymers, composite materials and other new materials.

**Course Outcomes:**

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

- Classify the various materials that will be essential for the mechanical engineering applications.
- Express the mechanical properties of metals and their testing procedures.
- Understand the application of materials and their processing
- Understand the requirement and need for the development of the new materials.

**UNIT-I: Introduction**

Classification of Engineering Materials, Ashby chart, Mechanical Properties and their testing equipment/procedures, ASTM standards for testing, Stress–Strain Behavior of various materials, Sources of Material Data.

**UNIT –II: Metallic Materials**

Metals and Alloys, Classification, Ferrous alloys: Classification, composition, properties and applications of steels and cast irons; Nonferrous Alloys: Classification, composition, properties and applications of Non-ferrous alloys with a basic approach on alloys of Aluminum, Titanium, Zinc, Copper, Nickel, and Cobalt.

**UNIT – III: Ceramics and Polymers**

Ceramics: Crystal Structure Classification, Properties and Applications of ceramic materials, Ceramic fabrication techniques. Polymers: Chemistry, Characteristics, Applications and classification of polymers, Thermoplastic and Thermosetting Polymers, Processing of Polymers, Elastomers.

**UNIT –IV: Composite Materials**

Composites: Conceptual study and classification, merits, demerits and applications, Types of reinforcements, Types of matrices, Manufacturing methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting.

**UNIT – V: Advanced Materials**

Materials for nanotechnology: Nanomaterials for semiconductor applications (Zinc oxide nano materials, titanium dioxide nanoparticles), Metallic nanomaterials (Silver, gold, iron and copper nanoparticles), ceramic nanomaterials and their applications, bio materials and other recently developed materials.

## Suggested Readings:

1. George Murray, Charles V. White, Wolfgang Weise, “Introduction to Engineering Materials”, CRC Press, 2007.
2. William. D. Callister, David G. Rethwisch, “Materials Science and Engineering: An Introduction”, John Wiley & Sons, 2018.

## Reference Books:

1. Myer Kutz, “Mechanical Engineers’ Handbook”, John Wiley & Sons, 2015.
2. M.A. Shah, K.A.Shah, Nano technology, the science of Small, WILEY, Second Edition, 2019.
3. E. Paul De Garmo, J.T. Black, R.A. Kohler. Materials and Processes in Manufacturing, John Wiley and Sons, Inc., NY, 11 the Edition, 2012.
4. R.J. Crawford, plastics engineering, Pergamon Presss, 2013.
5. Donald R Askland and Pradeep P Phule “Essentials of Materials Science and Engineering”, by Pradeep P. Fulay (Author), Donald R. Askeland, 2013.
6. K. K. Chawala, Cermic Matrix composite Materials, Kluwer Academic Publishers, 2002.

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## B.Tech. in Mechanical Engineering (Mechatronics)
## II Semester Syllabus
### CH251BS : Engineering Chemistry Lab
(Common to all branches)

**Course Objectives**:

The course consists of experiments related to the principles of chemistry required for an Engineering student and the student will learn the following:

- Estimation of hardness of water to check its suitability for industrial and drinking purpose and estimation procedures through volumetric analysis.
- Estimation procedures using conductometry and potentiometry.
- Preparation of polymers such as Bakelite and Polystyrene in the laboratory.
- Understand the lubricant properties such as saponification value and viscosity of oils.
- Understand the corrosion of metals in a corrosive medium.

**Course Outcomes**:

After completing the course, the student will gain practical knowledge on:

- Determination of parameters like hardness of water and estimations through volumetric analysis.
- Performance of experiments of conductometry and potentiometry and estimation procedures using them.
- Preparation of polymers like Bakelite and Polystyrene.
- Performing experiments related to estimation of saponification value and viscosity of lubricating oils.
- Performing experiments to know rate of corrosion of mild steel in various conditions.

**List of Experiments:**

I. **Volumetric Analysis:** Estimation of hardness of water by EDTA - Complexometry method.
II. **Volumetric Analysis:** Estimation of $Fe^{+2}$ by Dichrometry.
III. **Conductometry:** Estimation of the concentration of an acid by Conductometry.
IV. **Potentiometry:** Estimation of the amount of $Fe^{+2}$ by Potentiometry.
V. **Potentiometry:** Determination of an acid concentration using Potentiometer.
VI. **Preparations:**
   1. Preparation of Bakelite.
   2. Preparation Polystyrene
VII. **Lubricants:**
   1. Estimation of acid value of given lubricating oil.
   2. Estimation of viscosity of lubricating oil using Ostwald's Viscometer.
VIII. **Corrosion:** Determination of rate of corrosion of mild steel in the presence and absence of inhibitor
IX. **Virtual lab experiments**
   a. Construction of Fuel cell and its working.
   b. Smart materials for Biomedical applications
   c. Batteries for Electrical vehicles.
   d. Functioning of Solar cell and its applications.

**REFERENCE BOOKS:**

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna - S Chand Publications,New Delhi (2022)
2. Vogel's text book of practical organic chemistry - 5th edition
3. Inorganic Quantitative analysis by A.I. Vogel - ELBS Publications.
4. College Practical Chemistry by V.K. Ahluwalia - Narosa Publications Ltd., New Delhi (2007).

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# B.Tech. in Mechanical Engineering (Mechatronics)
## II Semester Syllabus
### CS251ES: PYTHON PROGRAMMING LABORATORY
### (Common to All Branches)

**Course Objectives:**

- To install and run the Python interpreter
- To learn control structures.
- To Understand Lists, Dictionaries in python
- To Handle Strings and Files in Python

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

- Develop the application specific codes using python.
- Understand Strings, Lists, Tuples and Dictionaries in Python
- Verify programs using modular approach, file I/O, Python standard library
- Implement Digital Systems using Python

Note: The lab experiments will be like the following experiment examples

**Week -1:**

1. i) Use a web browser to go to the Python website http://python.org. This page contains information about Python and links to Python-related pages, and it gives you the ability to search the Python documentation.
   ii) Start the Python interpreter and type help() to start the online help utility.
2. Start a Python interpreter and use it as a Calculator.3.
   i) Write a program to calculate compound interest when principal, rate and number of periods aregiven.
   ii) Given coordinates (x1, y1), (x2, y2) find the distance between two points
4. Read name, address, email and phone number of a person through keyboard and print the details.

**Week - 2:**

1. Print the below triangle using for loop.5
   4 4
   3 3 3
   2 2 2 2
   1 1 1 1 1
2. Write a program to check whether the given input is digit or lowercase character or uppercasecharacter or a special character (use 'if-else-if' ladder)
3. Python Program to Print the Fibonacci sequence using while loop
4. Python program to print all prime numbers in a given interval (use break)

**Week - 3:**

1. i) Write a program to convert a list and tuple into arrays.
   ii) Write a program to find common values between two arrays.
2. Write a function called gcd that takes parameters a and b and returns their greatest common divisor.
3. Write a function called palindrome that takes a string argument and returnsTrue if it is a palindromeand False otherwise. Remember that you can use the built-in function len to check the length of a string.

**Week - 4:**

1. Write a function called is_sorted that takes a list as a parameter and returns True if the list is sortedin ascending order and False otherwise.
2. Write a function called has_duplicates that takes a list and returns True if there is any element thatappears more than once. It should not modify the original list.

i). Write a function called remove_duplicates that takes a list and returns a new list with only theunique elements from the original. Hint: they don't have to be in the same order.

ii). The wordlist I provided, words.txt, doesn't contain single letter words. So you might want to add"I", "a", and the empty string.

iii). Write a python code to read dictionary values from the user. Construct a function to invert itscontent. i.e., keys should be values and values should be keys.

3. i) Add a comma between the characters. If the given word is 'Apple', it should become 'A,p,p,l,e'
   ii) Remove the given word in all the places in a string?
   iii) Write a function that takes a sentence as an input parameter and replaces the first letter of everyword with the corresponding upper case letter and the rest of the letters in the word by corresponding letters in lower case without using a built-in function?
4. Writes a recursive function that generates all binary strings of n-bit length

**Week - 5:**

1. i) Write a python program that defines a matrix and prints
   ii) Write a python program to perform addition of two square matrices
   iii) Write a python program to perform multiplication of two square matrices
2. How do you make a module? Give an example of construction of a module using different geometricalshapes and operations on them as its functions.
3. Use the structure of exception handling all general purpose exceptions.

**Week-6:**

1. a. Write a function called draw_rectangle that takes a Canvas and a Rectangle as arguments anddraws a representation of the Rectangle on the Canvas.
   b. Add an attribute named color to your Rectangle objects and modify draw_rectangle so that ituses the color attribute as the fill color.
   c. Write a function called draw_point that takes a Canvas and a Point as arguments and draws arepresentation of the Point on the Canvas.
   d. Define a new class called Circle with appropriate attributes and instantiate a few Circle objects.Write a function called draw_circle that draws circles on the canvas.
2. Write a Python program to demonstrate the usage of Method Resolution Order (MRO) in multiplelevels of Inheritances.
3. Write a python code to read a phone number and email-id from the user and validate it forcorrectness.

**Week- 7**

1. Write a Python code to merge two given file contents into a third file.
2. Write a Python code to open a given file and construct a function to check for given words present init and display on found.
3. Write a Python code to Read text from a text file, find the word with most number of occurrences
4. Write a function that reads a file *file1* and displays the number of words, number of vowels, blankspaces, lower case letters and uppercase letters.

**Week - 8:**

1. Import numpy, Plotpy and Scipy and explore their functionalities.
2. a) Install NumPy package with pip and explore it.
3. Write a program to implement Digital Logic Gates – AND, OR, NOT, EX-OR
4. Write a program to implement Half Adder, Full Adder, and Parallel Adder
5. Write a GUI program to create a window wizard having two text labels, two text fields and two buttonsas Submit and Reset.

**TEXT BOOKS:**

1. Supercharged Python: Take your code to the next level, Overland
2. Learning Python, Mark Lutz, O'reilly

**REFERENCE BOOKS:**

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Python Programming A Modular Approach with Graphics, Database, Mobile, and WebApplications, Sheetal Taneja, Naveen Kumar, Pearson
3. Programming with Python, A User's Book, Michael Dawson, Cengage Learning, India Edition
4. Think Python, Allen Downey, Green Tea Press
5. Core Python Programming, W. Chun, Pearson
6. Introduction to Python, Kenneth A. Lambert, Cengage

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**II Semester Syllabus**
**MM251ES: Fuels and Lubricants Laboratory**
**(Common to Mechanical & MCT)**

**Course Objective:**

- To Understand the fuels and lubricants properties.

**Course Outcomes:**

At the end of the course, students will be able to

- Find the kinematic viscosity of lubricants and its variation with temperature
- Determine the flash point, fire point, cloud point and pour point of liquid fuels
- Determine the calorific value of solid, liquid, and gaseous fuels
- Determination of the dropping point of lubricating grease
- Determination of distillation characteristics of petroleum products

**List of Experiments:**

1. Determination of Flash point of liquid fuels using Abel's Flash point Apparatus
2. Determination of Flash and Fire points of liquid fuels using Pensky Marten's Apparatus.
3. Carbon residue test: Liquid fuels.
4. Determination of Kinematic and Absolute viscosity of liquid lubricants using Saybolt/Universal viscometer.
5. Determination of Kinematic and Absolute viscosity of liquid lubricants using Redwood-I viscometer.
6. Determination of Kinematic and Absolute viscosity of liquid lubricants using Redwood-II viscometer.
7. Determination of Kinematic and Absolute viscosity of liquid lubricants using Engler viscometer.
8. Determination of Calorific value of Gaseous fuels using Junkers Gas Calorimeter.
9. Determination of Calorific value of Solid/Liquid fuels using Bomb Calorimeter.
10. Determination of grease penetration number by using grease penetration apparatus.
11. ASTM Distillation test Apparatus.
12. Cloud and Pour points apparatus.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**II Semester Syllabus**
**MC201BS: Environmental Science**
**(**Common to all branches**)**

## Course Objectives:

- To understand the importance of ecosystem and ecological balance.
- To understand the natural resources and their conservation.
- To understand the importance of biodiversity and its values.
- To gain knowledge about environmental pollution, effects and controlling measures. To study about global environmental problems and global issues.
- To understand the environmental policies, regulations and sustainable development.

## Course Outcomes:

**After completing the course, the student will be able to:**

- Get the information about ecosystem and their usage and conservation.
- Learn different types of natural resources and take up the measures to protect the resources.
- Get the information about biodiversity and their usage and conservation.
- Get the information about the types of pollution, understand their effects and controlling measures. Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
- Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations.

### UNIT – I

**Ecosystems:** Definition, scope, and importance of ecosystem. Classification, structure, and function of an ecosystem, food chains, food webs, and ecological pyramids. Flow of energy, biogeochemical cycles, bioaccumulation, biomagnification, ecosystem value, services and carrying capacity. Field visits.

### UNIT – II

**Natural Resources: Classification of resources:** Living and non-living resources. **Water resources:** Use and over utilization of surface and ground water, floods and droughts. Dams: Benefits and problems. **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources. **Land resources** and **Forest resources**. **Energy resources:** Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources. Case studies.

### UNIT – III

**Biodiversity and Biotic Resources:** Introduction, definition, genetic, species and ecosystem diversity. Values of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, hot spots of biodiversity. Field visit. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In - Situ and Ex -situ conservation. National biodiversity act.

### UNIT – IV

**Environmental Pollution and Control Technologies: Environmental pollution:** Classification of pollution. **Air pollution:** Primary and secondary pollutants, automobile and industrial pollution. Ambient air quality standards. **Soil pollution:** Sources and types, impacts of modern agriculture, degradation of soil. **Solid waste:** Municipal solid waste management, composition and characteristics of e-waste and its management.

**Pollution control technologies:** Wastewater treatment methods: Primary, secondary and tertiary. Overview of air pollution control technologies, concepts of bioremediation.

**Global Environmental issues and Global efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal protocol. NAPCC-GoI Initiatives.

## UNIT – V

**Environmental Policy, Legislation & EIA:** Environmental Protection Act, legal aspects Air Act- 1981, Water Act, biomedical waste management and handling rules, hazardous waste management and handling rules.

EIA: EIA structure, methods of baseline data acquisition. Concepts of environmental management plan (EMP).

**Towards Sustainable Future:** Concept of sustainable development goals, population and its explosion. Crazy consumerism, Environmental education, Human health, Environmental ethics. Concept of green building, Principles of green chemistry, Ecological footprint, Life cycle assessment (LCA), Low carbon life style.

## TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

## REFERENCE BOOKS:

1. Environmental Science: Towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008, PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New Age International publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BSPublications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS Publications.

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# B.Tech. in Mechanical Engineering (Mechatronics)
## III Semester Syllabus
## EC332PC: Electronic Devices and Circuits
## (Common to ECE & MCT)

**Course Objectives**

- To introduce components such as diodes, BJTs and FETs.
- To know the applications of components.
- To know the switching characteristics of components
- To give understanding of various types of amplifier circuits.

Upon successful completion of the course, students will be able to
- Know the characteristics of various components.
- Understand the utilization of components.
- Understand the biasing techniques
- Design and analyze small signal amplifier circuits

**Course Outcomes**

***Unit-I: Diode and Applications***

Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Derivation of Diffusion and Transition Capacitances, Diode Applications: Switch-Switching times.

**Rectifier** - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, comparison of rectifiers, Rectifiers with filter, Derivation for ripple factor with capacitor filter and Inductive Filters, Problems related to capacitor and inductor filter, **Clippers & Clampers-**Clipping at two independent levels, Transfer function, Clamper-Clamping Operation, Types of Clampers, Clamping Circuit Theorem, problems on clippers and clampers.

***Unit-II: Bipolar Junction Transistor (BJT)***

(BJT):Construction, Principle of Operation, Symbol, Amplifying Action, Common Emitter, Common Base and Common Collector Configurations, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Collector to Base Bias, Self Bias, Stability factor, Bias Stability, Problems related to Biasing, Bias Compensation using Diodes, Transistor as a switch, switching times.

***Unit-III: Junction Field Effect Transistor (FET), Special Purpose Devices***

**Junction Field Effect Transistor (FET)**: Construction, Principle of Operation, Pinch-Off Voltage, Volt- Ampere Characteristic, Comparison of BJT and FET, Biasing of FET-Fixed Bias, Self-Bias and Voltage divider Bias, FET as Voltage Variable Resistor.

**Special Purpose Devices:** Zener Diode - **V-I** Characteristics, Zener diode as Voltage Regulator, SCR-Principle of Operation, Applications, Tunnel diode- Principle of Operation, V-I Characteristics, UJT- Principle of Operation, V-I Characteristics and applications, Varactor Diode.

***Unit-IV: Analysis and Design of Small Signal Low Frequency BJT Amplifiers***

BJT modeling, Hybrid model, Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Comparison of CE, CB and CC configurations.

Transistor Hybrid model, Determination of h-parameters from transistor Static characteristics, Typical values of h-parameters in CE, CB and CC configurations, Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors on CE Amplifier.

***Unit-V: FET Amplifiers***

Small Signal Model**,** Analysis of JFET Amplifiers, Analysis of CS, CD, CG JFET Amplifiers. MOSFET- Depletion and Enhancement type MOSFET, Volt- Ampere Characteristic of Enhancement and Depletion mode, Basic Concepts of MOSFET Amplifiers.

***Suggested Readings:***

1. Jacob Millman, Electronic Devices and Circuits, McGraw Hill Education
2. Robert L. Boylestead, Louis Nashelsky, Electronic Devices and Circuits theory, Pearson**,** 11th Edition, 2009.

***Reference Books:***

1. ZHorowitz, The Art of Electronics,, 3rd Edition Cambridge University Press
2. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford.
3. J. Millman, H. Taub and Mothiki S. Prakash Rao, Pulse, Digital and Switching Waveforms , Mc Graw Hill, 2Ed., 2008.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**III Semester Syllabus**
**MM331ES: Material Science and Metallurgy**
**(Common to ME & MCT)**

**Course Objectives**

The objectives of the course is to make the student
- This course provides the fundamental knowledge of science behind metals.
- This course introduces the concept of structure property relations, which lays the basis for studies in fieldssuch as solid-state physics, mechanical behavior of materials, phase diagram and heat treatment.
- To develop an understanding of the atomistic and defect structures, and how they result in the microstructure and influence the properties of metals.
- To develop an understanding of the processes occurring in metals during heating that influences themicrostructure and properties.
- To develop an understanding of the effects of alloying of metals upon the microstructure and properties.

**Course Outcomes**

At the end of the course, the student will be able to
- Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell,FCC, BCC, HCP, APF and Coordination Number etc.
- Understand the concept of phase, phase diagram and understand the basic terminologies associated with metallurgy. Construction and identification of iron –Iron carbide phase diagrams and invariant reactions.
- Understand the objectives of heat treatment and suggest the heat treatment process for various applications.Introduce the concept of Hardenability.
- Understand the construction and Significance of Time Temperature Transformation and Continuous Cooling Transformation diagrams. Understand the various Surface hardening mechanisms.
- Understand the significance and microstructure of alloy steels, cast irons and non-ferrous (aluminum,copper and Titanium) alloys.

**Unit-I: Crystal Structure**

Crystal Structure: Unit cells, Metallic crystal structures, SC, FCC, BCC and HCP, Atomic Packing Factor, coordination number, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; Edge and screw dislocations, strengthening mechanisms and slip systems, critically resolved shear stress.

***Unit-II: Phase Diagrams***

Alloys, substitutional and interstitial solid solutions: Hume-Rothery rules, Phase rule, Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, eutectoid, peritectic, peritectoid and monotectic reactions. Iron-Iron carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite.

***Unit-III: Heat Treatment of Steel***

Objectives of Heat treatment: Annealing, Normalising, Hardening, Tempering and Spheroidising, Isothermal transformation diagrams for Fe-C alloys and microstructures development, Bainite, Pearlite, Martensite. TTT diagrams for eutectoid, hypoeutectoid and hypereutectoid steels, Continuous cooling curves and interpretation of finalmicrostructures and properties-austempering, martempering.

***Unit-IV: Surface Hardening Treatments***

Surface Hardening Treatments, Case Hardening, Carburizing, Nitriding, Cyaniding, Carbo-Nitriding, Flame and Induction Hardening, Vacuum and Plasma Hardening.

***Unit-V: Ferrous and Nonferrous Alloys***

Alloying of steel, properties of stainless steel and tool steels, maraging steels, cast irons; grey, white, malleable and spheroidal cast irons, copper and copper alloys (Brass, bronze and cupro-nickel), Aluminium and Al-Cu-Mg alloys, Titanium alloys.

***Suggested Readings****:*

1. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
2. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.

***Reference Books:***

1. S.H. Armer, Introduction to Physical Metallurgy, Mc. Graw Hill.
2. R.E. Reed Hill, Physical Metallurgical Principles, EWP Publishers.

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# B.Tech. in Mechanical Engineering (Mechatronics)
## III Semester Syllabus
## ME301PC: Mechanics of Solids
## (Common to ME, MCT & MME)

**Course Objectives**

At the end of this course, students are expected to
- Understand basic concepts of stress, strain and their relations based on elasticity.
- Concepts of material behavior due to different types of loading.
- Calculate stresses and deformation of a bar due to loading under various conditions.
- Draw Shear Force and Bending Moment diagrams of a beam and find the maximum moment/shear and theirlocations.
- Compute normal and shear stresses.

**Course Outcomes**

After successful completion of this course, students should be able to
- Apply knowledge of materials and structural elements for the analysis of simple structures;
- Analyze the behavior of the solid bodies subjected to various types of loading.
- Design the structural members subjected to bending and shear loads.
- Analyze and interpret materials testing data relating to behavior of structures.
- Undertake problem identification, formulation, and solution using a range of analytical methods.

***Unit – I***

**Simple Stresses & Strains:** Elasticity and plasticity; Types of stresses & strains; Hooke's law; Stress-strain diagram for mild steel; Working stress; Factor of safety; Lateral strain, Poisson's ratio & volumetric strain; Elastic moduli & the relationship between them; Bars of varying section; Composite bars; Temperature stresses; Strain energy; Resilience; Gradual, sudden and impact loadings.

***Unit – II***

**Shear Force and Bending Moment:** Definition of beam; Types of beams; Concept of Shear Force (SF) and BendingMoment (BM); SF and BM diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads; Point of contra flexure; Relation between SF, BM and rate of loading at a section of a beam.

***Unit - III***

**Flexural Stresses**: Theory of simple bending; Assumptions; Derivation of bending equation: M/I = f/y = E/R; Neutral axis; Determination of bending stresses – section modulus of rectangular and circular sections, I-section and T- sections.

***Unit-IV***

**Shear Stresses:** Derivation of shear stress equation – Shear stress distribution across various beams sections like rectangular, triangular, I-section and T-sections.

**Principal Stresses and Strains:** Introduction; Stresses on an inclined section of a bar under axial loading; Normal and tangential stresses on an inclined plane for biaxial stresses; Principal stresses and strains - analytical approach.

***Unit – V***

**Torsion of Circular Shafts:** Theory of pure torsion; Assumptions; Derivation of Torsion equation: $T/J = \tau/r = G\theta/L$; Torsional moment of resistance – Polar section modulus.

**Thin Cylinders:** Thin cylindrical shells; Derivation of formula for longitudinal and circumferential stresses; Hoop, longitudinal and volumetric strains – changes in diameter and volume of thin cylinders; Thin spherical shells

***Suggested Readings:***

1. S.Ramamrutham and R.Narayanan, Strength of materials, Dhanpatrai Publishing Company.
2. Sadhu Singh, Strength of Materials, Khanna Publishers

***Reference Books:***

1. Popov, Solid Mechanics.
2. Ryder. G.H.Strength of Materials; Macmillan Long Man Publication.
3. Jindal, Strength of Materials, Umesh Publications.
4. D.S Prakash Rao, Strength of Materials Universities Press Pvt. Ltd.
5. S. S. Rattan, Strength of Materials Tata McGraw Hill Education Pvt. Ltd.
6. M. L. Gambhir, Fundamentals of Solid Mechanics PHI Learning Pvt. Ltd

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## B.Tech. in Mechanical Engineering (Mechatronics)
## III Semester Syllabus
## MT301PC: Thermal Science

***Course Objectives***

At the end of this course, students are expected to
- Understand the terminology associated with Basic Thermodynamics
- State and illustrate zeroth and I laws of thermodynamics
- Explain the concepts of entropy, illustrate II law of Thermodynamics and causes of irreversibility
- Study various processes involved in gas powered cycles and plot them on P-v, T-s diagrams
- Understand the working of 2S & 4S engines with their ignition systems and know about cooling andlubricating systems.

**Course Outcomes**

At the end of the course students are able to:
- Identify various processes involved in Thermodynamics and able to calculate work and Heat Transfer
- Apply the laws of thermodynamics to various processes and systems
- Apply II law of Thermodynamics and analyze the effect of entropy and its generation in various processes
- Estimate the performance of various Thermodynamic gas powered cycles
- Distinguish a 4-stroke engine from 2-stroke engine and draw port timing and valve timing diagrams

***Unit-I: Introduction: Basic Concepts***

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process Work and Heat, Point and Path function.

***Unit-II: Zeroth Law of Thermodynamics***

Concept of quality of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale – PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation. Limitations of the First Law.

***Unit-III: Second Law of Thermodynamics***

Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle,Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Statement of Third Law of Thermodynamics.

***Unit-IV: Power Cycles***

Otto, Diesel, Dual Combustion cycles, – Description, and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison with Ideal and Actual Cycles. Determination of friction power, calculation of IP, BP, FP and Break thermal efficiency, Indicated thermal efficiency,Volumetric efficiency, heat balance.

***Unit-V: I.C. Engines***

Classification –Two & Four Stroke Engines, Working principles, Valve and Port Timing Diagrams, - Types Engine arrangement systems. Fuels used, Modes of fuel Admission to engine cylinder, carburetor, Fuel Injector, Ignition, Cooling and Lubrication systems, Introduction to boilers and air compressors.

***Suggested Readings:***

1. Rajput, Thermal Engineering, Lakshmi Publications
2. P. K Nag, Engineering Thermodynamics –TMH
3. V. Ganesan, I.C. Engines –TMH
4. Merle C. Potter, Elaine P. Scott, Thermal Sciences –Cengage Learning

***Reference Books****:*

1. Jones & Dugan, Engineering Thermodynamics
2. Yunus Cengel & Boles, Thermodynamics – An Engineering Approach –/TMH
3. J. P. Holman, Thermodynamics –Mc Graw Hill
4. J. P. Holman, An introduction to Thermodynamics, University Press

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**III Semester Syllabus**
**MT302PC: Fluid Mechanics and Heat Transfer**

Pre-requisite: Thermodynamics

**Course Objectives**

At the end of this course, students are expected to
- Identify the behavior of incompressible fluid in rest and in transit and understand various types of flow
- Learn how to apply laws of mass conservation and energy conservation for various steady flow devices
- Understand modes of the mechanisms of conduction, convection, and radiation heat transfer concepts.
- Differentiate between free convection and forced convection.
- Understand the usage of LMTD and effectiveness NTU methods in the analysis of Heat exchangers

**Course Outcomes**

After successful completion of this course, students should be able to
- Describe physical properties of a fluid, pressure distribution and formulate the motion of fluid element.
- Apply modified Bernoulli's equation for real time applications and evaluate major and minor losses.
- Understand the basic laws of Heat transfer and analyze problems involved in steady state Heat conduction.
- Evaluate Heat transfer coefficients for natural and forced convections
- Analyze performance of a heat exchanger by using LMTD and Effectiveness-NTU methods and calculateRadiative heat transfer between black body surfaces as well as grey body surfaces.

**Note:** Heat Transfer Data Book is permitted.

***Unit-I***

Properties of fluids, Measurement of pressure. Fluid kinematics - Streamline, path line and streak Lines and stream tube, classification of flows, steady, unsteady, uniform, non-uniform, laminar, Turbulent. Rotational and irrotational flows – Equation of continuity for one dimensional flow.

***Unit-II***

Fluid Dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a stream Line. Bernoulli's equations for real fluids, Flow measurement by Venturi meter and orifice meter, Momentum equation – impact of jet on flat and curved - stationary and moving vanes.

***Unit-III***

Conduction: Modes of Heat Transfer, Fourier heat conduction equation, general heat condition Equation, conduction through homogeneous slab, cylinder and sphere, Heat Transfer through Composite structures as plane wall, cylinder.

***Unit-IV***

Convection: Dimensional analysis, Rayleigh and Buckingham methods applied to heat transfer, Non-dimensional members in heat transfer. Thermal and velocity boundary layer, Mean Temperature for evaluation of fluid properties. Forced convection of laminar flow inside ducts and Over bodies. Local and average heat transfer coefficients.

***Unit-V***

Radiation: Emission characteristics and laws of Black body radiation, Incident radiation, total and Monochromatic quantities. Laws of black, Kirchoff, Lambart, Stephan and Boltzman. Concept of Shape factor, Emissivity. Classification of heat exchangers – overall heat transfer Coefficient and Fouling factor – Concepts of LMTD and NTU methods.

***Suggested Readings:***

1. Sachdev, Heat Transfer - TMH
2. Dr. R. K. Bansal, Fluid Mechanics and Hydraulics Machines
3. Heat and Mass Transfer Data Book –Kondandaraman – New Age

***Reference Books:***

1. Dixit, Heat and Mass Transfer – Mc Graw Hill
2. Yunus Cengel, Boles, Heat Transfer – A Practical Approach –TMH.
3. Dr. P N Modi, Dr. S M Seth, Hydraulics and Fluid Mechanics Including Hydraulic Machines, SBH
4. K. L. Kumar, Engineering Fluid Mechanics, S. Chand & Co.

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## B.Tech. in Mechanical Engineering (Mechatronics)
## III Semester Syllabus
## MC301HS: Constitution of India

### Course objectives

At the end of this course, students are expected to
- Students will get to know about the history of Indian Constitution
- Students will get to know about President election and his Powers
- Students will get to know about Council of Ministers and their election Procedure and their Powers andResponsibilities
- Students will get know about Judicial System in India
- Students will get know about Panchayat-raj System in India

### Course Outcomes

After successful completion of this course, students should be able to
- This enables the Students to know about the Rights of Citizen.
- This enables the Students to know about Fundamental Duties of People.
- This enables the Students to Know the Directive principles of State Policy.
- This enables the Students to know about Functioning of Parliament and its Powers.
- This enables the Students to know about various Constitutional bodies in India.

### Course content

1. Meaning of the constitution law, and constitutionalism
2. Historical perspective of the Constitution of India
   - Drafting Committee
3. Salient features and characteristics of the Constitution of India
   - Preamble
   - Salient Features
   - Major Sources of Indian Constitution
4. Scheme of the fundamental rights
   - Article 13 to 32
   - Scheme of the Fundamental Right to Equality
   - Scheme of the Fundamental Right to certain Freedom
   - Scope of the Right to Life and Personal Liberty
5. The scheme of the Fundamental Duties and its legal status
   - List of Fundamental Duties
   - Justifiability of Fundamental Duties
6. The Directive Principles of State Policy – Its importance and implementation
   - Categories - Gandhian, Socialist and Liberal Principles
   - Significance of Directive Principles of State Policy
   - Relation between Fundamental rights and Directive Principles of State Policy
7. Federal structure and distribution of legislative and financial powers between the Union and the States
   - Union List
   - State List
   - Concurrent List
   - Residuary Powers

8. Parliamentary Form of Government in India.
9. The constitutional powers and status of the President of India vs the constitutional powers and status of theCouncil of ministers headed by the Prime Minister
10. Amendment of the Constitution and its Procedure
    - Procedure of Amendment to Constitution of India
    - Important Amendments
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
    - Urban local Self Government
    - Rural local Self Government
13. Important Constitutional Bodies
    - Election Commission of India
    - Finance Commission of India
    - Union Public Service Commission
    - C-AG

**Suggested Readings**:

1. Subhash Kashyap, Our Constitution, National Book Trust, 5th Edition,Reprint- 2017.
2. V. N Shukla,The Constitution of India,Law literature Publication, 11th Edition, 2020.

**Reference Books**:

1. M P Jain, Indian Constitutional Law, Lexis Nexis, 8th Edition, 2018.
2. Samaraditya Pal, Indian Constitution-Origin& Evolution, Lexis Nexis, 1st Edition, 2019

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**III Semester Syllabus**
**EC362PC: Electronic Devices and Circuits Lab**
**(Common to ECE & MCT)**

**Course Objectives**

- To familiarize with various circuit components, Display devices.
- To understand the characteristics of Diode, Zener Diode
- To understand the applications of diode as rectifiers, clippers and clampers.
- To understand the characteristics of BJT and FET
- To understand the Common Emitter Amplifier Characteristics

**Course Outcomes**

Upon completing of this course, the student will be able to:

- Illustrate the utility of various semiconductor devices, passive elements, circuit behavior and parameters to beestimated.
- Identify specifications, choice of device and equipment required.
- Measurement of various diodes and transistor circuit characteristics.
- Set up different types of rectifier and Filter circuits and estimate of their performance characteristics.
- Design, develop and test BJT and FET amplifier circuits and estimate the Amplifier parameters.

**List of Experiments (Twelve experiments to be done):**

Verify any twelve experiments in H/W Laboratory

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Zener diode characteristics and Zener as voltage Regulator
3. Full Wave Rectifier with & without filters
4. Input and output characteristics of BJT in CE Configuration
5. Input and output characteristics of FE in CS Configuration
6. Common Emitter Amplifier Characteristics
7. Common Base Amplifier Characteristics
8. Common Source amplifier Characteristics
9. Measurement of h-parameters of transistor in CB, CE, CC configurations
10. Switching characteristics of a transistor
11. SCR Characteristics.
12. Types of Clippers at different reference voltages
13. Types of Clampers at different reference voltages
14. The steady state output waveform of clampers for a square wave input

***Major Equipment required for Laboratories:***

1. Regulated Power Suppliers, 0-30V
2. 20 MHz, Dual Channel Cathode Ray Oscilloscopes.
3. Functions Generators-Sine and Square wave signals
4. Multimeters
5. Electronic Components

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**III Semester Syllabus**
**MM361ES: Metallurgy & Mechanics of Solids Lab**
**(Common to ME & MCT)**

***A) Metallurgy Lab:***

***Course Objectives***

At the end of this course, students are expected to
- Impart fundamental knowledge of materials properties, their selection and application.
- Explain the role of Metallurgy and Material Science in all manufacturing processes.
- Understand the metallography of ferrous and non-ferrous metals.

**Course Outcomes**

After successful completion of this course, students should be able to develop following skills
- Study the atomic structure of the materials.
- Analyze the microstructure of the materials.
- Correlate the microstructure to mechanical properties of the materials.

***List of Experiments:***

1. Preparation and study of crystal structure models for simple cubic, body centred cubic, face centered cubicand hexagonal close packed structures.
2. Preparation and study of microstructure of pure metals like Iron, Cu, and Al.
3. Preparation and study of microstructure of mild steels, low carbon steels and high carbon steels.
4. Study of microstructures of Cast Irons.
5. Study of microstructures of Non-Ferrous alloys.
6. Hardenability of steels by Jominy End Quench Test.

***B) Mechanics of Solids:***

**Course Objectives**

- Understand basic concepts of stress, strain and their relations based on elasticity.
- Understand basic concepts of material behavior due to different types of loading.
- Understand how to calculate stresses and deformation of a bar due to an axial loading.

***Course Outcomes***

- Analyze the behavior of the solid bodies subjected to various types of loading.
- Apply knowledge of materials and structural elements to the analysis of simple structures.
- Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of.

**List of Experiments:**

1. Tension test
2. Bending test on Simply supported beam
3. Bending test on Cantilever beam
4. Torsion test
5. Hardness test (Brinell & Rockwell)
6. Test on springs
7. Impact test.( Charpy and Izod)

**Note:** Any 10 experiments from the above are to be conducted taking at least four from each section.

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## B.Tech. in Mechanical Engineering (Mechatronics)

## III Semester Syllabus

## MT351PC: Fluid Mechanics and Heat Transfer Lab

***Course Objectives***

At the end of this course, students are expected to

- Determine the co-efficient of discharge for various flow measuring devices
- Find out the major losses in flow through pipes.
- Determine the performance characteristics of impulse and reaction turbines
- Understand the performance of impact of jet on vanes
- Calculate the co-efficient of discharge for various flow measuring devices
- Analyze the characteristics of hydraulic turbines
- Analyze the coefficient of jets for different vanes

**Course Outcomes**

After successful completion of this course, students should be able to develop following skills

- Calculate the co-efficient of discharge for various flow measuring devices
- Calculate the major losses and minor losses in the flow through pipes
- Analyze the characteristics of hydraulic turbines and coefficient of jets for different vanes
- Perform steady state conduction experiments to estimate thermal conductivity of different materials fordifferent geometries
- Estimate Heat Transfer coefficients in forced and free convections and determine effectiveness of Heatexchangers
- Perform radiation experiments and determine emissivity using emissivity apparatus
- Determine Stefan Boltzmann constant and experimentally

***Any Five experiments from each Lab***

### A) Fluid Mechanics Lab

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Calibration of Venturi meter.
6. Calibration of Orifice meter.
7. Determination of friction factor for a given pipeline.
8. Calibration of V- Notch and Rectangular Notch

### *B) Heat Transfer Lab*

1. Composite slab apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat transfer through a concentric sphere.
4. Thermal conductivity of given metal rod.
5. Heat transfer in forced convection apparatus.
6. Heat transfer in natural convection.
7. Emissivity apparatus.
8. Stefan Boltzman constant.

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# Mahatma Gandhi Institute of Technology (A)
## B.Tech. IV Semester
## MA403BS: Probability, Statistics and Complex Variables
## (ME, MCT and MME)

**Course Objectives**

- The ideas of random variables and various discrete and continuous probability distributions and their properties.
- The concept of theoretical distributions
- The testing of hypothesis and making statistical inferences
- Differentiation of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem. Expansion of complex functions using Taylor's and Laurent's series.

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

- Formulate and solve problems involving random variables and probability distributions
- Understand the theoretical distributions
- Apply concept of testing of hypothesis to case studies
- Analyze the complex function with reference to their analyticity
- Evaluating integrals using Cauchy's integral and residue theorems. Taylor's and Laurent's series expansions of complex function

**UNIT-I: Random Variables and Probability Distributions**

Concept of a Random variables - Discrete and Continuous random variables and their distribution functions – Expectation, Variance and standard deviation of random variables.

**UNIT-II: Theoretical Distributions**

Binomial, Poisson distributions and their properties, Poisson approximation to the binomial distribution, Uniform distribution, Normal distributions and its properties. Normal approximation to Binomial distribution

**UNIT-III: Tests of Hypotheses:**

Test of significance- Basics of testing of hypothesis, Null and Alternate hypothesis, types of errors, level of significance, Critical region, Large sample test - single mean, single proportion, difference of means, difference of proportions; Small sample tests- Student's t-distribution, single mean, difference of means.

**UNIT-IV: Complex Differentiation**

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations in Cartesian and Polar co-ordinates (without proof), finding harmonic conjugate, Mobius transformation.

**UNIT-V: Complex Integration**

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series, Residues, Cauchy Residue theorem (All theorems without Proof).

**Text Books:**

1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition,2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.

**Reference Books:**

1. Fundamentals of Mathematical Statistics, Khanna Publications, S.C.Guptha and V.K.Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations.
3. N.P.Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. J. W. Brown and R.V.Churchill, ComplexVariables and Applications, 7th Edition, Mc-GrawHill,2004.

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# B.Tech. in Mechanical Engineering (Mechatronics)
# IV Semester Syllabus
# EC432PC: Switching Theory and Logic Design

## Course Objectives

This course provides in-depth knowledge of switching theory and the design techniques of digital circuits, which is the basis for design of any digital circuit. The main objectives are:

- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations
- To implement simple logical operations using combinational logic circuits
- To design combinational logic circuits, sequential logic circuits
- To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines.
- To implement synchronous state machines using flip-flops.

## Course Outcomes

Upon completion of the course, students should possess the following skills:

- Be able to manipulate numeric information in different forms, e.g. different bases, signed integers, various codes such as ASCII, Gray, and BCD.
- Be able to manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
- Be able to design and analyze small combinational circuits and to use standard combinational functions/building blocks to build larger more complex circuits.
- Be able to design and analyze small sequential circuits and devices and to use standard sequential functions/building blocks to build larger more complex circuits.

***Unit - I***

**Number System and Boolean Algebra and Switching Functions:** Number Systems, Base Conversion Methods, Complements of Numbers, Codes- Binary Codes, Binary Coded Decimal Code and its Properties, Unit Distance Codes, Alpha Numeric Codes, Error Detecting and Correcting Codes. **Boolean Algebra:** Basic Theorems and Properties, Switching Functions, Canonical and Standard Form, Algebraic Simplification of Digital Logic Gates, Properties of XOR Gates, Universal Gates, Multilevel NAND/NOR realizations.

***Unit - II***

**Minimization and Design of Combinational Circuits:** Introduction, The Minimization with theorem, The Karnaugh Map Method, Five and Six Variable Maps, Prime and Essential Implications, Don't Care Map Entries, Using the Maps for Simplifying, Tabular Method, Partially Specified Expressions, Multi- output Minimization, Minimization and Combinational Design, Arithmetic Circuits, Comparator, Multiplexers, Code Converters, Wired Logic, Tristate Bus System, Practical Aspects related to Combinational Logic Design, Hazards and Hazard Free Relations.

***Unit - III***

**Sequential Machines Fundamentals:** Introduction, Basic Architectural Distinctions between Combinational and Sequential circuits, The Binary Cell, Fundamentals of Sequential Machine Operation, The Flip-Flop, The D-Latch Flip-Flop, The "Clocked T" Flip-Flop, The "Clocked J-K" Flip- Flop, Design of a Clocked Flip-Flop, Conversion from one type of Flip- Flop to another, Timing and Triggering Consideration, Clock Skew.

***Unit - IV***

**Sequential Circuit Design and Analysis:** Introduction, State Diagram, Analysis of Synchronous Sequential Circuits, Design Steps, Realization using Flip-Flops Counters - Design of Single mode Counter, Ripple Counter, Ring

Counter, Shift Register, Shift Register Sequences, Ring Counter Using Shift Register.

***Unit - V***

**Sequential Circuits:** Finite state machine-capabilities and limitations, Mealy and Moore models- minimization of completely specified and incompletely specified sequential machines, Partition techniques, and Merger chart methods-concept of minimal covertable approaches. Design of Synchronous Sequential Finite State Machines, Design Aspects, State Reduction

**Algorithmic State Machines:** Salient features of the ASM chart-Simple Examples-System design using data path and control subsystems-control implementations-examples of Weighing machine and Binary multiplier.

***Suggested Readings:***

1. Zvi, Kohavi & Niraj K. Jha -Switching and Finite Automata Theory , 3rd Edition, Cambridge
2. Morris Mano, PHI, 3rd Edition -Digital Design.

***Reference Books:***

1. Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc -Introduction to Switching Theory and Logic Design .
2. Thomas L. Floyd, Pearson, 2013-Digital Fundamentals – A Systems Approach.
3. Ye Brian and Holds Worth, Elsevier -Digital Logic Design.
4. Charles H. Roth, Cengage Learning, 5th, Edition, 2004-Fundamentals of Logic Design.
5. John M. Yarbrough, Thomson Publications, 2006-Digital Logic Applications and Design.
6. Comer, 3rd, Oxford, 2013-Digital Logic and State Machine Design.

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**MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)**
**IV Semester Syllabus**
**EE432ES: ELECTRICAL ENGINEERING**
**(MCT)**

*Prerequisite:* ***Mathematics, Physics***

**Course Objectives:**

This course introduces:
1. The concepts of electrical DC and AC circuits, basic laws of electricity
2. Instruments to measure the electrical quantities,
3. Different methods to solve the electrical networks.
4. The construction, operational features of DC machines
5. The construction, operational features of transformers, induction motors and synchronous machines.

**Course Outcomes:**

After going through this course the student gets a thorough knowledge on
1. Basic electrical circuits, parameters
2. Analysis of simple electrical circuits
3. Operation of the transformers in the energy conversion process, electromechanical energy conversion
4. Construction, operation characteristics of DC and AC machines
5. Different applications of DC and AC machines

**Unit – I: DC CIRCUITS**

Electrical circuit elements (R, L and C), Power, Energy, Circuit Ground, Kirchhoff's Voltage Law & Kirchhoff's Current Law, analysis of simple circuits with DC excitation - Mesh (Loop) Analysis, Nodal Analysis, Delta-Wye Conversion. Electrical Instruments: Basic principles of indicating instruments – moving coil and moving iron instruments.

**Unit – II: AC CIRCUITS**

Generating AC Voltages, peak and rms values, R, L, and C Circuits with Sinusoidal Excitation, Analysis of single-phase AC circuits consisting of R, L, C, RL, RC, RLC combinations, real power, reactive power, apparent power, power factor, Three-Phase Voltage Generation, Three-phase connections, voltage and current relations in star and delta connections

**Unit – III: DC MACHINES**

Working principle and construction of DC machine, EMF equation of DC generator, types of DC generators, Magnetization characteristics of DC generators, Principle of operation of DC Motor, torque in DC motor, types of DC motors, Efficiency of DC machine, DC Motor Starter (Three Point starter), DC machine losses, Efficiency Calculation, Swinburne's Test

**Unit – IV: TRANSFORMERS**

Principle of operation, construction of transformers, EMF equation of transformer, Open circuit and short circuit tests, regulation, and efficiency calculations.

**Unit – V: INDUCTION MOTORS AND SYNCHRONOUS MOTORS**

Generation of rotating magnetic fields, construction and working of a three-phase induction motor, types of induction motor, synchronous speed, slip of induction motor, torque in three phase induction motor, significance of torque-slip characteristic.

**Synchronous Motors:** Basic Principle, Details of Construction

**Suggested Readings:**

1. M S Sukija, TK Nagasarkar Basic Electrical and Electronics Engineering – Oxford University.
2. D.P. Kothari, I J Nagrath, Basic Electrical and Electronics Engineering - McGraw Hill Education.

**Reference Books:**

1. R. L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, PEI/PHI, 9th Ed, 2006.
2. J. Millman and C. C. Halkias, Satyabrata Jit, Millman's Electronic Devices and Circuits, TMH, 2/e, 1998.
3. William Hayt and Jack E. Kemmerly, Engineering circuit analysis, McGraw Hill Company, 6th edition.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**IV Semester Syllabus**
**ME401PC: Kinematics of Machinery**
**(Common to ME & MCT)**

**Prerequisites:** Basic principles of Mechanics

***Course Objectives***

At the end of this course, students are expected to
- To study the relative motion, velocity, and accelerations of the various elements in a mechanism.
- To study the concept of mobility of Linkages, mechanisms such as four bar /slider crank/double slidercrank/straight line motion mechanism etc.
- To analyze and understand the mechanisms with Lower pairs and Steering gear mechanisms and workingof hooks joint.
- Develop the skills for designing and analyzing the mechanisms with higher pair such as Cams, Gears and GearTrains.
- To study the types and motion relation of the belt, rope and chain drives.

**Course Outcomes**

Upon successful completion of this course, the student will be able to
- Identify different relative motions among various elements in mechanisms.
- Understand the position, velocity and acceleration in kinematics of mechanisms.
- Design the mechanisms with lower pairs and higher pairs.
- Understand the application of gears and gear trains
- Apply the knowledge of the types and motion relation of the belt, rope and chain drives in industrialapplications and solve the problems on power transmission.

***Unit – I***

**Mechanisms:** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.

**Mechanism and Machines** – Mobility of Mechanisms: Grubler's criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains.

***Unit – II***

**Kinematics:** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

**Plane motion of body:** Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

***Unit – III***

**Straight-line motion mechanisms:** Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism – Pantographs

**Steering gears:** Conditions for correct steering – Davis Steering gear, Ackerman's steering gear. **Hooke's Joint:** Single and double Hooke's joint –velocity ratio – application – problems.

***Unit – IV***

**Cams:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers:** Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

***Unit – V***

**Higher pair:** Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

**Gear Trains:** Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile.

***Suggested Readings:***

1. JOSEPH E. SHIGLEY, Theory of Machines and Mechanisms, Oxford
2. R S Khurmi & J.K. Gupta.Theory of Machines

***Reference Books:***

1. S. S. Rattan, Theory of Machines Mc Graw Hill Publishers
2. Sadhu Singh, Theory of Machines, Pearson.
3. Thomas Bevan, Theory of Machines, CBS.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**IV Semester Syllabus**
**MT401PC: Machine Drawing and Computer Aided Graphics**

**Course Objectives**

At the end of this course, students are expected to
- Familiarize with the standard conventions for different materials and machine parts in working drawings.
- Make part drawings including sectional views for various machine elements.
- Prepare assembly drawings given the details of part drawings.
- Learn the concept of fluid system and analysing the applications of fluid systems in power transmission.
- Prepare CAD 2D and 3D part models using AUTOCAD and Solid works.

**Course Outcomes**

Upon successful completion of this course, the student will be able to
- Preparation of engineering and working drawings with dimensions and bill of material during design anddevelopment. Developing assembly drawings using part drawings of machine components.
- Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts,keys, gears, webs and ribs, Sections
- Types of Drawings – working drawings for machine parts. Title boxes, their size, location and details–Methods of dimensioning.
- Understand the use of hydraulic and pneumatic systems and design of hydraulic and Pneumatic circuits forindustrial applications.
- Preparation of 2D Drawings and 3D Basic solid models using CAD.

***Machine Drawing Conventions:***

Need for drawing conventions– introduction to BIS conventions, Conventional representation of materials, commonmachine elements and parts such as screws, nuts, bolts, keys, gears, webs and ribs.

***I. Drawing of Machine Elements and simple parts***

Selection of Views, additional views for the following machine elements and parts with easy Drawing proportions.

1) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws and gears.
2) Keys, cotter joints and knuckle joint.
3) Riveted joints for plates.
4) Shaft coupling: Universal coupling, Oldham's coupling.
5) Journal, pivot and collar and foot step bearings.

***II. Assembly Drawings:***

Drawings of assembled views, detailing for the part drawings of the following using conventions and easydrawing proportions.

1) Engine parts – stuffing box, Eccentric, Petrol Engine connecting rod.
2) Machine tool parts: Tool Post, Machine Vice.
3) Other machine parts-Screws jack, Plummer block.
4) Valves: Air Cock, Rams bottom safety valve, blow-off cock valve.

***III. Introduction to Industrial fluid system***

Circuit Drawings for Double Acting Hydraulic Cylinder, Single Acting / Double Acting Pneumatic Cylinder with direct, flow, and pressure control Valves

**IV. Introduction to Computer Aided Graphics: (For internal Evaluation weightage only)** Fundamentals of 2D construction- line, circular, polyline, spline, polygon, simple problems, conversion of simplepictorial views into orthographic views.

**Note:** First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

***Suggested Readings:***

1. Ajeet Singh, Machine Drawing–TMH Publications
2. K.L.Narayana, P.Kannaiah & K.VenkataReddy, Machine Drawing–New Age/Publishers
3. N.D.Bhatt, Machine Drawing
4. James D.Bethune, Engineering Graphics with AutoCAD–PHI2009Edition.
5. S.R. Majundar, Oil Hydraulic Systems: Principles & Maintenance–Mc.Grawhill Publication

***Reference Books:***

1. P.S.Gill, Machine Drawing
2. Luzzader, Machine Drawing
3. Rajput, Machine Drawing

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**MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)**
**IV Semester Syllabus**
**EE462ES: ELECTRICAL ENGINEERING LABORATORY**
**(MCT)**

*Prerequisite:* ***Basics of Electrical Engineering***

**Course Objectives:**

1. To study a given network by applying various electrical laws
2. To understand the response of different types of electrical circuits to different excitations.
3. To study a given network by applying various network theorems
4. To understand the measurement, calculation and relation between the basic electrical parameters
5. To understand the performance characteristics of DC and AC machines

**Course Outcomes:**

After completion of the course, students will be able to:

1. Analyze the network by applying various electrical laws
2. Analyze different types of electrical circuits to different excitations.
3. Analyze the network by applying various network theorems
4. Acquire the knowledge of relation between the basic electrical parameters
5. Analyze the performance characteristics of DC and AC machines

**LIST OF EXPERIMENTS/ DEMONSTRATIONS:**

1. Verification of Ohm's Law
2. Verification of KVL and KCL.
3. Resonance in series RLC circuit.
4. Calculation and Verification of Impedance and Current in series RL, RC and RLC circuit.
5. Verification of Superposition theorem.
6. Verification of Reciprocity theorem
7. Verification of maximum power transfer theorem.
8. Measurement of Active and Reactive Power in a balanced Three-phase circuit
9. Magnetization characteristics of D.C. Shunt generator.
10. Performance characteristics of DC shunt motor.
11. Open Circuit & Shot Circuit test on Single-phase transformer.
12. Performance characteristics of three phase Induction motor
13. Load Test on Single Phase Transformer (calculate efficiency and regulation)
14. No-Load Characteristics of a Three-phase Alternator

**Note: Any 10 of the above experiments are to be conducted**

**TEXT BOOKS:**

1. D.P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 4 th Edition,2019.
2. MS Naidu and S Kamakshaiah, “Basic Electrical Engineering”, Tata McGraw Hill, 2 nd Edition,2008.

**Reference books:**

1. P. Ramana, M. Suryakalavathi, G.T.Chandrasheker,”Basic Electrical Engineering”, S. Chand, 2nd Edition, 2019.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
3. Abhijit Chakrabarthi, Sudipta Debnath, Chandan Kumar Chanda, “Basic Electrical Engineering”, 2nd Edition, McGraw Hill, 2021.
4. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

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**B.Tech. in Mechanical Engineering (Mechatronics)**
**IV Semester Syllabus**
**MT451PC: Thermal Science Lab**

**Course Objectives**

At the end of this course, students are expected to
- Impart practical knowledge of operating an IC engine, i.e Spark ignition Engine and compression ignitionengine.
- Analyse the working and performance of IC engines.
- Learn experimentally the performance characteristics of an IC engine and performance of air compressors.
- Understand the various components of steam boilers.
- Understand valve and port timing diagrams experimentally.

**Course *Outcomes***

Upon successful completion of this course, the student will be able to
- Analyse the performance and operating characteristics of an IC engine using rope brake and electricaldynamometer.
- Draw the heat balance sheet for an IC engine.
- Analyse the performance of reciprocating air compressor.
- Understand of working of steam boilers and their accessories and mountings.
- Calculate & compare the performance characteristics and IC engine load variations with air fuel ratio.

**List of Experiments**

1. I.C. Engines Performance Test of 4 -S single cylinder Diesel Engine
2. Heat Balance test on 4-S single cylinder Diesel Engine
3. I.C. Engines Performance Test of 4 -S double cylinder Diesel Engine
4. I.C. Engines - Determination of A/F Ratio and Volumetric Efficiency
5. Performance Test on Variable Compression Ratio Engines.
6. I C Engine Morse and retardation Test
7. Performance Test on Reciprocating Air Compressor
8. Study of I.C. Engines Valve / Port Timing Diagrams
9. Dis-Assembly and Assembly of a automobile vehicle
10. Study of Boiler Models

**Note:** Perform all TEN experiments.

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**B.Tech. in Mechanical Engineering (Mechatronics)**

**IV Semester Syllabus**

**MC451HS: Gender Sensitization Lab**

**(An Activity-based Course)**

**(Common to CE, EEE, ECE, ME, MCT & MME)**

**Course Objectives**

This course aims:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

**Course Outcomes**

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

***Course Description***

This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. Thiscourse also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

***Unit-I: Understanding Gender***

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender- Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male.

***Unit-II: Gender Roles and Relations***

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

***Unit-III: Gender and Labour***

Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."- Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

***Unit–IV: Gender - Based Violence***

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu".

Domestic Violence: Speaking Out -Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

***Unit – V: Gender and Culture***

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature-Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks-The Brave Heart.

**Note:** Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of **English Literature** or Sociology or Political Science or **any other qualified faculty who has expertise in this field from engineering departments.**

- Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on "Gender".

***Suggested Readings:***

- The Textbook, "Towards a World of Equals: A Bilingual Text Book on Gender" written by A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu published by Telugu Akademi, Telangana Government in 2015.

***Assessment and Grading:***

- Discussion & Classroom Participation: 20%
- Project/Assignment: 30%
- End Term Exam: 50%