22MTC02

CALCULUS
(CIVIL)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to

1. To explain the solutions of system of linear equations by Matrix Methods.
2. To discuss mean value theorems.
3. To explain the Partial Derivatives and the extreme values of functions of two variables.
4. To explain the shape of curves, their areas and volumes of revolutions.
5. To discuss the convergence and divergence of the series.

COURSE OUTCOMES: Completion this course, students will be able to

1. Apply the Matrix Methods to solve system of linear equations.
2. Analyze the geometrical interpretation of Mean value theorems and curvature.
3. Determine the extreme values of functions of two variables.
4. Find the shape of the curve, surface areas and volumes of revolution.
5. Examine the convergence and divergence of infinite Series.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO 2	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO 3	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO 4	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO 5	3	3	3	1	-	-	-	-	-	-	-	1	1	1	-

UNIT-I

Matrices: Rank of a matrix, Echelon form, consistency of linear system of equations, Linear dependence and independence of vectors. Eigen values, Eigenvectors, Properties of Eigen values and Eigen vectors, Cayley Hamilton theorem, Quadratic form, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

UNIT-II

Calculus: Rolle's Theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem (without proofs). Curvature, Radius of curvature, Centre of curvature, Evolute and Involute, Envelopes.

UNIT-III

Partial Differentiation and Its Applications: Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

UNIT-IV

Applications of definite integrals: Curve tracing of standard curves (Cartesian only), Applications of definite integrals to evaluate length of curves, surface areas and volumes of revolutions.

UNIT-V

Sequences and Series: Convergence of sequence and series. Tests for convergence of series: Comparison test, limit comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's series, absolute and conditional convergence.

TEXT BOOKS:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

SUGGESTED READING:

1. B.V.Ramana., "Higher Engineering Mathematics", 11th Reprint, Tata McGraw-Hill, New Delhi, 2010.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.
3. David.Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/ Cole, 2005.

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CHEMISTRY

(CIVIL)

Instruction:	3L Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	3

COURSE OBJECTIVES: This course aims to

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

COURSE OUTCOMES: Completing this course, students will be able to

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	2	-	-	2	2	-	-	-	-	2

UNIT-I Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2, He_2^+, N_2 , O_2 , O_2^- , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, and – Reference electrodes (NHE, SCE) electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides), Cyclization (Diels - Alder reaction)

UNIT–IV Water Chemistry:

Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V Engineering Materials and Drugs:

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation-Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson,Delhi, 7th edition(2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla ,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition(2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

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CIVIL ENGINEERING

22EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring, safety rules and methods of earthing.

COURSE OUTCOMES: Completion this course, students will be able to

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

UNIT-I

DC Circuits: Electrical circuit elements (R,L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables. Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

TEXT BOOKS:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

SUGGESTED READING:

1. D. P. Kothari & I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989
3. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013

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22CSC01

PROBLEM SOLVING AND PROGRAMMING

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

COURSE OUTCOMES: Completion of this course, students will be able to

1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data.
6. Handle data using files.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	1	1	-	1	-	-	-	-	-	-	1
2	3	1	1	-	1	-	-	-	-	-	-	1
3	3	1	1	-	1	-	-	-	-	-	-	1
4	3	1	1	-	1	-	-	-	-	-	-	1
5	3	1	1	-	1	-	-	-	-	-	-	1
6	3	1	1	-	1	-	-	-	-	-	-	1

UNIT I

Introduction to Programming - *Evolution of languages*: Machine, Assembly and High-level languages. *Software requirements for programming*: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

UNIT II

Data Types and Operators, Variable, Sequences and Iteration - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

UNIT III

Conditional Statement, Loops, Arrays and Strings, user-defined Data Types - if..else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

UNIT IV

Dictionaries and Dictionary Accumulation, Functions/Methods - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

UNIT V

File Handling and Memory Management - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, "Programming for Problem Solving", First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Media, Inc.
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. "Programming in Python", R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM Course:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming

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CHEMISTRY LAB
(CIVIL)

Instruction:	3P Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	50 Marks
Credits:	1.5

COURSE OBJECTIVES: This course aims to

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theorical concepts in the preparation of new materials like drugs and polymers.

COURSE OUTCOMES: Completion of this course, students will be able to

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

List of Experiments:

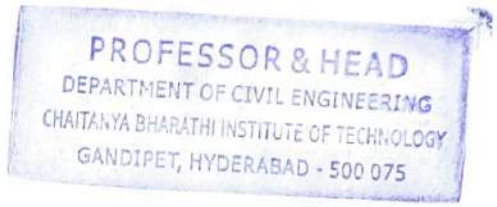
1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2} & Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution with effect from the A.Y. 2022-23
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

TEXT BOOKS

1. J. Mendham and Thomas , "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg & A.Gulati,; R. Chand & Co. : New Delhi (2011).

SUGGESTED READINGS

1. Dr. Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.



22MBC02

COMMUNITY ENGAGEMENT

Instruction	3P Hours per week
SEE	Nil
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

COURSE OUTCOMES: Completion this course, students will be able to

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

Module I Appreciation of Rural Society

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community. Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV Rural Development Programmes

History of Rural Development in India, Current National Programmes: SarvaShikshaAbhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM AwasYojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

TEXT BOOKS:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

22CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Master the fundamentals of writing Python scripts
2. Learn Python elements such as variables, flow controls structures, and functions
3. Discover how to work with lists and sequence data, and files

COURSE OUTCOMES: Completion this course, students will be able to

1. Understand various Python program development Environments
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

Laboratory / Practical Experiments:

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations.
3. Demonstration of operators.
4. Demonstration of selective control structures.
5. Demonstration of looping control structures.
6. Demonstration of List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations

Text Books and References:

1. R.S Salaria, "Programming for Problem Solving", Khanna Book Publishing Co., Delhi
2. Jeeva Jose, "Taming Python by Programming", Khanna Book Publishing Co., Delhi

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22MEC37

ROBOTICS AND DRONES LAB

(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamitic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

COURSE OUTCOMES: Completion this course, students will be able to

1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and Open CV.

CO-PO Articulation Matrix:

PO#/ CO#	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO11	PO12
CO1	3	2	1	1	1	2	1	1	1	2	2	2
CO2	2	3	1	2	3	1	1	1	1	2	2	1
CO3	2	2	2	2	2	1	1	1	1	2	2	2
CO4	2	2	1	2	2	2	1	1	1	2	2	2
CO5	1	1	1	1	1	3	3	3	1	3	3	3

LAB EXPERIMENTS:

1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs: i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects: i)Making a line follower robot using a Camera; ii) Writing code for a complex function
11. Assembly of a drone

Suggested readings

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584
4. https://dronebotworkshop.com/

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22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components

COURSE OUTCOMES: Completion this course, students will be able to

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

List of Laboratory Experiments/Demonstrations:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
4. Verification of Norton's theorem.
5. Charging and discharging of Capacitor.
6. Determination of parameters of a choke or coil by Wattmeter Method.
7. Power factor improvement of single-phase AC System.
8. Active and Reactive Power measurement of a single-phase system using
   (i) 3-Ammeter method (ii) 3-Voltmeter method
9. Measurement of 3-Phase Power in a balanced system
10. Calibration of single-phase energy meter.
11. Verification of Turns/voltage ratio of single-phase Transformer.
12. Open Circuit and Short Circuit tests on a given single phase Transformer
13. Brake test on DC Shunt Motor
14. Speed control of DC Shunt Motor
15. Demonstration of Measuring Instruments and Electrical Lab components.
16. Demonstration of Low-Tension Switchgear Equipment/Components
17. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes.

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22PYC05

MECHANICS AND MATERIALS SCIENCE
(Civil & Mechanical)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Acquire knowledge about physics of oscillations and rotational motion
2. Understand the physical properties of crystalline and magnetic materials
3. Aware of characteristic properties of dielectric materials and superconductors
4. Familiarize with coherent properties of light waves.

COURSE OUTCOMES: Completion this course, students will be able to

1. Compare the various types of oscillations
2. Demonstrate rotational motion of rigid body
3. Classify different types of crystals and their imperfections
4. Identify magnetic and dielectric materials for engineering applications
5. Make use of lasers and superconductors in technological applications

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	1	1	1	1	2	2	1	1	2	1	2
C02	3	1	2	1	2	2	2	1	2	2	2	2
C03	2	2	1	1	1	1	1	1	1	2	1	2
C04	3	2	2	2	2	2	2	1	1	2	1	2
C05	3	2	2	2	2	1	2	2	1	2	1	2

UNIT-I

Oscillations: Simple harmonic motion–Harmonic oscillator–Damped harmonic motion–over damped, critically damped and under damped oscillators–Forced oscillations and resonance.

UNIT-II

Rigid body Dynamics: Definition of rigid body–Rotational kinematic relations–Angular momentum and torque–Equation of motion for a rotating rigid body–Inertia tensor and its properties– Euler's equations and applications: law of energy conservation and law of conservation of angular momentum.

UNIT-III

Crystallography: Space lattice –Unit cell –Crystal systems –Bravais lattices –Number of atoms per unit cell – Coordination number –Atomic radius –Packing fraction (for *sc, bcc, fcc*) –Lattice planes – Miller indices – Bragg's law –Experimental determination of lattice constant of a cubic crystal by powder X-ray diffraction method–Structure of NaCl.

Crystal Imperfections: Classification of defects–Point defects–Concentration of Schottky and Frenkel defects.

UNIT-IV

Dielectric Materials: Introduction–Dielectric polarization–Types of dielectric polarization: electronic & ionic polarizations (quantitative); orientation & space-charge polarizations (qualitative) –Frequency and temperature dependence of dielectric polarization–Determination of dielectric constant (Schering bridge method) – Ferroelectricity–Barium titanate–Applications of ferroelectrics.

Magnetic Materials: Origin of magnetism – Magnetic moment - Bohr magneton–Classification of magnetic materials: dia, para, ferro, anti-ferro and ferrimagnetic materials – Weiss molecular field theory–Domain theory–Hysteresis curve, soft and hard magnetic materials –Applications.

UNIT-V

Lasers: Characteristics of lasers – Einstein's coefficients – Amplification of light by population inversion - Ruby, He-Ne, semiconductor laser – Applications of lasers in engineering and medicine.

Fiber Optics: Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers – Pulse dispersion – Fiber losses – Fiber optic communication system – Applications

Superconductors: General properties of superconductors – Meissner's effect – Type I and Type II superconductors – BCS theory (qualitative) – Applications.

TEXT BOOKS:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P. G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S. L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill Education Publications, 2013.
3. P. K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

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22MTC05

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS (CIVIL)

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to

1. To explain scalar and vector functions with its Physical interpretations.
2. To discuss vector line, surface and volume integrals.
3. To explain relevant methods to solve first order differential equations.
4. To discuss the solution of higher order Differential Equations
5. To learn Numerical solution of ODE and Engineering problems.

COURSE OUTCOMES: Completion this course, students will be able to

Upon completing this course, students will be able to:

1. Apply the vector differential operators to Scalars and Vector functions.
2. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
3. Calculate the solutions of first order linear differential equations.
4. Solve higher order linear differential equations.
5. Find solution of algebraic, transcendental and ODE by Numerical Methods.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	2
CO 5	2	2	2	2	-	-	-	-	-	-	-	1

UNIT-I

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

UNIT-II

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT-III

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact equations, Linear equation, Bernoulli's equation, Clairaut's equation, Riccati's equation, Orthogonal trajectories, Rate of decay of Radio-active materials.

UNIT-IV

Higher Orders Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of variation of parameters, solution of Cauchy- Euler equation, LR and LCR circuits

UNIT-V:

Numerical Methods: Solution of Algebraic and transcendental equations by Bisection method, Regula-Falsi method Newton-Raphson method. Numerical Solutions of First Order Ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

TEXT BOOKS:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

SUGGESTED READING:

1. N.P.Bali and Dr. Manish Goyal, "A text book of Engineering Mathematics", 9th edition, Laxmi Publications, 2017.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.

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22CEC01

ENGINEERING MECHANICS

Instruction	3L+1T Periods per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to

1. Understand the resolution of forces and to obtain resultant of all force systems,
2. Understand equilibrium conditions of static loads for smooth and frictional surface
3. Analyse simple trusses for forces in various members of a truss
4. Obtain centroid, centre of gravity for various regular and composite areas and bodies
5. Obtain Moment of inertia for various regular and composite areas and bodies and also to obtain Mass moments of inertia of elementary bodies

COURSE OUTCOMES: Completion this course, students will be able to

1. Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure
2. Understand the mechanism of friction and can solve friction problems
3. Analyse simple trusses for forces in various members of a truss.
4. Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
5. Determine moments of inertia, product of inertia of plane and composite areas and mass moments of inertia of elementary bodies,

CO-PO Articulation Matrix:

PO / PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

UNIT – I

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane. Resultant of coplanar concurrent force system. Moment of a force, couple and their applications. Resultant of coplanar non-concurrent force system

Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of coplanar force systems.

UNIT – II

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge and belt friction

UNIT – III

Analysis of Simple Trusses: Introduction to trusses, Assumptions, analysis of simple trusses using method of joints and method of sections.

UNIT– IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappus & its applications. Center of gravity of elementary and composite bodies

UNIT – V

Moment of Inertia: Definition of MI, Area MI. Polar Moment of Inertia, radius of gyration, transfer theorem, Moment of Inertia of elementary & composite areas, and Product of inertia. Mass moments of inertia of elementary bodies.

TEXT BOOKS:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer's Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L. Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

SUGGESTED READING:

1. A. Nelson, Engineering Mechanics, Tata McGraw Hill, New Delhi, 2010.
2. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
3. S.B. Junarkar and H.J Shah, Applied Mechanics, Charotar publishers, New Delhi, 2001.
4. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
5. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010

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22EGC01

ENGLISH
(Common to All Branches)

Instruction	2L Hours per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

COURSE OBJECTIVES: This course aims to

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

COURSE OUTCOMES: Completion this course, students will be able to

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques

CO-PO-PSO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

UNIT-I

Understanding Communication in English:

Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II

Developing Writing Skills I:

Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT-III

Developing Writing Skills II:

Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response

Vocabulary and Grammar: Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV

Developing Writing Skills III:

Report writing – Importance, structure, elements of style of formal reports; Writing a formal report.

Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V

Developing Reading Skills:

The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.

Vocabulary and Grammar: Words often confused; Use of standard abbreviations.

TEXT BOOKS:

1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan,2017.
2. Swan Michael, Practical English Usage.OUP.1995.

Suggested Readings:

1. Wood F.T, Remedial English Grammar,Macmillan,2007
2. Zinsser William, On Writing Well, Harper Resource Book, 2001
3. Sanjay Kumar and PushpLata, Communication Skills. Oxford University Press,2011.

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22PYC08

MECHANICS AND MATERIALS SCIENCE LABORATORY
(Civil & Mechanical)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Apply the concepts of physics while doing experiments
2. Learn the working of lasers and optical fibers
3. Understand the properties of magnetic and dielectric materials
4. Capable of measuring mechanical properties of solids and liquids
5. Understand the motion of electrons in electric and magnetic fields

COURSE OUTCOMES: Completion this course, students will be able to

1. Estimate the error in an experimental measurement
2. Make use of lasers and optical fibers in engineering applications
3. Recall the physical properties of dielectrics and magnetic materials
4. Find the mechanical properties of solids and viscosity of liquids
5. Demonstrate the motion of electrons in electric and magnetic fields

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	2	3	1	3	1	3	3	2	1	2
C02	3	2	1	2	2	2	1	2	2	1	1	3
C03	3	2	3	2	3	1	2	2	3	2	1	2
C04	3	3	2	2	2	1	2	3	2	1	1	3
C05	3	1	2	3	2	1	1	2	2	2	1	2

Experiments

1. Error Analysis : Estimation of errors in the determination of time period of a torsional pendulum
2. Flywheel : Determination of moment of inertia of given flywheel
3. Compound Pendulum : Determination of acceleration due to gravity
4. Young's Modulus : Determination of Young's modulus of the given steel bar/wooden scale by non-uniform bending method
5. Helmholtz's Resonator : Determination of resonating volume of air and neck correction
6. Melde's Experiment - : Determination of frequency of the electrically maintained vibrating bar/fork
7. Viscosity of Liquid : Determination of viscosity of a given liquid by oscillating disc method
8. Coupled Oscillator : To determine the coupling constant of a coupled oscillator performing parallel and antiparallel oscillation
9. Dielectric Constant : Determination of dielectric constant of given PZT sample

10.	M & H Values	:	Determination of magnetic moment M of a bar magnet and absolute value H of horizontal component of earth's magnetic field
11.	B-H Curve	:	Determination of hysteresis loss of given specimen
12.	Thermoelectric Power	:	Determination of thermoelectric power of given sample
13.	Laser	:	Determination of wavelength of given semiconductor laser
14.	Optical Fiber	:	Determination of numerical aperture and power losses of given optical fiber
15.	e/m of an electron	:	Determination of specific charge of an electron by J.J. Thomson method

NOTE: A minimum of TWELVE experiments should be done.

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22EGC02

ENGLISH LAB
(Common to All Branches)

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To listen to listening comprehension material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behavior while developing their ability to discuss in groups and making oral presentations.

COURSE OUTCOMES: Completion this course, students will be able to

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

EXERCISES

1. **Introduction to English Phonetics:** Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English:** Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation**: Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with Software available in (K-van solutions)
6. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary** – weaving an imaginative story around a given picture.
9. **Information Gap Activity** – Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation** – Theme, poster preparation, team work and representation.

SUGGESTED READING

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan,2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India,2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd2011
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press,2016

22MEC01

CAD AND DRAFTING

Instruction	1 T + 3 D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

COURSE OBJECTIVES: This course aims to

1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

Outcomes: At the end of the course, the Students are able to

1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

CO-PO-PSO Correlation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	-	1	2	3	1	3
CO2	3	2	2	1	2	2	-	1	2	2	1	2
CO3	3	3	2	1	2	2	-	1	2	2	1	2
CO4	3	3	3	2	2	2	-	1	2	2	1	2
CO5	3	2	2	1	2	2	-	1	2	2	1	2

List of Exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice-versa.

TEXT BOOKS:

1. N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishers, 2012.
2. K.Venugopal, "Engineering Drawing and Graphics + AutoCAD", New Age International Pvt.Ltd,2011.
3. Basanth Agrawal and C M Agrawal, "Engineering Drawing", 2/e, McGraw-Hill Education (India) Pvt. Ltd.

SUGGESTED READING:

1. Shaw M.B and Rana B.C., "Engineering Drawing", 2/e, Pearson, 2009. K.L. Narayana and P.K. Kannaiah, "Text Book of Engineering Drawing", Scitech Publications, 2011.

22MEC38

DIGITAL FABRICATION LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization positive &team work attitude to get things right the first time.
3. Provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting manufacturing, metrology, and allied skills.
5. Advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

COURSE OUTCOMES: Completion this course, students will be able to

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

CO-PO-PSO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	1
CO2	1	-	-	-	1	-	-	-	-	-	-	2
CO3	2	1	1	1	3	-	1	-	-	-	-	2
CO4	2	2	2	1	3	-	-	-	-	-	-	2
CO5	3	2	1	-	3	-	-	-	-	-	-	2

List of exercises:

Group-1

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3.
    a. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch
    b. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.
6.
    a. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
    b. To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

Group- 2

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To Print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students using a 3D printer

TEXT BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Sachidanand Jha, 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer, June 7, 2019.

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015

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GANDIPET, HYDERABAD - 500 075

20CE C16

TRANSPORTATION ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1) Understand the types of highways, patterns, master plans, alignment finalization and components of highway projects.
2) Apply various IRC Standards for the Geometric design of highways.
3) Organize collection of traffic related data and analyzing the data for different applications
4) Apply the design concepts to flexible and rigid pavements as per IRC standards.
5) Execute construction of pavements as per IRC standards and evaluate of pavement condition to recommend suitable remedial measures.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
2	1	1	1	1	-	-	-	-	-	-	2	1	-	2	2
3	3	2	3	1	-	-	-	-	-	-	2	1	1	2	2
4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
5	1	1	1	-	-	-	-	-	-	-	-	-	-	1	1
AVERAGE	**2.2**	**1.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**1.6**	**1.8**

UNIT- I:

Highway Alignment: Objectives and phases of highway engineering, history of highway engineering, factors to be considered for highway alignment, engineering surveys, concepts of master plan, road patterns, highway project preparation, and classification as per IRC.

UNIT- II:

Geometric Design: Highway standards (IRC) - carriageway, shoulders, medians, camber, right of way, footpaths, cycle tracks, service roads, frontage roads, sight distance - stopping sight distance, overtaking sight distance, horizontal curves, super-elevation, transition curve, extra widening, gradient, and grade compensation.

UNIT- III:

Traffic Engineering: Objectives of traffic studies, traffic characteristics, volume, speed, density, headways and relationship among them. Traffic volume studies, speed and delay studies, origin and destination studies, intersection delay studies, parking and accident studies, highway capacity and level of service concept as per HCM 2010, intersection improvement studies at grade, and types of grade separated intersections, channelization, rotary planning and design, concept of signal design – Webster's method.

UNIT- IV:

Pavement Design: Various properties of highway materials, pavement types, factors to be considered for pavement design, structural difference between flexible and rigid pavement design. Flexible pavement design (IRC - 37: 2018), design wheel load, ESWL, EALF. IRC cumulative standard axles method.

Rigid pavement design (IRC 58-2015): Concepts -radius of relative stiffness, Modulus of subgrade reaction and other characteristics of concrete, wheel load stresses analysis by Westergaard's temperature stresses and critical combination of stresses. Longitudinal and transverse joints, contraction joints, expansion joints, and construction joints.

UNIT- V:

Pavement Construction and Maintenance: Construction of WBM roads and WMM roads, types of bituminous construction- interface treatment, bituminous surface dressing, seal coat, penetration macadam, built up spray grout, pre-mix methods, bituminous pre-mix carpet, bituminous concrete, bituminous sheet asphalt, mastic asphalt. Construction procedures – surface dressing, penetration macadam, bituminous bound macadam and bituminous concrete. Construction of cement concrete pavements and construction of joints. Pavement distress, failures of flexible and rigid pavements and remedial measures.

Text books:

1) S. K. Khanna, C. E. G. Justo, and A. Veeraraghavan, "*Highway Engineering*", revised 10th Edition, Nem Chand & Bros.. 2017.
2) L. R. Kadiyali, "*Traffic Engineering and transport planning*", Khanna Publishers.2011.
3) S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand Publishers, 2015.
4) R. Srinivas Kumar, "*Transportation Engineering*", Universities Press, 2020

Suggested Reading:

1) Fred L. Mannering and Scott S. Washburn, "*Principles of Highway Engineering and Traffic Analysis*", 4thEdition, John Wiley, 2007
2) R. Srinivas Kumar," *Pavement Evaluation, Maintenance and Management systems*", Universities Press, 2014.
3) L. A. Garber and N. J. Hoel, K. RamachandraRao, "*Traffic and Highway Engineering*, 5th Edition, 2017. Cengage learning India Pvt. Ltd., New Delhi
4) R. Srinivasa Kumar, "Textbook *of Highway Engineering*", Universities Press, 2011.
5) Dr. L.R. Kadiyali and Dr. N.B. Lal, "Principles and Practices of Highway Engineering", Khanna Publishers, 2018.
6) IRC 37:2018, "Flexible pavement design".
7) IRC 58:2015, "Rigid pavement design".

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R20 CE C17

GEOTECHNICAL ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1) Identify various types of soils and determine their properties.
2) Estimate coefficient of permeability, stresses in soils under various soil conditions and compute discharge in soil.
3) Modify the properties of soil by using various compaction methods and compute the settlement of compressible soils.
4) Estimate the shear strength of different soils under various loading conditions.
5) Evaluate earth pressures and slope stability under different field conditions.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

UNIT- I:

Physical and Index properties of soils: Introduction about origin and formation of soils, basic definitions from soil three phase diagram (weight ratios & volume ratio), Inter relationships of preliminary properties. Determination of laboratory tests for water content, field density, specific gravity by various methods, Index properties, sieve analysis, consistency limits, Indian soil classification IS-1498-1970.

UNIT- II:

Permeability of soils: Darcy"s. law of seepage water through soils- Determination of co-efficient of permeability (constant head, variable head permeability tests) – Field tests (Pumping in and pumping out tests) – Equivalent permeability of stratified soils.

Stress in Soils: Total, effective and neutral stress for different soil conditions.

Seepage in Soil: Seepage flow, seepage pressure – Flow nets – Locating phreatic line in a homogeneous earthen dam using Kozeny's parabola – computation of seepage quantity.

Quick Sand Phenomena: Critical Hydraulic gradient.

UNIT- III:

Compaction: Compaction Mechanism, factors affecting compaction. Laboratory determination of compaction characteristics- standard and modified Proctor tests – IS Light and Heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control.

Consolidation: Spring Analogy, Laboratory consolidation test, calculation of void ratio, compression characters and settlement equation, differential equation for one dimensional consolidation, co-efficient of consolidation – square root & logarithm time fitting method.

UNIT- IV:

Shear strength: Significance of Shear strength of soils – Mohr-Coulomb equation – shear parameters – Laboratory tests for determination of shear strength – Direct shear test, Tri-axial compression tests. (UU, CU and CD), Un-confined compression test, Vane shear test. Factors affecting shear strength of cohesion less and cohesive soils.

UNIT- V:

Earth pressure: States of earth pressure – Active, Passive and at rest condition; Rankine"s theory; computation of active and passive earth pressure in cohesion less (ø)& Cohesive © soils and c-ø soils; Coulomb"s Wedge theory; Rebhann"s graphical solution.

Slope stability: Definition and classification of slopes – types of slope failures- Factors of safety with respect to cohesion, angle of shearing resistance, Height – Analysis of stability of slope using Swedish slip circle method and Taylor"s stability number.

Text Books:

1) K. R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publisher Dist.; 7th Edition, 2009
2) B. C. Punmia, A. K Jain, and A. K. Jain "Soil Mechanics and Foundations", Laxmi Publications; Sixteenth edition, 2017.

Suggested Reading:

1) R. F. Scott, "Principles of Soil Mechanics", Wesley Educational Publishers Inc., 1st edition, 1963.
2) T. W. Lambe and R. V. Whitman, "Soil Mechanics", Wiley; 1 7 edition, 2012.
3) GopalRanjan, "Basic and Applied Soil Mechanics", New Age International Pvt Ltd; Third Edition 2016.
4) C.Venkatramaiah, "Geotechnical Engineering", New Age Publications, revised Fifth edition, 2017.
5) B. M. Das and K. Sobhan, "Principles of Geotechnical Engineering", NPTEL study material.
6) IS 2720-11: Methods of test for soils, Part 11: Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure..

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20CE C18

STRUCTURAL ANALYSIS – II

Instruction:	3L Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40
Marks	
Credits:	3

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

1) Develop the ILD's for reactions, shear force and bending moment at a section, determine the maximum SF and BM for various positions of the moving point loads and uniformly distributed loads.
2) Construct the ILD's for forces in the members of trusses and evaluate the maximum forces for various positions of the moving point loads and uniformly distributed loads.
3) Apply slope – deflection method for indeterminate beams with and without sinking of supports subjected to point loads and udl on the entire span and analyse rigid jointed plane frames with and without lateral sway using slope deflection method.
4) Apply moment distribution method for indeterminate beams with and without sinking of supports subjected to point loads and udl on the entire span and analyse rigid jointed plane frames with and without lateral sway using moment distribution method.
5) Apply matrix, flexibility and stiffness method to continuous beams.

Articulation Matrix:

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
2	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
3	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
4	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
5	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
Average	**3**	**2**	-	-	-	-	-	-	-	-	-	**1**	**3**	**2**	-

UNIT– I:

Moving loads: Influence line diagrams for support reactions, shear force and bending moment for a simply supported beam/girder traversed by (i) single point load, (ii) two point loads (iii) uniformly distributed load longer than the span, (iv) uniformly distributed load shorter than the span and (v) several point loads. Determination of maximum values of support reactions, shear force and bending moment at any section for various moving load systems on simply supported beam/ girder.

UNIT– II:

Moving loads on truss girders: Influence lines for forces in the members of statically determinate trusses like Warren truss, Pratt truss, and Curved flange trusses. Determination of maximum forces in truss members due to moving point loads and uniformly distributed loads. Counter bracing.

UNIT– III:

Slope-deflection method: Analysis of Indeterminate beams with and without sinking of supports and Analysis of rigid jointed plane frames with and without lateral sway. Shear force and bending moment diagrams.

UNIT- IV:

Moment distribution method: Analysis of Indeterminate beams with and without sinking of supports and Analysis of rigid jointed plane frames with and without lateral sway. Shear force and bending moment diagrams.

UNIT- V:

Matrix methods of structural analysis: Introduction, Static and Kinematic Indeterminacy, Compatibility and Equilibrium equations.

Flexibility method of Analysis: Introduction, Analysis of continuous beams with static indeterminacy not exceeding three.

Stiffness method of Analysis: Introduction, Analysis of continuous beams with kinematic indeterminacy not exceeding three.

Text Books:

1) B.C Punmia, and A. K. Jain, "SMTS - II Theory of Structures", Laxmi Publications, New Delhi, 2017.
2) S. Ramamrutham, "Theory of Structures", Khanna Publishers, New Delhi, 2018.

Suggested Reading:

1) H. J. Shah, S. B. Junnarkar, "Mechanics of Structures Vol. II [Theory and analysis of structures]", 24th Edition, Charotar Publishing House Pvt. Ltd., 2015.
2) T. S. Thandava Moorthy, "Structural Analysis", 2nd edition, Oxford University Press, 2012.
3) C. S. Reddy, "Basic Structural Analysis", 3rd Ed., Tata McGraw Hill, New Delhi, 2017.
4) D. S. Prakash Rao, "Structural Analysis" - A Unified Approach, University Press, 2012

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20CE C19

DESIGN OF STEEL STRUCTURES - I

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	
40 Marks	
Credits	3

Codes required: IS 800 – 2007, IS 875 Part II & Part III and Steel Tables.

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

1) Understand the material properties, loads and design philosophies, design bolted and welded connections.
2) Know, how yielding & buckling takes place, design simple and built-up compression members and column bases
3) Understand the modes of failure of tension members ,design tension members using limit state method ,designtension and compression members using working stress method as per IS: 800-2007
4) Classify structural steel sections, distinguish between laterally supported and laterally unsupported beams, designsimple flexural members including secondary considerations
5) Estimate the loads on roof trusses and design purlins and members of trusses

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	-	-	-	-	-	-	-	1	3	3	-
2	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
3	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
4	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
5	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
Average	**3**	**3**	**3**	**1.8**	-	-	-	-	-	-	-	**1**	**3**	**3**	-

UNIT – I:

Materials and Specifications: Chemical composition of steel, types of Structural Steel, classification of RolledSteel Sections.

Design Philosophies: Working Stress Method, Limit State Method, Loads and Load Combinations, Partial safetyfactors for materials and loads.

Bolted Connections (Limit State Method):

Bolted Joints -Modes of failure - Design of Bolted joints using ordinary Black Bolts - Lap & Butt joints - ConcentricConnections and Eccentric Connections, Introduction to High Strength Friction Grip Bolted connections.

Welded Connections (Limit State Method): Types of Welds, Lap and Butt Joints- strength of welded joints - designof welded joints - Concentric Connections and Eccentric Connections.

UNIT – II

Design of Compression Members (Limit State Method): Introduction, yielding & Buckling phenomena, Sections used for compression Members. Effective Length of Compression Members, Design of Compression Members with single section and Built-up Sections, Lacing and Battening, Column Splices.

Design of Column Bases: Design of Slab and Gusset Bases.

UNIT – III

Design of tension members (Limit State Method): Introduction to tension members - Applications of tension members, Modes of Failure, Design of Tension Members –Staggered bolting ,Design of Lug Angles.

Working Stress Method as per IS 800-2007: Permissible Stresses, Slenderness Ratio, Design of tension members,Design of Simple Compression Members.

UNIT – IV

Design of Beams (Limit State Method) : Introduction to Plastic Analysis –Plastic Hinge, Plastic moment, Shape factor; Classification of Cross Sections, Phenomenon of Lateral Torsional Buckling; Design of Laterally Supported beams and laterally Unsupported Beams, Secondary considerations - Check for Web crippling, web buckling & deflection.

UNIT – V

Design of Roof trusses (Limit State Method): Types of trusses, Estimation of loads- dead load, live load and wind load, Design of purlins, Analysis of roof trusses and design of its members with angle sections.

Text Books:

1) S. K. Duggal, "Limit State Design of Steel Structures", 3rd Edition, McGraw Hill HED, 2019.
2) N. Subramanian, "Design of Steel Structures, Limit States Method", 2nd Edition, Oxford University Press, 2016

Suggested Reading:

1) M.R. Shiyekar, "Design of Steel Structures, (Limit State Method", Second Edition, PHI Learning Pvt Ltd. 2013.
2) S. S. Bhavikatti, "Design of steel Structures", 3rd Edition, I.K.International Publishing House Pvt. Ltd. 2012.

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20CE C20

TRANSPORTATION ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Outcomes: The student will be able to

1) Conduct various tests on bitumen, define its quality and decide its suitability for its use in pavements.
2) Conduct various tests on aggregates, define its quality and decide its suitability for its use in roads.
3) Organize various traffic studies and analyze the data by applying statistical tools.
4) Prepare representative samples for various tests on aggregates.
5) Generate technical report based on the studies carried in the laboratory and field studies.

	POs												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	-	-	-	-	-	-	-	-	1	-	2
2	2	2	2	2	-	-	-	-	-	-	-	-	1	1	-
3	2	1	1	2	-	-	-	-	-	-	-	-	-	1	2
4	2	1	1	-	-	-	-	-	-	-	-	-	1	1	1
5	2	1	1	2	-	-	-	-	-	-	-	-	1	1	1
Average	**2**	**1.4**	**1.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1.5**

A) Tests on bitumen

1. Penetration test
2. Ductility test
3. Softening point test
4. Specific gravity test
5. Viscosity test

B) Tests on road aggregates

6. Aggregate crushing value test
7. Los Angeles abrasion test
8. Aggregate impact value test
9. Aggregate shape test (flakiness & elongation)
10. Water Absorption test

C) Traffic Studies

11. Traffic volume study
12. Spot Speed study

D) Miscellaneous Tests (demonstration only)

13. Determination of CBR.
14. Preparation of representative sample by coning and quartering.
15. Bitumen extraction test
16. Marshall stability concepts and tests.

Suggested Reading:

1) Khanna and Justo, "*Highway materials and Pavement Testing*", Nem Chand & Bros. 2013.
2) R. Srinivasa Kumar, "*Highway Engineering*", Universities Press, 2011
3) IRC codes and specifications

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20CE C21

GEOTECHNICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Outcomes: Upon successful completion of this course, students will be able to

1) Identify soils with reference to their characteristics.
2) Evaluate and classify soils according to IS classification.
3) Calculate seepage volume for different soils.
4) Examine methods to improve soil stability of soils.
5) Conduct tests according to IS laboratory standards and procedures

CO	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
4	3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
5	3	1	1	-	1	-	-	-	-	-	-	-	-	3	-
Average	**3**	**1**	**1**		**1**	-	-	-	-	-	-	-	**1.5**	**2.33**	-

List of Experiments:

1) Grain size distribution by Sieve Analysis.
2) Consistency limits - Liquid limit and Plastic limit using Casagrande's method.
3) Compaction test: Standard Proctor test.
4) Field Density using Sand Replacement method.
5) Field Density using Core Cutter method.
6) Specific gravity of soils.
7) Natural Moisture Content using Pycnometer method.
8) Direct Shear test.
9) Permeability test using Falling-head method.
10) Relative density

Demo Experiments:

1) Consolidation test
2) Triaxial test (UU)
3) Vane Shear test

Suggested Reading:

1) B. C. Punmia, "Soil Mechanics and Foundation Engg", (2005), 16th Edition Laxmi Publications Co., New Delhi.
2) IS : 2720(part-3 1964) for specific gravity, (IS : 2720 (Part 17), 1966) for Sieve analysis IS : 2720 (Part-IV), 1965) for Grain size analysis, IS: 2720 (Part 1) - 1983 for shear strength tests and compaction.
3) T. W. Lambe," Soil Testing for Engineers"-., Wiley Eastern Ltd., New Delhi.
4) K. H. Head K.H."Manual of Soil Laboratory Testing"-., (1986)- Vol. I, II, III, Princeton Press, London.

5) 5. J. E. Bowles J.E". Properties of Soil and Their Measurements",. (1988), - McGraw Hill Book Co. New York.
6) https://smfe-iiith.vlabs.ac.in/List%20of%20experiments.html
7) http://home.iitk.ac.in/~madhav/geolab.html

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20CE M01

ENVIRONMENTAL SCIENCE

Instruction	2L Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	0

Course Outcomes: At the end of the course, student is able to

1) Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
2) Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3) Contribute for the conservation of bio-diversity.
4) Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5) Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

	POs												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	-	-	-	3	-	-	-	-	1	1	-	-
2	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
3	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
4	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
5	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
Aver	**1**	**-**	**-**	**-**	**-**	**1**	**2.2**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1) Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2) Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009.

Suggested Reading:

1) C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2) S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006

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20CE E05

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Outcomes: On Successful completion of this course, student will be able to

1) Recall fundamental knowledge on artificial intelligence.
2) Understand neural networks and their types and apply neural networks in the domain of civil engineering.
3) Understand and apply fuzzy controllers to solve real-world civil engineering problems.
4) Explain basic concepts of support vector machines and choose appropriate techniques relevant to civilengineering.
5) Develop a regression models for civil engineering problems.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-
2	1	1	1	-	2	-	-	-	-	-	-	1	1	-	-
3	1	1	1	-	2	-	-	-	-	-	-	1	1	1	-
4	1	1	1	-	2	-	-	-	-	-	-	1	-	1	-
5	1	1	1	-	2	-	-	-	-	-	-	1	1	1	-
Average	1	1	1	-	2	-	-	-	-	-	-	1	1	1	-

UNIT I:

Introduction: Introduction and Brief history of intelligent systems: ELIZA, categorization of intelligent systems, components of AI program. Foundations of AI, sub areas of AI, applications, current trends in AI.

UNIT II:

Artificial Neural Networks: introduction, artificial neural networks: neuron model, activation functions, neural network architecture. Single layer feed forward networks, multi-layer feed forward networks, radial basis function networks, design issues of artificial neural networks, recurrent networks. Applications of ANN in civil engineering.

UNIT III:

Fuzzy sets and fuzzy logic: introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules, fuzzy systems. Applications of fuzzy set and fuzzy logic in civil engineering.

UNIT IV:

Machine learning: introduction, machine learning systems, supervise and unsupervised learning, inductive and deductive learning, clustering, support vector machines. Applications of Machine learning in civil engineering.

UNIT V:

Regression Analysis: Relationship between attributes using Covariance and Correlation, Relationship between multiple variables: Regression (Linear, Multivariate) in prediction. Residual Analysis. Hypothesis testing of Regression Model, R-square and goodness of fit, Multiple Linear Regression, Non-Linear Regression, logistic regression. Applications of Regression analysis in civil engineering.

Text Books:

1) Pijush Samui, Dwarkadas Pralhaddas Kothari, Artificial intelligence in Civil Engineering: AI in Civil Engineering, 2012.
2) Ian Flood, Nabil Kartam, Artificial Neural Networks for Civil Engineers: advanced features and applications, 1998.

Suggested Reading:

1) S.M Yadav, Application of soft computing techniques in civil engineering, 2018.
2) Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2012.
3) Nelson M. Mattos, "An Approach to Knowledge Base Management", Springer Berlin Heidelberg, 1991.

Online Resources:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

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20CE E06

PRESTRESSED CONCRETE

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course outcomes: At the end of the course, Students will be able to

1) Understand the general mechanism of pre stressed concrete members, types of pre stressing
2) Analyze and understand the behaviour of pre stressed concrete beams.
3) Identify and apply design concepts for the pre stressed concrete beams under flexure and shear.
4) Analyze the stresses in anchorage zones and design the end anchorages.
5) Understand the fundamental concepts of primary and secondary moments in continuous beams.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	-	-	-	-	1	1	1	1
2	2	2	1	1	-	-		-	-	-	-	1	1	1	-
3	2	2	3	2	-	-	-	-	-	-	-	1	1	-	-
4	2	2	3	2	-	-	-	-	-	-	-	1	-	-	-
5	2	2	3	2	-	-	-	-	-	-	-	1	1	1	1
Average	2	2	2.2	1.6								1	1	1	1

UNIT- I:

General Principles of Pre Stressed Concrete:

Introduction: Basic concepts Materials –Need for High strength materials. Advantages and Applications of prestressed concrete. Different methods of Pre stressing. Pre-tensioning and post-tensioning.

Hoyer System, Freyssinet system, Magnel-Blaton system, Lee Mecal system. Use of IS 1343 code, concepts of pre tensioned and post tensioned elements.

UNIT-II:

Design of Section for Flexure and Shear:

Allowable Stresses: Elastic Design and Limit state method of Design of Rectangular and I Section beams for Flexure. Check for ultimate flexural strength as per I S 1343 Codal Provisions. Check for deflections.

Design of Section for Shear: Shear and principal stresses. Factors affecting shear resistance, Cracked and uncracked sections Codal provisions - ultimate shear resistance. Design of shear reinforcement in beams.

UNIT III:

Analysis, Losses and Deflection of PSC beams: Analysis of sections for pre stress and flexure for Straight Concentric, Eccentric, Bent and Parabolic Tendons. Pressure Line Cable, concept of cracking moment of resistance . Load balancing concept.

Losses of Pre stress: Losses in P.S.C. members due to elastic shortening Shrinkage Creep in Concrete Relaxation of Steel Slip in anchorage Frictional Loss

Deflections of P.S.C members: Importance of deflections - factors influencing deflections, short term and long term deflections IS code requirements for Maximum deflections Computation of short term deflections due to prestressing force Dead and Live loads.

UNIT IV: Anchorage Zone stress in Post tensioned members:

Stress distribution in End Block: Analysis by Magnel and Guyon's methods – IS 1343 Code Provisions – Bursting Tensile Force Design of anchorage zone reinforcement.

UNIT-V: Continuous beams:

Advantage and Disadvantages – Primary and Secondary moment P and C –lines Linear transformation, Concordant and Non-concordant cable profile – Analysis of Continuous beams

Text Books:

1) N. Krishna Raju, "Prestressed Concrete", Tata Mc Graw Hill, 2018
2) G.S. Pandit and S.P. Gupta, "Prestressed Concrete", CBS Pub., 2009

Reference Books:

1) Arthur H. Nilson by "Design of Prestressed Concrete", John Wiley, 1987
2) T.Y. Lin and Burn, "Design of Prestressed Concrete", Wiley India Private Limited, 2010, 52 53 18CE

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20CE E07

HAZARDS AND MANAGEMENT

Instruction	3 L Hours per Week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1) Identify and understand the fundamental terminologies in disaster management.
2) Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and non-structural mitigation measures.
3) Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
4) Analyze various mechanisms and consequences of human induced disasters.
5) Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central and State Government bodies at different levels.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	2	2	2	2	1	2	2	2	1	1	1	1
2	1	1	2	2	2	3	3	1	2	1	1	1	1	1	-
3	2	2	2	2	2	2	3	2	1	1	2	1	1	-	-
4	2	2	2	2	3	2	1	1	1	1	1	1	-	-	-
5	2	1	2	1	2	3	1	2	2	2	2	1	1	1	1
Average	1.8	1.4	1.8	1.8	2.2	2.4	2	1.4	1.6	1.4	1.6	1	1	1	1

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and manmade; Introduction to Disaster management cycle; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA) Objectives.

UNIT- II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Applications. Case studies related to various hydro-meteorological disasters.

UNIT- III:

Geographical based disasters: Causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various geographical based disasters.

UNIT- IV:

Human Induced Disasters: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas leakage; Management of chemical terrorism disasters and biological disasters; Case studies related to power break downs, fire accidents, traffic accidents, oil spills and stampedes, building failure disasters, Impact of COVID 19 at national and international level

UNIT- V:

Concept of Disaster Impacts and Management: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects, gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

Disaster management cycle and its phases, risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India.

Text Books:

1) Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003
2) B.K. Singh, "Handbook of Disaster Management: Techniques & Guidelines", Rajat Publication, 2008

Suggested Reading:

1) Ministry of Home Affairs, Government of India, National Disaster Management Plan, Part I and II
2) K.K. Ghosh, "Disaster Management", APH Publishing Corporation, 2006
3) http://www.indiaenvironmentportal.org.in/files/file\disaster_management_india1.pdf
4) http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5) Hazards, Disasters and your community: A booklet for students and the community, Ministry of Home Affairs.
6) Disaster Medical Systems Guidelines, Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
7) Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings, Geneva: IASC.
8) http://ndma.gov.in/ (Home page of National Disaster Management Authority)

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20CE E08

DESIGN OF MASONRY STRUCTURES

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES:

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

1) Explain engineering properties, uses of masonry units, defects, crack in masonry and its remedial measures and factors affecting compressive strength of masonry units.
2) Explain the different masonry elements, permissible stresses, design considerations and criteria as per IS: 1905 and SP-20.
3) Design different types of masonry walls subjected to axial loads ; UDL and concentrated axial loads.
4) Design different types of masonry walls subjected to eccentric loads, lateral loads and transverse loads
5) Design infill walls of frames and implement the design principles and detailing aspects to ensure seismic safety of unreinforced and reinforced masonry walls

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
2	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
3	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
4	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
5	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
Average	**2**	**2**	**1**	**1**	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**2**	**1**

UNIT I

Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units-strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding and repairing cracks

Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

UNIT II

Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.

Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars

UNIT III

Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings.

UNIT IV

Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs.

UNIT V

In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Seismic safety Considerations for Masonry walls : Design principles, detailing aspects and construction features for seismically safe masonry structures (both – unreinforced and reinforced)

Text Books:

1) Dayaratnam P. Brick and Reinforced Brick Structures. Scientific International Pvt. Ltd.
2) M. L. Gambhir, Building and Construction Materials, McGraw Hill education Pvt. Ltd.
3) Henry, A.W., " Structural Masonry" , Macmillan Education Ltd., 1990.

References:

1) IS 1905-1987 "Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi.
2) SP 20 (S&T) – 1991. "Hand book on masonry design an d construction (1 st revision) BIS, New Delhi.
3) A. W. Hendry, B. P. Sinha and S. R. Davies, An introduction to load bearing brickwork design.
4) Sven Sahlin, Structural Masonry, Prentice-Hall Inc., 1971 4. Miha Tomezevic, Earthquake resistant design of masonry buildings, Imperial College Press, 1999, 693.852N99
5) Robert Drysdale and A A Hamid, Masonry structures behaviour and design, Publisher: The Masonry Society, Boulder, Colorado USA, 3rd Ed. 2008

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20EE O02

ENERGY MANAGEMENT SYSTEMS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites:

Students should have prior knowledge on different energy generation systems, basic idea about audit instruments.

Course Outcomes: After completion of this course, students will be able to:

1. Know the current Energy Scenario and importance of Energy Conservation.
2. Understand the concepts of Energy Management, Energy Auditing.
3. Interpret the Energy Management methodology, Energy security and Energy Strategy .
4. Identify the importance of Energy Efficiency for Engineers and explore the methods of improving Energy Efficiency in mechanical systems, Electrical Engineering systems
5. Illustrate the Energy Efficient Technologies in Civil and Chemical engineering systems

CO-PO/PSO ARTICULATION MATRIX

	POs												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	1	-	1	2	1	-	-	-	1	-	-	-
2	2	1	1	1	-	1	2	1	-	-	-	1	-	-	-
3	2	2	2	1	-	1	2	1	-	-	-	1	-	-	-
4	2	2	1	2	2	1	2	1	-	-	-	1	-	-	-
5	1	1	2	1	1	1	2	2	-	-	-	1	-	-	-
Average	**1.6**	**1.5**	**1.5**	**1.2**	**1.5**	**1**	**2**	**1.2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

UNIT-I

Various form of Energy and its features: Electricity generation methods using different energy sources such as Solar energy, wind energy, Bio-mass energy, and Chemical energy such as fuel cells. Energy Scenario in India, Impact of Energy on economy, development, and environment sectors of national and international perspective.

UNIT-II

Energy Management-I: Defining Energy Management, need for Energy Management, Energy management techniques, importance of Energy Management, managing the Energy consumption, Energy Audit and Types, Energy Audit Instruments.

UNIT-III

Energy Management-II: understanding Energy costs, bench marking, Energy performance, matching energy use to requirement, optimizing the input, fuel & Energy substitution, material and Energy balance diagrams, Energy pricing, Energy and Environment, Energy Security

UNIT-IV

Energy Efficient Technologies-I: Importance of Energy Efficiency for Engineers, Energy Efficient Technology in Mechanical engineering: Compressed Air System, Heating, ventilation and air-conditioning, Fans and blowers, Pumps and Pumping Systems.

Energy Efficient Technology in Electrical engineering: Automatic Power Factor Controllers, Energy Efficient Motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, space cooling, energy efficiency of lifts and escalator, energy saving potential of each technology.

UNIT-V

Energy Efficient Technologies-II: Energy Efficient Technology in Civil Engineering: Intelligent Buildings, And Various Energy Efficiency Rating Systems for Buildings, Green Buildings Energy Efficiency: management of green buildings, importance of embodied energy in selection of sustainable materials, green building design, waste reduction/recycling, rainwater harvesting, maintenance of the green buildings, green building certification, Renewable energy applications.

Energy Efficient Technology in Chemical Engineering: Green chemistry, Low carbon cements, recycling paper.

Textbooks:

1. Umesh Rathore, 'Energy Management', Kataria publications, 2nd edition, 2014.
2. G Hariharaiyer, "Green Building Fundamentals", Notion press.com
3. K V Shama, P Venkataseshaiah, "Energy management and conservation", I. K. International Publishing agency pvt. ltd., 2011, ISBN: 978-93-81141-29-8

Suggested Reading:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
2. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.
3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

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20ME O12

3D PRINTING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Objectives:

1. To make students understand the basic concept of digital manufacturing.
2. To teach different processes involved in digital fabrication of products.
3. To demonstrate the STL file generation and manipulations.
4. To demonstrate various post processing techniques.
5. To demonstrate the applications of RP in different fields of engineering.

Outcomes: At the end of the course, the students are able to

1. Understand the concept of 3D printing processes, advantages and limitations.
2. Evaluate real-life scenarios and recommend the appropriate 3D printing technology.
3. Analyze various pre-processing and post processing techniques.
4. Explain current and emerging 3D printing technologies in diversified applications.
5. Identify components required in construction of3Dprinter.

UNIT-I

Introduction to 3D Printing: Introduction to 3D printing, evolution, distinction between 3D printing & CNC machining.

Design considerations: Materials, size, resolution, mass customization. additive vs. subtractive manufacturing, its advantages and limitations

UNIT-II

Photo polymerization processes: Photo polymerization, Stereolithography Apparatus (SLA), Applications, advantages and disadvantages.

Powder bed fusion processes: Introduction, Selective laser Sintering (SLS), Materials, Applications, advantage and disadvantages.

Extrusion-based systems: Fused deposition modeling (FDM), laminated object manufacturing (LOM), Principles, Materials, Process Benefits and Drawbacks.

Material Jetting AM Processes: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes.

UNIT-III

Pre processing in AM: Modeling and viewing - 3D scanning; Model preparation – STL conversion, STL error diagnostics, STL file Repairs, generic solution, slicing, newly proposed file formats.

Post processing in AM: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non–thermal and thermal techniques.

UNIT-IV

Construction of basic 3D printer: Construction of 3D printing machine – axes, linear motion guide ways, ball screws, motors, bearings, encoders, process chamber, safety interlocks, sensors.

UNIT-V

Applications of AM: Application in aerospace industry, automotive industry, jewelry industry, coin industry, medical and bioengineering applications: planning and simulation of complex surgery, forensic science.

Text Books:

1. Gibson, DW. Rosen and B.Stucker; Additive manufacturing methodologies: Rapid prototyping to direct digital manufacturing, Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, 3D printing and additive manufacturing: principles and application, 4 th edition of rapid proto typing, World scientific publishing company, 2014.
3.P.K. Venuvinod, Rapid prototyping – Laser based and other technologies, Kluwer, 2004.

Suggested Reading:

1. Jacob, Paul, Rapid tooling: Technologies and industrial applications, Taylor & Francis Group, 2000.
2. Alain Bernard, Georges Taillandier, Additive Manufacturing, Wiley, 2014.

20EC O02

BASICS OF DIGITAL SIGNAL PROCESSING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisite: Basic concepts of signals are required

Course Objectives:

This course aims to:

1. Learn the advantages of DSP over analog signal processing.
2. Analyze discrete-time signals in the frequency domain using DFT and FFT.
3. Learn the theory of digital filters.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concept of Discrete time signals and systems
2. Analyze the frequency domain representation of discrete time sequence using DTFT and DFT.
3. Apply FFT to the given sequence.
4. Implementation of FIR filter for the given specifications
5. Design an IIR filter for the given specifications.

Course Articulation Matrix:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02
2	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
3	03	03	03	02	03	02	-	-	02	02	-	02	03	03	01
4	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
5	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02
Aver	**3**	**3**	**3**	**2**	**2.6**	**2**			**2**	**2**		**2**	**3**	**3**	**1.8**

UNIT-I

Discrete Time Signals and Systems: Introduction, basic elements of a digital signal processing system, advantages and disadvantages of Digital Signal Processing over Analog signal processing, sampling theorem, analog to digital and digital to analog conversion. Discrete-Time System: Mathematical representation of Discrete Time Systems, Concept of Impulse response and Transfer function, Linear and Time invariant systems, Concept of causality and stability.

UNIT-II

Frequency Domain Analysis of Discrete Time Sequences: Discrete Time Fourier Transform (DTFT), properties of DTFT. Discrete Fourier Transform (DFT) and its properties, relationship between DFT to the DTFT, circular convolution.

UNIT-III

Fast Fourier Transform (FFT): Introduction, Radix-2 Decimation –In- Time (DIT) and Decimation- In-Frequency (DIF) FFT algorithms, Bit reversal order, In-place computation.

UNIT-IV

FIR Filter Design: Characteristics of FIR filters, Linear phase filters, Design of FIR (LPF, HPF, BPF and BSF) filters using Truncation and Windows, Comparison between FIR and IIR filters.

UNIT-V

IIR Filter Design: Characteristics of IIR filters, Conversion from analog filters to digital filters using Impulse Invariance Method (IIM) and Bilinear Transformation (BLT) methods, prewarping. Realization diagrams-Direct form I & II.

Text Books:

1. Alan V. Oppenheim & Ronald W. Schafer, "Digital Signal Processing," PHI, 2/e, 2010.
2. John G. Proakis&Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application," PHI, 4/e, 2012.

Suggested Reading:

1. Sanjit K Mitra, " Digital Signal Processing", Tata Mc Graw Hill, Third edition, 2006
2. ChiTsong Chen, "Digital Signal Processing", Indian edition, 2009.