Scheme of Instruction, Evaluation and Syllabi
of
B.Tech.
ELECTRICAL AND ELECTRONICS ENGINEERING
With effect from Academic Year 2023

UNIVERSITY COLLEGE OF ENGINEERING &TECHNOLOGY
Mahatma Gandhi University
Nalgonda– 500 254, TS, INDIA

UNIVERSITY COLLEGE OF ENGINEERING & TECHNOLOGY

B.TECH., (CBCS) 4-YEARS (8-SEMESTERS) REGULAR PROGRAMME

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

(Applicable from the batch admitted from the Academic Year 2023-24 onwards)

SEMESTER-I

S. NO	CODE	COURSE TITLE	Scheme of Instructions				Scheme of Examinations			Credits
			L	T	P/D	CONTACT Hrs/Wk	Hrs	CIE	SEE	
Theory										
1	BS101MT	Engg. Mathematics-I	3	0	-	3	3	40	60	3
2	BS102PH	Engg. Physics	3	0	-	3	3	40	60	3
3	ES101CS	Programming for problem solving	3	0	-	3	3	40	60	3
4	PC101EE	Electrical & Electronics Engineering Material	3	0	-	3	3	40	60	3
5	PC102EE	Electrical Wiring Estimation and Automation	3	0	-	3	3	40	60	3
Practical										
6	BS 151PH	Engg. Physics lab	-	-	3		3	40	60	1.5
7	ES151CS	Programming for problem solving lab	-	-	2		3	40	60	1
8	ES152 ME	Workshop lab	-	-	6		3	40	60	3
										20.5

L: Lectures T: Tutorials
P: Practical's CIE: Continuous Internal Evaluation
SEE: Semester End Examination BSC: Basic Science Course
HS: Humanities and Social Sciences ESC: Engineering Science Course

BS 101 MT	ENGINEERING MATHEMATICS – I					
Pre-requisites	Mathematical Knowledge of 12th / Intermediate level		L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- To Introduce the Concepts of Sequences, Series and their properties.
- To Study the Concepts of Mean Value Theorems.
- To Introduce the Concepts of Functions of Several Variables and its applications.
- To Introduce the Concepts of Multiple Integrals and its applications.
- To Study Vector Differential and Integral Calculus.

Course Outcomes:

On completion of this course, the student will be able to:

- Find the Nature of Sequences and Series.
- To Apply the Mean Value Theorem and to Find the Roots of Continuous Functions.
- To find the Maximum and Minimum Values of Multiple Variable Functions.
- Use the Knowledge of Multiple Integrals in Finding the Area and Volume of any Region Bounded by Given Curves.
- Apply the Knowledge of Vector Calculus to Find Line, Surface and Volume Integrals.

UNIT – I

Sequences and Series: Sequences, Series, General properties of series, Series of positive terms, Comparison tests, P- test, tests of Convergence, D'Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test, Integral test, Alternating series, Series of positive and negative terms, Absolute convergence and Conditional convergence.

UNIT – II

Calculus of one variable: Rolle's Theorem, Lagrange's, Cauchy's mean value theorems (without proof) Taylor's series, Curvature, Radius of curvature, Circle of curvature, Envelope of a family of curves, Evolutes and Involutes

UNIT– III

Multi variable Calculus (Differentiation): Functions of two variables, Limits and continuity, Partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions(Chain rule),Change of variables, Jacobian Higher order partial derivatives, Taylor's series of functions of two variables, Maximum and minimum values of functions two variables, Lagrange's method of multipliers.

UNIT – IV

Multivariable Calculus (Integration): Double integrals, Change of order of integration, Triple integrals, Change of variables in integrals and applications-areas and volumes, Beta and Gamma functions.

UNIT –V

Vector Calculus: Scalar and vector fields, Gradient of a scalar field, Directional derivative, Divergence and Curl of a vector field, Line, Surface and Volume integrals , Green's theorem in a plane, Gauss's divergence theorem, Stoke's theorem(without proofs)and their verification.

Suggested Reading:

1. R.K.Jain &S.R.KIyengar,*Advanced Engineering Mathematics*,Narosa Publications,4th Edition 2014.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley, 9th Edition, 2012
3. B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43rd Edition, 2014.
4. G.B.Thomas , Maurice Weir and Joel Hass, *Thomas' Calculus* , Peterson, 12th Edition,2010
5. B.V. Ramana, *Higher Engineering Mathematics*, 23rd reprint, 2015.
6. N.P.Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications 2010
7. H.K. Dass, Er. Rajnish Varma, Higher Engineering Mathematics, Schand Technical Third Edition

BS 102 PH	ENGINEERING PHYSICS					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40Marks	

Course Objectives:

The course is taught with the objectives of enabling the student to:

- Understand the basic concepts of matter waves and experimental implications. To understand Schrodinger's wave equation and its implications.
- Appraise significance of stimulated emission and laser light production. Subsequently propagation of laser light through waveguides.
- Understand the formation of energy bands and classification of the solids based on the band theory. To understand the concept of superconductors.
- Understand implications of basic laws of electricity and magnetism to know the significance of techniques of Modern Optics.
- Sensitize towards nanomaterial and appraise the various characterization techniques.

Course Outcomes:

On completion of this course, the student will be able to :

- Enrich and ***understand*** concepts and real time applications of mater waves and implications of matter waves as quantum mechanics evolution.
- Understand construction and working of the laser systems and ***apply*** them to Propagate through fiber optical cable as cutting edge application.
- ***Analyze*** semiconducting materials, superconducting materials, basic laws of electricity and magnetism to know the significance of techniques of Modern Optics.
- ***Evaluate*** the different material characterization techniques.
- Appreciate significance of nanomaterials and ***create*** desired properties by using various methods of synthesis processes.

UNIT – I

Matter waves: de-Broglie hypothesis – properties of matter waves – Davison and Germer's experiment – G.P. Thomson experiment – Uncertainty principle.

Quantum Mechanics: Physical significance of wave function–Schordinger's time independent and time dependent wave equation– Particle in 1-D box– Wave function,

Probability function, energy level

UNIT – II

Electromagnetic Theory: Basic laws of electricity and magnetism – Derivation of Maxwell's equations in integral and differential forms - Conduction and displacement current –modification of Ampere's law - Relation between Displacement Current (D), Electric Intensity (E) and Polarization (P) - Equation of plane wave in free space – Poynting theorem.

Modern Optics: Interference – Newton's Rings by reflected light – Experimental arrangement. Types of diffraction – diffraction grating (Conditions of maxima and minima) – Resolving power of grating –Types of polarized light – Polarization by reflection – Malus law – Double refraction – Nicol's Prism. – Optical activity and polarimeter.

UNIT– III

Lasers: Characteristics of lasers – Absorption of radiation, spontaneous and stimulated emission of radiation - Einstein's coefficients and their relation - Population inversion– Types of lasers - Ruby laser, Helium-Neon laser and Semiconductor laser – Applications of lasers

FibreOptics: Constructionofanopticalfiber–Propagationoflightthroughanopticalfiber-Acceptance angle - Numerical aperture – Types of optical fibers (Based on number of modes and refractive index profile) – Fibre drawing process (double crucible method)-Applications of optical fibers.

UNIT– IV

Semiconductor Physics: Classification of materials based on band theory - Kronig-Penney model (qualitative treatment) - Energy band formation in solids - Intrinsic and Extrinsic semiconductors - Concept of a hole - Carrier concentration and conductivity in intrinsic semiconductors – Formation of P-N junction diode, Zenor diode, Light Emitting Diode and their I-V characteristics – Thermistor and its characteristics - Hall effect and its applications.

Superconductivity: Introduction - General properties of super conductors - Meissner effect Type -I and Type- II superconductors - BCS theory (qualitative) – Introduction to High T_c
Super conductors - Applications of superconductors.

UNIT – V

Nanomaterials: Introduction - Properties of materials at reduced size - Surface to volume ratio – Quantum confinement effect – Classification of nanomaterials - Preparation of nanomaterials: bottom–up methods (e.g., Sol Gel method and Chemical Vapor Deposition method), Top-down methods (e.g., Ball milling method) - Basic ideas of carbon nanotubes – Applications of nanomaterials and their health hazards.

Techniques for Characterization: Morphological studies of materials – X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM). Spectroscopic studies of materials – Fourier Transform Infrared (FTIR), Beer's law, UV-Visible and Raman spectroscopy.

Suggested Reading:

- M.S. Avadhanulu and P.G. Kshirasagar - Engg. Physics, S.Chand& Co.
- C.M. Srivastava and C. Srinivasan - Science of Engg. Materials, New Age International.
- R.K. Gour and S.L. Gupta – Engg. Physics, Dhanpat Rai Publications.
- B.K. Pandey and S.Chaturvedi – Engineering Physics, Cengage Learning.
- A.K Bhandhopadhya - Nano Materials, New Age International.
- S.K. Sharma, et al., Hand book of Material Characterization – Springer.

ES 101 CS	PROGRAMMING FOR PROBLEM SOLVING					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- To introduce the basic concepts of Computing environment, number systems and flowcharts.
- To familiarize the basic constructs of C language – data types , operators and expressions.
- To understand modular and structured programming constructs in C.
- To learn the usage of structured data types and memory management using pointers.
- To learn the concepts of data handling using files.

Course Outcomes:

On completion of this course, the student will be able to :

- Explain various functional components in computing environment
- Develop algorithmic solutions to problems and draw the flow charts
- Explain and use basic constructs of C in writing simple programs
- Use standard library functions in C and develop modular programs using user defined functions and structured data types.

UNIT – I

Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. **Number Systems**: Binary, Octal, Decimal, And Hexadecimal.

Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements

Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

UNIT – II

Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do-While and Examples. Continue, Break and Go to statements

Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. **Recursion-** Recursive Functions.

Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers

UNIT– III

Preprocessors: Preprocessor Commands

Arrays - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two-Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort

UNIT – IV

Pointers - Introduction, Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, L -value and R-value, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command-line Arguments.
Strings - Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions

UNIT –V

Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self Referential Structures, Unions, Type Definition (typedef), Enumerated Types.
Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/Output Functions, Character Input/Output Functions.

Suggested Reading:

1. B.A. Forouzan and R.F. Gilberg, "*A Structured Programming Approach in C"* ,Cengage Learning, 2007 Kernighan BW and Ritchie DM, "*The C Programming Language"*, 2nd Edition,Prentice Hall of India, 2006.
2. Rajaraman V, "*The Fundamentals of Computer"*, 4th Edition, Prentice-Hall of India,2006
3. Dromey " *How to Solve it By Computer* , Pearson education, 2006

PC 101 EE	Electrical & Electronics Engineering Material					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

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

1. To understand the theory of electrical conduction in conductors and semiconductors and to learn about the basic properties of magnetic materials.
2. To learn about dielectric polarization and its characteristics.
3. To get basic understanding about material used for solar power.
4. To learn about techniques for material studies.

UNIT I

Conducting materials: Review of metallic conduction on the basis of free electron theory Fermi-Dirac distribution – variation of conductivity with temperature and composition, Materials for electric resistances- General Electric properties: brushes of electrical machines, lamp filaments, fuses and solder.

Semiconductors: Compound semiconductors – basic ideas of amorphous and organic semiconductor – preparation of semiconductor materials – zone-refining technique – fabrication of p-n-p junction.

Insulating Materials and their applications: Plastics, classification, Thermosetting materials, Thermo-plastic materials, Natural insulating materials, properties and their applications, Gaseous materials; Air, Hydrogen, Nitrogen, SF6 their properties and applications.

UNIT II

Magnetic materials: Classification of magnetic materials – origin of permanent magnetic dipoles – ferromagnetism - hysteresis curve – hard and soft magnetic materials – magnetic material used in electrical machines, instruments and relays.**Nonferrous Alloys and Ceramics:** Aluminum Alloys, Magnesium and Beryllium Alloys,Copper Alloys, Nickel and Cobalt Alloys, Titanium Alloys. Ceramics: Bonding in Ceramics, Structures of Crystalline Ceramics, Defects in Crystalline Ceramics, Flaws in Ceramics, Synthesis and Processing of Crystalline Ceramics, Silica and Silicate Compounds, Inorganic Glasses, Glass-Ceramics, Processing and Applications of Clay Products

UNIT III

Dielectrics: dielectric polarization under static fields – electronic, ionic and dipolar polarizations – behavior of dielectrics in alternating fields – mechanism of breakdown in gases, liquids and solids - factors influencing dielectric strength

– capacitor materials Insulating materials – complex dielectric constant – dipolar relaxation dielectric loss insulator materials used – inorganic materials (mica, glass, porcelain, asbestos) – organic materials (paper, rubber, cotton silk, fibre, wood, plastics, bakelite)- resins and varnishes – liquid insulators (transformer oil) – gaseous insulators (air, SF6, and hydrogen) – ageing of insulators.

UNIT IV

Superconducting Materials: Introduction, The Phenomenon of Superconductivity, Electrical Resistance Behavior at Low Temperature, The Critical Magnetic Field, The Meissner Effect, Two Fluid Model, Thermodynamics of Superconductors, Thermal Conductivity, Thermoelectric Power, The Energy Gap, The Isotope Effect, Flux Quantization, The Concept of Coherence Length and Positive Surface Energy, Determination of Energy Gap (Single Particle Tunneling), The Josephson Effect, Type II Superconductors, High Temperature Cuprate Superconductors and Later Discoveries, A Review of Theories of Superconductivity, Practical Superconductors.

UNIT V

Solar energy and Materials: Solar radiation, spectrum, UV, VIS, IR Solar constant, optical response of materials, optical band gap. Photo thermal conversion – use of coatings for enhanced solar thermal energy collection – Solar selective coatings – Cold mirror coatings – Heat mirror coatings – Anti reflection coatings. Photovoltaic conversion – Solar cells – cell efficiency, characteristics, equivalent circuit–Silicon, Cadmium sulphide and Gallium arsenide. Planner PN Junction. I-V curve of dark and illuminated junction. Solar cell parameters.

Suggested Reading:

1. Indulkar, C.S. Thirivengadam , S An Introduction to Electrical Engineering Materials, S Chand Co, 1998.
2. A.J Dekker Electrical Engineering Materials, Prentice Hall of India. 2008.
3. Arumugam , M Materials Science, Anuradha Publishers, 1990.
4. The Science and Engineering of Materials, Seventh Edition, Donald R. Askeland, Wendelin J. Wright, Cengage Learning, Seventh Edition – 2016.
5. Superconductivity Basics and Applications to Magnets, R.G. Sharma, Springer Series in Materials Science, Volume 214, Springer International Publishing Switzerland 2015.
6. Electrical and Electronic Engineering Materials by K.B. Raina, Dr. S.K. Bhattacharya, S.K. Kataria & Sons,Edition 10^{th} 2021.

PC102EE	ELECTRICAL WIRING ESTIMATION AND AUTOMATION					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives

1. To provide the knowledge and estimation of different electrical components selection and purchase.
2. To give awareness about electrical wiring.
3. To introduce the basic concepts of earthing and materials used for earthing.
4. To acquire the basic knowledge of domestic service wire and fuses.
5. To explain the students about different electrical ventilation systems and basic domestic wiring.

Course Outcomes:

After completion of this course, the students shall be able to:

1. Understand different electrical components estimations.
2. Construct wiring diagrams for different domestic and intertrial applications.
3. Ability to design practical earthing circuits and usage of materials for earthing.
4. Obtain the knowledge of fuses and installation of service wire.

UNIT – I

Estimation Principles: Estimation purpose Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labour conditions, Determination of cost material and labour, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form.

UNIT – II

Wiring and Safety Systems: Systems of distribution of electrical energy, Methods of wiring, Systems of wiring, Choice of wiring systems, general rules for wiring, Determination of number of points, total loads, sub circuits size of conductor, layout of wiring. Fuses, Fuse element material, Necessity of fuse, Types of fuses, Determination of size of fuse wire, Fuse units, HRC fuses, Working principle and installation of MCB, Service line, Service lines installation methods.

UNIT – III

Installation of Lighting Sub – Circuits and Ventilation: Types of lighting circuits, Various circuit diagrams, two-way switching, bed room lighting. Methods of ventilation, Fans, Terminology, Ceiling fans, Table fans, Pedestal fans, Exhaust fans, Industrial fans, Fan selection, Desert coolers.

UNIT – IV

Earthing: Earthing specifications, Points to be earthed, Methods of reducing earth resistance, earth electrodes and earthing leads, Methods of earthing, Determination of size of earth wire and plate for domestic and motor, Materials required for pipe earthing, Specifications of earth wire and earth plate, Measurement of earth resistance, Effect of electric current on human body.

UNIT – V

Smart Homes: Smart Home Foundations, Smart Home Design, The Cost of a Smart Home, Designing and Building the Smart Home LAN, Smart Home Safety Systems, Smart Home Utility Systems, Smart Home Entertainment and Integration.

Suggested Reading:

1. J.B.Gupta, " A Course in Electrical Installation Estimating & Costing" S.K.Kataria and Sons, Ninth Edition, reprint 2016.

2. K.B. Raina & S.K. Bhattacharya, "Electrical Design, Estimating and Costing", New age International publishers, 1991.

3. S.L.Uppal, "Electrical Wiring, Estimating and Costing" Khanna Publishers, seventh reprint 2006.

4. Robert C. Elsenpeter, mToby J. Velte, "Build Your Own Smart Home" , McGraw-Hill,

BS 151 PH	ENGINEERING PHYSICS LAB					
Pre-requisites			L	T	P	C
			-	-	3	1.5
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- Demonstrate an ability to make physical measurements and understand the limits of precision in measurements.
- Demonstrate the ability to use experimental statistics to determine the precision of a series of measurements.
- Demonstrate the ability to understand optical / Semiconducting / dielectric properties of materials.
- Demonstrate the ability to understand the construction and working of different experiments

Course Outcomes :

On completion of this course, the student will be able to :

- Recognize the transformation concepts into practical's.
- Use a best fit to create a graph from a series of data points. Students can extrapolate and interpolate.
- Appreciate the mathematical abilities to meaningful physical conclusions.
- Develop skills to impart practical knowledge in real time solution and learn to design new instruments with practical knowledge.
- Understand the link between theory and practicals

Experiment - I

To calculate the Numerical aperture (NA), acceptance angle of a given optical fibre

Experiment - II

Determination of wavelength of LASER using diffraction grating.

Experiment - III

Determination of planks constant by PHOTO CELL.

Experiment - IV

To determine specific rotatory power of a given solution by using Laurent's Half shade polarimeter.

Experiment - V

To Estimate Radius of curvature of given lens by forming Newton's rings.

Experiment - VI

To determine resolving power of plane grating.

Experiment - VII

Determination of carrier concentration, Mobility and Hall Coefficient of Ge Crystal using Hall Effect Experiment.

Experiment - VIII

To draw the I-V Characteristics of P-N Junction diode and to evaluate the value of potential barrier of the diode.

Experiment - IX

To find the values of Electrical conductivity and energy gap of Ge crystal by Four probe method.

Experiment – X

To determine the constants of A, B and α of given Thermistor.

Experiment - XI

To study characteristics of Solar Cell

Experiment - XII

To draw the I-V characteristics of Zenor diode.

ES 151 CS	Programming for Problem Solving Lab					
Pre-requisites			L	T	P	C
			-	-	2	1
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- To use tools available under LINUX for C programming.
- To gain hands-on experience on basic constructs of C programming.
- To formulate problems and implement algorithmic solutions in C.
- To write modular programs in C using structure programming techniques and data files.

Course Outcomes:

On completion of this course, the student will be able to:

- Write, compile and debug C programs in Linux environment.
- Write simple programs using control structures, user defined functions and data manipulation using arrays.
- Use standard C library functions to develop modular programs in C.

1. Write programs using arithmetic, logical, bitwise and ternary operators.
2. Write programs simple control statements :

   Roots of a Quadratic Equation, extracting digits of integers,reversing digits ,finding sum of digit ,printing multiplication tables, Armstrong numbers, checking for prime, magic number,
3. Sin x and Cos x values using series expansion
4. Conversion of Binary to Decimal, Octal, Hexa and Vice versa
5. Generating a Pascal triangle and Pyramid of numbers
6. Recursion: Factorial, Fibonacci, GCD
7. Finding the maximum, minimum, average and standard deviation of given set of numbers using arrays
8. Reversing an array ,removal of duplicates from array
9. Matrix addition , multiplication and transpose of a square matrix .using functions
10. Bubble Sort, Selection Sort ,
11. Programs on Linear Search and Binary Search using recursion and iteration
12. Functions of string manipulation**:** inputting and outputting string , using string functions such as strlen( ),strcat( ),strcpy( )……etc
13. Writing simple programs for strings without using string functions.
14. Finding the No. of characters, words and lines of given text file
15. File handling programs : student memo printing
16. Create linked list, traverse a linked list, insert a node, delete a node, reversing list

ES 152 ME	WORKSHOP PRACTICE					
Pre-requisites			L	T	P	C
			-	-	6	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives :

- To learn about different tools used in workshop.
- To understand the different manufacturing processes.
- To learn about fabrication of components using different materials.

Course Outcomes :

On completion of this course, the student will be able to :

- Study and practice on tools and their operations of different trades.
- Practice on manufacturing of components using workshop trades including carpentry, fitting, foundry, smithy, sheet metal &welding
- Select suitable tools for machining process including facing, turning &knurling
- Attain basic electrical knowledge for house wiring practice.

LIST OF EXPERIMENTS:

1. **Carpentry shop**
   Making of Cross lap joint with Wood,
   Making of End Lap/Tee Lap Joint with wood
2. **Fitting shop**
   Making of Step cut with Mild Steel flat,
   Making of semicircular and V-cut with Mild Steel flat
3. **Sheet metal shop**
   Making of Funnel with GI Sheet,
   Making of Rectangular box with GI Sheet
4. **House wiring**
   Making of Cleat wiring,
   Making of casing wiring
5. **Welding shop**
   Making of Butt joint using Arc Welding,
   Making of Lap Joint using Arc Welding
6. **Machine shop**
   Making of Step turning on MS cylindrical rod,
   Making of Taper turning on MS cylindrical rod
7. **Foundry shop**
   Preparation of casting using single piece pattern,
   Preparation of casting using core pattern

8. Smithy shop

Forging of square shape peg from cylindrical work piece,

Forging of square shape L- bend peg from cylindrical work piece

Suggested Reading:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology",Vol.I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai

UNIVERSITY COLLEGE OF ENGINEERING & TECHNOLOGY

B.TECH., (CBCS) 4-YEARS (8-SEMESTERS) REGULAR PROGRAMME

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

(Applicable from the batch admitted from the Academic Year 2023-24 onwards)

SEMESTER-II

S. NO	CODE	COURSE TITLE	Scheme of Instructions				Scheme of Examinations			Credits
			L	T	P/D	CONTACT Hrs/Wk	Hrs	CIE	SEE	
Theory										
1	BS 201 MT	Engg. Mathematics-II	3	0	-	3	3	40	60	3
2	BS 201 CH	Engg. Chemistry	3	0	-	3	3	40	60	3
3	HS 201 EG	Communicative English	3	0	-	3	3	40	60	3
4	PC 201 EE	Digital Electronics & Logic Design	3	0	-	3	3	40	60	3
Practical										
6	BS 251 CH	Engg. Chemistry lab	-	-	3		3	40	60	1.5
7	HS 251 EG	Communicative English lab	-	-	2		3	40	60	1
8	PC 251 EE	Computer Aided Electrical Drawing Lab	-	-	2		3	40	60	1
9	ES 251 ME	Engineering Graphics	2	-	4		3	40	60	4
										19.5

L: Lectures T: Tutorials

P: Practical's CIE: Continuous Internal Evaluation

SEE: Semester End Examination BSC: Basic Science Course

HS: Humanities and Social Sciences ESC: Engineering Science Course

BS 201 MT	ENGINEERING MATHEMATICS-II					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- To study Matrix Algebra and its use in solving System of Linear Equations and solving Eigen Value Problems.
- To study the First Order Linear and Non-Linear Ordinary Differential Equations.
- To study the Higher Order Linear Ordinary Differential Equations with Variable and Constant Coefficients.
- To introduce the Concept of Functions of Complex Variable and their Properties.
- To study the Values of Improper Integers using Residue Theorem.

Course Outcomes:

On completion of this course, the student will be able to:

- Solve System of Linear Equations and Eigen Value Problems.
- Find the solution of First Order Ordinary Differential Equations.
- Identify the solution of Higher Order Ordinary Differential Equations.
- Determine the Analyticity and Integrals of Complex Functions.
- Evaluate Complex and Real Integrals Using Residue Theorem.

UNIT – I

Matrices:
Elementary row and column operations, Rank of a matrix, Echelon form, System of linear equations, Linearly dependence and independence of vectors, Linear transformation, Orthogonal transformation, Eigen values, Eigenvectors, Properties of Eigen values, Cayley-Hamilton theorem, Quadratic forms, Diagonalization of Matrices, Reduction of quadratic form to canonical form by orthogonal transformation, Nature of quadratic forms.

UNIT – II
First Order Ordinary Differential Equations:
Exact first order differential equations , Integrating factors, Linear first order equations, Bernoulli's, Riccati's and Clairaut's differential equations ,Orthogonal trajectories of a given family of curves.

UNIT– III
Differential Equations of Higher Orders : Linear Independence and Dependence, Solutions of Second and Higher Order Linear Homogeneous Equations with Constants Coefficients, Method of Reduction of order for the Linear Homogeneous Second Order Differential Equations with Variable Coefficients , Solutions of Non- Homogeneous Linear Differential Equations, Method of Variation of Parameters, Solution of Euler-Cauchy Equation, Simultaneous Linear Differential Equations.

UNIT – IV

Functions of a Complex Variable: Limits and Continuity of a Function, Differentiability and Analyticity, Elementary Analytic Functions, Necessary and Sufficient Conditions for a Function to be Analytic, Cauchy-Riemann Equations in Polar form, Harmonic Functions, Complex Integration, Cauchy's Integral Theorem, Extension of Cauchy's Integral Theorem for multiply connected regions, Cauchy's Integral Formula, Cauchy's Formula for Derivatives

UNIT –V

Residue Calculus: Power Series, Taylor's Series, Laurent's Series, Zeros and Singularities, Residues, Residue Theorem, Evaluation of Real Integrals Using Residue Theorem, Bilinear Transformations **(All Theorems without Proof).**

Suggested Reading:

- R.K. Jain& S.R.K. lyengar, *Advanced Engineering Mathematics*, Narosa Publications, 4th Edition, 2014.
- Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley, 9th Edition, 2012.
- Dr.B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43rd Edition,2014.
- Dr.M.D.Raisinghania, *Ordinary and Partial differential equations*, S.CHAND,17thEdition 2014.
- James Brown, R.V Churchill, *Complex Variables and applications*, Mc Graw Hill 9th Edition 2013
- N. Bali, M.Goyal, A text book of *Engineering Mathematics*, Laxmi publications,2010
- H.K. Dass, Er. Rajnish Varma, *Higher Engineering Mathematics*, Schand Technical Third Edition

BS 202 CH	ENGINEERING CHEMISTRY					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- Understand the fundamentals of application of water chemistry in industry and applications of principles of corrosion to minimize corrosion and associated problems.
- Gain the knowledge of application of Electrochemical principles to construct the electrodes for various purposes and the criterion for determination of feasibility of processes.
- Analyze and interpret the structure of molecules by applying basic principles of spectroscopy.
- Acquire knowledge of biopolymers used for medical purposes with various applications.
- Grasp the latest application of nanotechnology in various industries and Manufacturing different kinds of batteries.

Course Outcomes:

On completion of this course, the student will be able to :

- Attains knowledge about the disadvantages of hard water for domestic and industrial purposes. Also teaches the techniques of softening of hard water and treatment of water for drinking purpose and throws light on prevention of corrosion.
- Rationalize bulk properties and processes using thermodynamic considerations.
- Distinguishes the ranges of electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
- Analyze the basic methods of reactions of organic molecules and study their properties.
- Knowing about different batteries, fuel cells and their applications of nanomaterials.

UNIT – I

WATER CHEMISTRY AND CORROSION (10L):

Water chemistry: Hardness of water-Types and units of hardness, estimation of temporary and permanent hardness of water by EDTA method. Alkalinity of water and its determination Water softening by Ion exchange and Reverse Osmosis methods. Boiler troubles-scales and sludge formation-causes, effects and prevention. Specifications of potable water. Water treatment for drinking purpose-coagulation, sedimentation, filtration, sterilization by Chlorination.

Corrosion- causes and its effects. Types of corrosion-Dry or Chemical corrosion and Wet or Electrochemical corrosion and their mechanism. Electrochemical corrosion and its types. Factors influencing rate of corrosion. **Corrosion control methods**: Cathodic protection methods- Sacrificial anodic and impressed current methods. Surface coating methods: Hot dipping- Galvanizing and Tinning.

UNIT – II

THERMODYNAMICS AND ELECTRO CHEMISTRY(10L):

Thermodynamics: Terminology of Thermodynamics, thermodynamic processes, Work done in Reversible isothermal and adiabatic processes, concept of entropy, physical significance of entropy, Work function, Gibbs free energy and their significance, variation of free energy with temperature and pressure, criteria of spontaneity in terms of entropy and free energy-Numerical

Electrochemistry: Electrochemical cells- Electrolytic and Galvanic cells-notation, cell reaction and cell potentials. Types of electrodes-Calomel, Quinhydrone and Glass electrodes. Determination of P^H of a solution by using Quinhydrone electrode. Thermodynamics of emf of cells-Nernst equation and its derivation. Application of Nernst equation to electrode potential and emf of cells. Numericals. Principles and applications of Potentiometric titrations.

UNIT– III

MOLECULAR STRUCTURES AND SPECTROSCOPY(10L):

Molecular Orbital Theory. Linear Combination of Atomic Orbital's (LCAO).Molecular Orbital energy level diagrams of diatomic molecules-O_2, N_2 and NO.

Description of Electromagnetic spectrum.

Principles of UV-Visible Spectroscopy: Statement of Beer-Lambert Law. Absorption and intensity shifts: Bathochromic, Hypsochromic, Hyper chromic and Hypo chromic shifts with one example each. Principle and applications of UVSensors.

IR Spectroscopy: Principle of IR Spectroscopy.IR active and IR inactive molecules (two examples each). Principle and applications of IR Sensors.

NMR Spectroscopy: Principle of H^1-NMR Spectroscopy. Multiplicity, Chemical Shift. Principle and Applications of MRI.

UNIT – IV

Polymers: Introduction, Classification of polymers-Plastics, Fibres and Elastomers. Preparation, properties and engineering applications of the following polymers: Plastics: PVC and Bakelite Fibers: Nylon 6:6, and Dacron. Elastomers: Buna Sand Butyl Rubber.

Conducting polymers: Introduction. Mechanism of conduction in polymers. Intrinsic conducting polymers: Poly-acetylene and poly-aniline. Applications of conducting polymers

UNIT –V

Energy Sources and Nanomaterials (8L)

Batteries: Primary batteries-Zn carbon battery. Secondary batteries-Pb- Acid battery and Ni- Cd battery. Lithium-ion batteries- advantages and applications.

Fuel cells: Concept of fuel cells and their advantages. Construction and working of H_2-O_2 and methanol-Oxygen fuelcells.

Solar cells: Concept of solar energy conversion, photovoltaic cells.

Nanomaterials: Introduction Properties of nanomaterials. Synthesis of nanomaterials-Top down, Bottom up approach and Sol-gel method. Applications of nanomaterials.

Suggested Reading:

1. Jain & Jain, *Engineering chemistry*, Dhanpat Rai publishing Co.,16th Edition
2. B.L.Tembe,Kamaluddin and M.S.Krishnan, Engineering Chemistry(NPTELWeb- book)
3. Prashanth Rath, Engineering Chemistry, Cengage Learning.
4. M.J.Sienko and R.A.Plane, Chemistry: Principles and Applications, MGH Publishers.
5. B.H.Mahan, University Chemistry, Pearson Publishing Co., 4th Edition.
6. C.N. Banwell, *Fundamentals of Molecular Spectroscopy*, TMH

HS 201 EG	COMMUNICATIVE ENGLISH					
Pre-requisite	English proficiency above B1 level as per the CEFR (Common European Framework of Reference) for languages		L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40Marks	

Course Objectives:

- Communicate clearly, accurately and appropriately
- Know and use verbal and non-verbal communication appropriately
- Infer information from texts
- Learn basic grammar of the English language
- Use appropriate idiomatic expressions, one word substitutes etc.

Course Outcomes:

On completion of this course the student will be able:

- Heighten the awareness of correct usage of English Grammar and vocabulary in writing and speaking besides improving their fluency and comprehensibility.
- Develop their ability as critical readers and writers and will produce paragraphs independently on any context with coherence
- Draft effective business letters and emails
- Exercise critical reading skills by enhancing the quality of life and support lifelong learning.
- Will produce short reports using the drafting process.

UNIT-I

Importance of listening, Types of listening, Importance of communication, types of communication, styles of communication, Communication barriers, listening for specific purposes, Do' s and Don'ts of Listening, Discourse markers & linking words.

UNIT-II

Homonyms, Homophones, Homographs, Synonyms and Antonyms, Concord. one-word substitutes, tenses. Auxiliary Verbs, Question Tags, Root words, Active and Passive voice.

UNIT- III

Importance of reading, reading Comprehensions, Types of Comprehension questions, reading skills-skimming, scanning, intensive and extensive reading, critical reading passages,

UNIT-IV

Letter writing (Official Letter writing), Email Writing & Email Etiquette, Principles of Good Writing, (How to write Introduction and Conclusions for different types of writings) paragraph and precise writing, Essay writing

UNIT-V

Redundancy. Listening to various texts-continued… (In language Lab Inferential passages) Effective presentation, Proverb Expansion through JAM, Idioms and Phrases, Common Errors- I, Common Errors-II

Suggested Reading:

1. Ashraf, M. Rizvi. Effective Technical Communication. Tata McGrail, 2006.
2. Language and Life Skills Approach, Orient Black Swan, 2018.
3. Michael Swan Practical English Usage. OUP, 1995.
4. Meenakshi Ramanan and Sangeetha Sharma. Technical Communication: Principles and Practice-II, Oxford Uni. Press, 2011.
5. Sprignger. F. L. (1975). Engineering Mechanics Statics and Dynamics, III Edition, Harper Collings International Edition.

PC 201 EE	DIGITAL ELECTRONICS AND LOGIC DESIGN					
Pre-requisite			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives :

1. To be able to understand the principles of digital systems and binary arithmetic circuits.
2. To study the properties and realization of various logic gates, A/D and D/A converters.
3. To analyze and design various digital combinational circuits.

Course Outcomes:

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

1. Differentiate the number system, convert and compare a number system to another number systems used in digital logic design.
2. Understand Boolean algebra and its application to DeMorgan's theorems and Karnaugh map reduction method.
3. Analyze and design various digital combinational circuits.
4. Analyze and do some simple design of sequential logic

UNIT I

Boolean algebras and combinational logic, AND, OR and NOT operations. Laws of Boolean algebra, Minimization of Boolean expressions, Truth tables and maps. Sum of products and product of sums, Map method of reduction, Incompletely specified functions, Multiple output minimization.

UNIT II

Tabular minimization, Digital logic families and IC's, Characteristics of Digital IC's,

Introduction

to RTL, DTL, TTL, CMOS, ECL families, Details of TTL logic family, Totem pole, Open collector outputs, wired AND Operation, Comparison of performance, TTL sub-families, Multiplexer and dc-multiplexer, Encoder and decoder, Code converters, Implementation of combinational logic using standard logic gates and multiplexers.

UNIT III

Binary arithmetic and circuits, Half and Full adder, Subtractor and Magnitude comparator, Number complements, Two's complement arithmetic, Carry look ahead adder, Decimal numbers and their codes, BCD and Excess -3 arithmetic

UNIT IV

Synchronous Sequential Circuits: basic latch circuits, Debouncing switch, SR, JK, D and T flipflops, Truth table and execution table, Ripple and Synchronous counters, Up/down counters, General BCD counter, Shift registers, ring counters

UNIT V

A/D and D/A Converters: Converter types — Tracking type, Flash type, Successive approximation type: R-2R ladder, Weighed register type, Switched current source type, Switched capacitor type

Suggested Reading:

1. Anand Kumar A., *Fundamentals of Digital Circuits*, Prentice Hall of India, 4th Edition, 2003.
2. Morriss Mano M., *Digital Design*, Prentice Hall of India, 3rd Edition, 2002.

BS 251 CH	ENGINEERING CHEMISTRY LABORATORY					
Pre-requisites			L	T	P	C
			-	-	3	1.5
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- Determination of hardness of water by Complexometry.
- Determination of Alkalinity of water.
- Estimation of Acid by conductometry, P^H and Potentiometry.
- Verification of Beers law and estimation of $KMnO_4$ by colorimetry.
- To determine the rate constant of reactions from concentration as a function of Time

Course Outcomes:

On completion of this course, the student will be able to :

- Estimate the strength of acids and ions present in unknown solution by conductometry, P^H metry and potentiometry.
- Estimate the concentration of ions present in unknown solution from the absorbance by colorimetric analysis.
- Conduct experiment to estimate hardness of industrial water.
- Conduct experiment to estimate alkalinity of sample water.
- Estimate the rate constants of reactions from concentration of reactants/products as a function of time.

SYLLABUS:

Experiment - I

Estimation of HCL by Conductometry.

Experiment – II

Estimation of Acetic Acid by Conductometry.

Experiment - III

Estimation of HCL by Potentiometry.

Experiment - IV

Estimation of $KMnO_4$ by Potentiometr

Experiment – V

Estimation of HCL by P^H metry.

Experiment – VI

Estimation of Acetic acid by P^H metry

Experiment - VII

Verification of Beer's law and Estimation of $KMnO_4$ by colorimetry.

Experiment - VIII

Verification of Beer's law and Estimation of $CuSO_4$ by colorimetry.

Experiment - IX

Determination of Partition Coefficient of Acetic acid in BuOH and water.

Experiment – X

Estimation of Total hardness of water by Complexometry.

Experiment - XI

Estimation of Permanent and Temporary hardness of water by Complexometry.

Experiment - XII

Determination of Order of Acid catalysed Hydrolysis of Methyl acetate reaction.

Suggested Reading:

1. Senior practical Physical chemistry by BD Khosla, A.Ghulati, VC.Garg., ,R.Chand and Co., New Delhi 10^{th} ed. 2001.
2. Laboratory Manual in Engineering Chemistry, S.K. Bhasin and Sudha Rani Dhanpath Rai Publishing Co.,

HS 251 EG	COMMUNICATIVE ENGLISH LABORATORY					
Pre-requisites	English proficiency above B1 level as per the CEFR (Common European Framework of Reference) for languages.		L	T	P	C
			-	-	2	1
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- Learn IPA and transcription, using dictionary, Decode Phonetic Transcription, overcome the difficulties with the sounds of English, self-learning through CALL.
- Demonstrate Use of English, Speech sounds, Stress and Intonation in day-to-day situations/ conversations/interactions.
- Introducing one self in various context: Social, Academic and Professional
- Improve listening and understand various accent- GIE, RP and GenAm.
- Learn to participate in various contexts: Extempore, Group Discussions and presentation.

Course Out comes:

- On completion of this course the students will be able to
- Sensitize the nuances of English Speech Sounds with computer – Assisted Individualized and independent Language learning.
- Use Better pronunciation and right accent and Intonation.
- Use functional English.
- Listen and speak effectively by understanding various accents.
- Increase possibilities of job prospects and communicate confidently.

UNIT-I

English Sound system: Sounds of English, Vowels, consonants, Using Dictionary to decode phonetic transcription, Transcription exercises with the help CALL (Computer aided language Lab)

UNIT-II

Stress and Intonation: Syllable, word stress and its importance, intonation-falling falling and rising tones.

UNIT-III

Introduction and presentation skills: In social, formal, Academic and Professional context, JAM, Picture description/Prescription, Role plays: Use of Dialogues in various situations and settings, Occasions to give various presentations with emphasis on visual aids and body language.

UNIT-IV

Listening comprehension: Listening to various accents, Listening practice and Exercises, Resume/CV writing

UNIT-V

Group discussions: Types of group discussions, case studies, Do's and Don'ts's of group discussion- Intensive practice., Interview skills- Mock Interviews

Suggested reading/ software:

1. T. Balasubrmanian. A Text Book of English Phonetics for Indian students, McMillan, 2008.
2. J. Sethi et al. A Practical Course in English pronunciation (With CD) prentice Hall of India, 2005.
3. Hari Mohan Prasad. How to prepare for Group Discussions and Interviews, TATA McGraw-Hill, 2006.
4. English for
   Engineers and Technologists (Combined edition Vol. I & II) Orient Black swan, 2010.
5. Software

1. Sky pronunciation Suit.
2. Study Skills
3. English Pronunciation Dictionary-CALD

PC 251 EE	COMPUTER AIDED ELECTRICAL DRAWING LAB					
Pre-requisites			L	T	P	C
			-	-	2	1
Evaluation	SEE	60	CIE		40	

Course Objectives :

1. To understand the terminology of electric circuit and electrical components.
2. To be able to familiarize with electrical machines, apparatus and appliances.
3. To acquire knowledge on various Electrical Engineering software.

Course Outcomes:

At the end of the course students will be able to

1. Identify and draw different components of electrical systems,
2. Draw different control and wiring diagrams
3. Draw winding diagrams of electrical machines.

Drawing of the following using Electrical CADD / Corel Draw / MS Word / PPT/Visio

4. Lines, Arcs, Curves, Shapes, Filling of objects, Object editing & Transformation.
5. Electrical, Electronic & Electro – mechanical symbols.
6. House – wiring diagrams and layout.
7. Simple power and control circuit diagrams.
8. Electrical machine winding diagrams. (A.C & D.C)
9. Transmission tower, Over head lines – ACSR conductors, Single circuit, Double circuit, Bundle conductor.
10. Constructional features of D.C motors, AC motors and Transformers.
11. D.C and A.C motor starter diagrams.
12. Lamps used in illumination 10 . Single line diagram of Power System

Suggested Reading:

1. KB. Raina, S.K. Bhattacharya, Electrical Design, Estimating and Costing, Wiley Eastern Ltd.,1991.
2. Nagrath, Kothari, Electrical Machines, Tata McGraw Hill Publishing Company Ltd., 2000.

A.K. Sawhney, A Course in Electrical Machines Design, Dhanpat R

ES 251 ME	ENGINEERING GRAPHICS					
Pre-requisites			L	T	P	C
			2	-	4	4
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives:

- Introduction to fundamentals and need of AUTOCAD software drawings.
- Knowledge about various 2D command of AUTOCAD drawing applicable for drawing and printing options.
- Inputs on basic concepts of engineering drawing, lettering formats for analyzing various topics via. Conic Sections, Involutes.
- Awareness towards the various types of projections and the drawings of 2D and 3D views.
- Introduction to fundamentals and need of AUTOCAD software drawings.

Course Outcomes:

On completion of this course, the student will be able to :

- Knowledge on the fundamentals of AUTOCAD 2D commands
- Application of basic principles of drawing and scales for representation of prototype objects.
- Relate the logic of projections to points, straight lines and various views of 2D and 3D objects.
- Capability to imagine and project the developed surface and truncated portion of 3D solids.
- Assimilation of visualization process to efficiently communicate ideas graphically and provide editable solutions.

UNIT – I

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering. Geometrical Constructions (General method only), Conic sections (General and special method); Cycloid, Epicycloid, Hypocycloid and Involute (line, triangle, square, circle, Regular Polygons), Construction of Tangent and Normal to all General methods of Conic sections, Cycloid, Epicycloid, Hypocycloid and Involutes.

UNIT – II

Overview of Computer Graphics: Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning, Snap to objects manually and automatically; Drawings straight lines using various coordinate input entry methods, Applying various ways of drawing circles.

UNIT – III

Commands, initial settings, Drawing basic entities, Modify commands, Text and Dimensioning, Blocks Applying dimensions to objects, applying annotations to drawings. Setting up and use of Layers, Create, edit and use customized layers; Changing line lengths through modifying existing lines (Extend/Lengthen); Printing Options

UNIT – IV

Scales – Reduced and Enlarged scales, Representative Fraction, Problems - Plain, Diagonal and Vernier Scales, Projections of Points – projection when placed in different quadrants Projection of Straight lines– Projections when parallel to one plane, perpendicular to one plane, inclined to one plane and inclined to both planes.

UNIT – V

Projections of Planes – Projections when parallel to one plane, perpendicular to one plane, inclined to one plane and inclined to both planes. Projections of Regular Solids –Projections covering those parallel to one plane, perpendicular to one plane, inclined to one plane and inclined to both planes. Sections of Solids - sectional Views of Right regular solids covering Prism, Cylinder, Pyramid, and Cone Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

Suggested Reading:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics,Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Jeyapoovan T. (2015). *Engineering Graphics Using Autocad*, Vikas Publishing House Pvt. Ltd., Noida, 7th Edition
5. S.N. Lal., Engineering Drawing (2018), M/S. Cengage Learning India Pvt. Ltd.,Pratap Gunj, Delhi