UG-R22 Curriculum
With effective from 2022-23

Mechanical Engineering

Scheme of Instruction and Syllabi of
B.E I to IV Semester of
Four Year Degree Course

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institute | Affiliated to Osmania University)
Accreditated by NBA & NAAC (A++)
Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.
E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in
Phone No. : 040-24193276 / 277 / 279

SCHEME OF INSTRUCTION AND SYLLABI

OF

B.E. / B.TECH. I TO IV SEMESTERS

FOR

MECHANICAL ENGINEERING

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

(R–22 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Affiliated to OU, Approved by AICTE, Accredited by NBA, NAAC (A++)

Kokapet Village, Gandipet Mandal, Hyderabad– 500 075. Telangana

E-Mail: principal@cbit.ac.in; Website: www.cbit.ac.in;

Phone Nos.: 040-24193276 / 277 / 279

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION OF THE INSTITUTE

VISION

To be the centre of excellence in technical education and research

MISSION

To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION & MISSION

VISION

To be the destination for aspiring young minds to become globally competitive, enlightened, innovative, immediate contributors to the industry and successful in higher studies in the field of mechanical engineering.

MISSION

1. To impart quality and innovative education in mechanical engineering with basic and specialised training, internships to meet the current and emerging needs of the industry.
2. To prepare the students for successful professional career by inculcating ethical, entrepreneurial and leadership qualities.
3. To foster Research and Development environment by disseminating knowledge and technology by involving the students in publications, sponsored projects and consultancy.

PROGRAM EDUCATION OBJECTIVES (PEOs)

After Four years of graduation graduates will have

1. Ample technical knowledge and skills for a successful career in Mechanical Engineering and product development, design, development and implementation of engineering systems, services and processes
2. Capability to develop competitive technologies and find solutions to industry, societal challenges and engineering problems with ethical and professional standards
3. Ability to be entrepreneurial, innovative in the context of global scenarios of technological challenges and environmental issues.
4. To pursue life-long learning and to adapt to the changing industry requirements.
5. To be a team player, lead and engage diverse teams through effective communication, inter-personal and project management skills.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The graduates will be able to

1. Apply their learning to design and develop basic mechanical systems and processes.
2. Select manufacturing processes and their appropriate parameters for the production of typical engineering components.
3. Apply the concepts of mechanical engineering in power generation, aerospace, environmental, bio-medical, automotive, sustainable energy systems and with suitable safety precautions.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER – I

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC02	Calculus	3	1	0	3	40	60	4
2	22CYC01	Chemistry	3	0	0	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3	40	60	3
4	22CSC01	Problem Solving and Programming	2	1	0	3	40	60	3
PRACTICAL									
5	22CYC02	Chemistry Lab	0	0	3	3	50	50	1.5
6	22MBC02	Community Engagement	0	0	3	-	50	-	1.5
7	22CSC02	Problem Solving and Programming Lab	0	0	3	3	50	50	1.5
8	22MEC37	Robotics & Drones Lab	0	2	2	-	100	-	3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	3	50	50	1
TOTAL			**10**	**5**	**13**	**-**	**460**	**390**	**21.5**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC02

CALCULUS
(MECHANICAL)

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: After completion of this course, student will be able to
1. Apply the Matrix Methods to solve system of linear equations.
2. Analyse 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/ 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	3	3	3	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.

22CYC01

CHEMISTRY
(MECHANICAL)

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	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: After completion of this course, student 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:

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, Numerical.

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).

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: After completion of this course, student 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

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: After completion of this course, student 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
CO-1	3	1	1	-	1	-	-	-	-	-	-	1
CO-2	3	1	1	-	1	-	-	-	-	-	-	1
CO-3	3	1	1	-	1	-	-	-	-	-	-	1
CO-4	3	1	1	-	1	-	-	-	-	-	-	1
CO-5	3	1	1	-	1	-	-	-	-	-	-	1
CO-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 COURSES:

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

22CYC02

CHEMISTRY LAB
(MECHANICAL)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	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: After completion of this course, student 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
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: After the completion of this Course, Student 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 scrips.
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: After completion of this course, student 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.

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	2	1	-	-	-	-	-	-	-	-	1
2	3	3	2	2	3	-	-	-	-	-	-	1
3	2	3	3	2	3	-	-	-	-	-	-	1
4	2	3	3	2	2	-	-	-	-	-	-	1
5	2	3	3	3	3	-	-	-	-	-	-	1
6	2	3	3	3	3	-	-	-	-	-	-	1

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”, 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 COURSES:
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.

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: After completion of course, students would 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/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO 11	PO 12
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 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/

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEEE	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: At the end of the course, the student are expected 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.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvement of single-phase AC System.
7. Active and Reactive Power measurement of a single-phase system using
   (i) 3-Ammeter method (ii) 3-Voltmeter method
8. Measurement of 3-Phase Power in a balanced system
9. Calibration of single-phase energy meter.
10. Verification of Turns/voltage ratio of single-phase Transformer.
11. Open Circuit and Short Circuit tests on a given single phase Transformer
12. Brake test on DC Shunt Motor
13. Speed control of DC Shunt Motor
14. Demonstration of Measuring Instruments and Electrical Lab components.
15. Demonstration of Low-Tension Switchgear Equipment/Components
16. 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.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER –II

S. No	Course Code	Title of the Course	Scheme of Instruction			Credits	Assessment Marks		
			Hours per Week				CIE	SEE	Total
			L	T	P/D				
THEORY									
1	22MTC05	Vector Calculus and Differential Equations	3	1	0	4	40	60	100
2	22PYC05	Mechanics and Materials Science	3	0	0	3	40	60	100
3	22CEC01	Engineering Mechanics	3	1	0	4	40	60	100
4	22EGC01	English	2	0	0	2	40	60	100
PRACTICAL									
5	22PYC08	Mechanics and Materials Science Lab	0	0	3	1.5	50	50	100
6	22EGC02	English lab	0	0	2	1	50	50	100
7	22MEC01	CAD And Drafting	0	1	3	2.5	50	50	100
8	22MEC38	Digital Fabrication Lab	0	0	3	1.5	50	50	100
TOTAL			**11**	**3**	**11**	**19.5**	**360**	**440**	**800**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC05

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS (MECHANICAL)

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: After completion of this course, student 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/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	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.

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: After completion of this course, student 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/PSO 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.

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: After completion of this course, student 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.

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: After completion of this course, student 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/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	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.

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: After completion of this course, student 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 /PSO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	3	1	3	3	2	1	2
CO2	3	2	1	2	2	2	1	2	2	1	1	3
CO3	3	2	3	2	3	1	2	2	3	2	1	2
CO4	3	3	2	2	2	1	2	3	2	1	1	3
CO5	3	1	2	3	2	1	1	2	2	2	1	2

LIST OF 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.

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: After successful completion of the course the 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 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

LIST OF 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. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011
4. Aruna Koneru, 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.

COURSE OUTCOMES: After completion of this course, student will be 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 ARTICULATION MATRIX

PO/PSO CO	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.
2. 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: After completion of course, students would 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 ARTICULATION MATRIX

CO/PSO PO	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. 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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

B.E. (MECHANICAL ENGINEERING)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hrs	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC10	Partial differential Equations and Statistics	3	1	--	3	40	60	4
2	22CSC35	Data Structures using Python	2	--	--	3	40	60	2
3	22MEC02	Material Science and Metallurgy	3	--	--	3	40	60	3
4	22MEC03	Strength of Materials	3	1	--	3	40	60	4
5	22MEC04	Thermodynamics	3	--	--	3	40	60	3
6	22MEC05	Heat Transfer	2	--	--	3	40	60	2
7	22EEM01	Universal Human Values II: Understanding Harmony	--	1	--	--	50	--	1
8	22CEM01	Environmental Science	2	--	--	2	--	50	Non Credit
PRACTICALS									
9	22MEC06	Material Science and Metallurgy Lab	--	--	2	3	50	50	1
10	22MEC07	Strength of Materials Lab	--	--	2	3	50	50	1
11	22CSC36	Data Structures using Python Lab	--	--	2	3	50	50	1
12	22MEC08	Heat Transfer lab	--	--	2	3	50	50	1
13	22MEI01	MOOCs/Training/Internship	2-3 weeks/90 hours				50	-	2
TOTAL			**18**	**03**	**08**	--	**490**	**610**	**23+2**
Clock Hours Per Week: 29									

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

22MTC10

PARTIAL DIFFERENTIAL EQUATIONS AND STATISTICS (MECHANICAL)

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 expansion of functions in sine and cosine series.
2. To form PDE and to find its solution.
3. To know the model of wave and heat equations.
4. Able to analyze random phenomena using basic probability.
5. To learn fitting of distribution and predicting the future values.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Calculate the Euler's coefficients for Fourier series expansion of a function.
2. Solve Linear and Nonlinear PDEs.
3. Solve One-Dimension Wave and Heat equations and Two Dimensional Laplace equations.
4. Use the basic probability for fitting the Random phenomenon.
5. Analyze the random fluctuations of probability distribution and Principles of Least Squares approximations for the given data.

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
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	2	1
CO2	2	2	2	2	-	-	-	-	-	-	-	1	2	3	2
CO3	2	2	2	2	-	-	-	-	-	-	-	1	2	1	1
CO4	2	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO5	2	2	2	1	-	-	-	-	-	-	-	1	2	2	2

UNIT I

Fourier series: Periodic functions, Euler's formulae, Conditions for a Fourier series expansion, Fourier series of Functions having points of discontinuity, Change of interval, even and odd functions, Half range Sine & Cosine Series.

UNIT II

Partial Differential Equations: Formation of Partial Differential Equations, Linear Equations of First Order (Lagrange's Linear Equations), Solution of First Order Nonlinear Partial Differential Equations (Standard forms) and Charpits Method.

UNIT III

Applications of Partial Differential Equations: Solution by Method of Separation of Variables, Solution of One dimensional Wave equation, Solution of One dimensional Heat equation, Solution of Two dimensional Laplace equation and its related problems.

UNIT IV

Basic probability: Basic probability, Conditional probability, Baye's theorem. Random variable, Discrete probability distribution and Continuous probability distribution. Expectation, Addition and Multiplication theorem of expectation, properties of variance, Moments (Moments about the mean and moments about a point)

UNIT V

Probability Distributions and Curve Fitting: Poisson distribution, MGF and Cumulants of the Poisson distribution, Normal distribution, Characteristics of Normal distribution, MGF and CGF of Normal distribution, Areas under normal curve. Correlation, Coefficient of Correlation and Lines of Regression. Curve fitting by the Method of Least Squares, Fitting of Straight lines, Second degree parabola and exponential curves.

TEXT BOOKS:

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.
2. S.C.Gupta, V.K.Kappoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 2014.

SUGGESTED READING:

1. Erwin kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons, 2006.
2. S. J. Farlow, “Partial Differential Equations for Scientists and Engineers”, Dover Publications, 1993.
3. Sheldon Ross, “A First Course in Probability”, 9th Edition, Pearson publications, 2014.

22CSC35

DATA STRUCTURES USING PYTHON

(COMMON TO BIOTECH, CHEMICAL, CIVIL AND MECHANICAL ENGINEERING)

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

COURSE OBJECTIVES: This course aims to

1. Introduce object-orientation concepts in python.
2. Familiarize students with asymptomatic analysis of various functions and implement different sorting techniques.
3. Examine various linear and non-liner data structures.
4. Explore various string functions and hash functions.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Understand classes, objects, linear data structures, nonlinear data structures, time complexity.
2. Use python packages to work with datasets.
3. Implement sorting, searching algorithms and analyse their performance.
4. Build solutions for problems using linear, nonlinear data structures and hashing.
5. Apply pattern matching algorithms for real time problems.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I

Overview of Python, Concept of Class, and objects;
NumPy: The Basics of NumPy Arrays, Aggregations;
Pandas: Pandas Objects, Data Indexing and Selection;
Visualisation: Simple Line Plots, Simple Scatter Plots, Histograms, Binnings, and Density.

UNIT II

Introduction: Data Structures, Abstract Data Types, Algorithm, Analysis of Algorithms, Running Time Analysis, Commonly Used Rates of Growth, Big O Notation, Omega Notation, Theta Notation, Guidelines for Asymptotic Analysis.
Sorting: Introduction, Classification of Sorting Algorithms, Selection Sort, Merge Sort, Quick Sort, Radix sort, Comparison of Sorting Algorithms.

UNIT III

Linked Lists: Linked List ADT, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists;
Stacks: Stack ADT
Queues: Queue ADT.

UNIT IV

Trees: Introduction, Binary Trees, Types of Binary Trees, Properties of Binary Trees, Binary Tree Traversals, Binary Search Trees (BSTs);
Graph: Introduction, Applications of Graphs, Graph Representation, Graph Traversals

UNIT V

String Algorithms and Hashing: Introduction, String Matching Algorithms: Brute Force Method, Rabin-Karp. Hash Table ADT, Components of Hashing, Hash Table, Hash Function, Load Factor, Collisions, Collision Resolution Techniques.

TEXT BOOKS:

1. Narasimha Karumanchi, "Data Structures and Algorithmic Thinking With Python", Career Monk Publications, 2016.
2. Tony Gaddis, “Starting out with Python”, 4th Edition, Global Edition, Pearson Education Limited, 2019.
3. Jake Vander Plas, “Python Data Science Handbook”, OReilly, 2017.

SUGGESTED READING:

1. Wes McKinney, “Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython”, 2nd Ed, OReilly, 2018.
2. Michael T.Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2013.
3. Kenneth A. Lambert, "Fundamentals of Python: Data Structures", Cengage Learning, 2018.

ONLINE RESOURCES:

1. https://visualgo.net/en
2. https://jakevdp.github.io/PythonDataScienceHandbook/
3. https://www.coursera.org/specializations/data-structures-algorithms3.
4. https://nptel.ac.in/courses/106/106/106106182/
5. https://www.cs.usfca.edu/~galles/visualization/Algorithms
6. https://www.edx.org/course/algorithms-and-data-structures

22MEC02

MATERIAL SCIENCE AND METALLURGY

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

COURSE OBJECTIVES: This course aims to

1. Structure property relations, analyse the failures of metals and their prevention.
2. Fatigue, creep and diffusion mechanisms.
3. Classification of steels and their application.
4. Working principle of various heat treatment operations
5. Principles of extractive metallurgy.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Understand the crystal structure and various imperfections of crystals.
2. Related material failure by fatigue and creep.
3. Interpret phase diagrams and TTT diagrams.
4. Understand the methods of improvement of mechanical properties by various heat treatment operations.
5. Differentiate the properties and applications of ceramics, polymers and composites.

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	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	1	-	-	-	-	-	1	1	3	2
CO2	2	2	3	1	2	2	1	1	-	1	1	3	3	2	3
CO3	3	2	2	2	2	2	2	1	-	-	-	3	2	3	3
CO4	2	3	3	3	3	3	2	1	-	1	1	3	3	3	3
CO5	3	2	1	2	2	1	2	1	-	1	1	1	3	3	2

UNIT I

Plastic Deformation: Introduction to engineering materials, Imperfections in crystals, Dislocation in crystals, Types of dislocations, Effect of slip and twinning on plastic deformation, Strain hardening, Cold and hot working, Bauschinger effect, Recovery, Recrystallization, Grain growth and its effect on mechanical properties of metals.
Fracture: Types of fracture in metals, Ductile and brittle fracture, Griffith theory of brittle fracture, Crack propagation and ductile to brittle transition temperature.

UNIT II

Diffusion: Fick's laws of diffusion, Application of diffusion theory in mechanical engineering.
Fatigue: S–N curve, Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Low and high cycle fatigue, Experimental determination of fatigue strength (RR–Moore Test).
Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep test.

UNIT III

Structure of Alloys: Study of Eutectic, Eutectoid, Peritectic and Peritectoid reactions
Iron–Iron Carbide Equilibrium Diagram: Construction and interpretation, Types of plain carbon steels, Cast irons and their properties and characteristics.
Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon, Tungsten and Titanium, Types of stainless steel, HSLA, TRIP, HSS, Brass, Bronze, Their composition and properties.

UNIT IV

Heat Treatment: Purpose of heat treatment, Annealing, Normalizing, Hardening, Tempering, Construction and interpretation of T–T–T diagram, Austempering and Martempering, Case hardening, Carburizing, Nitriding, Carbo–nitriding, Flame hardening, Induction hardening, Laser and Electron beam hardening.
Introduction to Non-Destructive Testing: Importance of Non-Destructive Testing, Types: Liquid Penetrant Testing, Ultrasonic Testing, Radiography Testing, Applications of Non- Destructive Testing.

UNIT V

Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, Cast iron by cupola furnace and method of production of steel by electric arc process.

Polymers and Ceramics: Polymerization, Thermoplastics and thermosetting plastics, Elastomers, Resins, Types, properties and applications of ceramics

Composites: Concept of composites, Matrix and reinforcement, Classification and Applications of composites.

TEXT BOOKS:

1. V. Raghavan, Materials Science and Engineering, 4th edition, Prentice Hall of India Ltd., New Delhi, 2005.
2. S.H. Avner, Introduction to Physical Metallurgy, 2nd edition, Tata McGraw Hill Publishers, New Delhi, 2005.

SUGGESTED READING:

1. S.P. Nayak, Engineering Metallurgy and Material Science, 6th edition, Charotar Publishing House, Gujarat, 2005.
2. G. E. Dieter, Mechanical Metallurgy, 3rd edition, Tata McGraw Hill, New Delhi, 2005.
3. W.D. Callister (Adapted by R. Balasubramaniam), Materials Science and Engineering, 2nd edition, Wiley India, New Delhi, 2014.

22MEC03

STRENGTH OF MATERIALS

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. Student is exposed to the concept of different types of loads, stresses, strains and analysis of members for axial loads.
2. Student will acquire knowledge in drawing bending and shear force diagrams of beams of various loads and configurations.
3. Student becomes familiar with methods of evaluation of deflection of beams of various configurations and stresses that arise due to simple bending.
4. Student is exposed to the concept of shear stresses in beams, principal stresses, strains and phenomenon of torsion.
5. Student will acquire knowledge in estimating stresses for thin, thick cylindrical shells and buckling of columns.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Determine stresses and strains in members subjected to axial loads and temperature changes.
2. Draw shear force, bending moment diagrams for different types of beams and calculate stresses and strains due to simple bending.
3. Determine slope and deflection for various configurations of beams using different methods, analyse stress, strain and deflection due to torsion in circular members.
4. Analyse shear stress distribution in different sections of beams and find out principal stresses and strains.
5. Find out stresses and strains in thin, thick cylindrical shells and able to calculate critical buckling loads in columns and struts.

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
CO1	3	3	1	3	-	-	1	-	-	-	-	3	2	1	1
CO2	3	3	1	-	-	-	1	-	-	-	-	3	2	1	1
CO3	3	3	1	-	-	-	1	-	-	-	-	3	2	1	1
CO4	3	3	1	-	-	-	1	-	-	-	-	3	2	1	1
CO5	3	3	1	-	-	-	1	-	-	-	-	3	2	1	1

UNIT I

Stresses and Strains: Definitions, Types of stresses and strains, Elasticity and plasticity, Hooke's law, Stress strain diagrams for engineering materials, Modulus of elasticity, Poisson's ratio, Relationship between elastic constants, Linear and volumetric strains, Bars of uniform strength, Temperature stresses, Compound bars, Strain energy for axial and torsional loads.

UNIT II

Beams: Definition of shear force and bending moment, Relation between intensity of loading, Shear force and bending moment, shear force and bending moment diagrams for cantilever, simply supported and overhanging beams, Theory of simple bending, Moment of resistance and comparison of various cross-sections.

UNIT III

Slopes and Deflections: Slope and deflection calculations of cantilever, simply supported beams subjected to point loads and uniformly distributed loads with Macaulay's and double integration methods.

Torsion of Circular Cross-sections: Theory of pure torsion, Power transmission in solid and hollow circular shafts, combined bending and torsion.

UNIT IV

Shear Stresses in Beams: Distribution of shear stresses in rectangular, I-section, T-section, Solid and hollow circular sections.

Principal Stresses and Strains: Analysis of biaxial state of stress with and without shear, Mohr's Circle.

UNIT V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures.

Columns and Struts: Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

TEXTBOOKS:

1. S.S. Rattan., Strength of Materials, 3rd edition, Tata Mc-Graw Hill, 2017.
2. Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf and David F. Mazurek., Mechanics of Materials, 8th edition, McGraw-Hill, New York, 2020.

SUGGESTED READING:

1. James M Gere, Mechanics of materials, 8th edition, Cengage Learning, 2013.
2. R.C. Hibbeler, Mechanics of Materials, 9th edition, Pearson, 2018.
3. S. Ramamrutham., Strength of Materials, 16th edition, Dhanpatrai and Sons, 2011.

22MEC04

THERMODYNAMICS

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

COURSE OBJECTIVES: This course aims to
1. Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
2. The importance and application of first law of thermodynamics.
3. The principles associated with second law of thermodynamics.
4. Properties of pure substances, use of Mollier diagram and vapour power cycles.
5. Concepts of air standard cycles and properties of mixture of gases

COURSE OUTCOMES: After completion of this course, student will be able to
1. Understand the concepts of system, thermodynamic properties, thermodynamic equilibrium and various methods of pressure and temperature measurements.
2. Apply the first law of thermodynamics to various thermodynamic processes along with the applications of steady flow energy equation.
3. Apply the Second law of thermodynamics to analyze heat pumps, refrigerators, heat engines and to evaluate entropy changes.
4. Evaluate the properties of pure substances and analyze the performance of steam power cycles.
5. Evaluate performance of air standard cycles and analyze the properties of gas mixtures.

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
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	1
CO2	2	2	-	-	-	-	-	-	-	3	-	3	2	2	1
CO3	2	2	-	-	-	2	1	-	-	-	-	3	3	2	1
CO4	2	2	-	-	-	-	-	-	-	-	-	3	3	2	1
CO5	2	2	-	-	-	2	1	-	-	3	-	3	3	2	1

UNIT I

Introduction: Thermodynamics, Macroscopic and Microscopic approaches, Thermodynamic systems, Properties, Processes and cycles, Thermodynamic equilibrium, Quasi – static process, Measurement of pressure, Zeroth law of thermodynamics and its significance, Measurement of temperature, Reference points, Ideal gas equation.

UNIT II

Energy Interactions and First Law of Thermodynamics: Concept of heat and work, First law of thermodynamics for closed system, Energy a property of the system, Application of first law to various thermodynamic processes like isobaric, Isochoric, Isothermal, Adiabatic and polytropic, Definition of enthalpy, PMM1, First law applied to flow processes, Application of SFEE to Nozzle, Diffuser, Throttling device, Turbine, Compressor and heat exchanger.

UNIT III

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin– Planck and Clausius statements of second law of thermodynamics, PMM2, Equivalence of Kelvin-Planck and Clausius statement, Reversible and irreversible processes, Carnot theorem, Clausius inequality, Calculation of entropy change during various thermodynamic processes, Principle of entropy increase, T–s diagrams, Application of entropy principle for mixing of two fluids, Introduction to available and unavailable energy, Third law of thermodynamics, Helmholtz and Gibb's functions.

UNIT IV

Pure Substances: Properties of pure substances, P–V diagram, P–T diagram, P-V-T surface, T–s diagram, h–s diagram, Dryness fraction, Use of steam tables, Maxwell relations, Clapeyron equation.

Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle, Representation on p-v, T-s and h-s diagrams, Evaluation of performance parameters, Efficiency, Work ratio, Specific steam consumption and heat rate.

UNIT V

Air Standard Cycles: Air standard cycles, Otto, Diesel, Dual combustion cycles, Working principle, Derivation of expression for air standard efficiency, Comparison of Otto, Diesel and dual cycles for the same compression ratio, For the same maximum pressure and temperature.

Non-reactive Ideal Gas Mixtures: Mole fraction, Mass fraction, Partial pressure, Dalton's law of partial pressures, Amagat-Leduc law of partial volumes, Relation between partial pressures, Mole fraction and volume fraction, Gas constant, Molecular mass, Specific heats of gas mixtures, Relation between volumetric and gravimetric analysis. Determination of theoretical air fuel ratio and equivalence ratio for various fuels.

TEXT BOOKS:

1. P.K. Nag., Engineering Thermodynamics, 6th edition, Tata McGraw Hill Publishing, 2017.
2. Yunus Cengel and Michael Boles., Thermodynamics: An Engineering Approach, 8th edition, McGraw Hill Education, 2017.

SUGGESTED READING:

1. R.K. Rajput., Engineering Thermodynamics, 4th Edition, Laxmi Publications, 2016.
2. Mahesh M Rathore., Thermal Engineering, Tata McGraw Hill Publishers, 2013.
3. D.S. Kumar., Engineering Thermodynamics, S.K. Kataria and Sons, 2014.

22MEC05

HEAT TRANSFER

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

COURSE OBJECTIVES: This course aims to
1. The concepts of 1-D steady state heat conduction.
2. The concepts of heat transfer through fins and unsteady state conduction.
3. The relationship between various dimensionless numbers for free convection and forced convection.
4. The principles of radiation heat transfer.
5. The basic concepts of heat exchangers and phase change heat transfer

COURSE OUTCOMES: After completion of this course, student will be able to
1. Estimate heat transfer through composite slabs and cylinders with and without heat generation.
2. Estimate the heat transfer through rectangular straight and pin fins; and temperature distribution in unsteady state conduction.
3. Estimate the heat transfer in case of flow over plates, cylinders and flow through tubes.
4. Estimate radiation heat exchange between surfaces in different situations and the effect of radiation shield.
5. Estimate the effectiveness of heat exchanger by LMTD, NTU methods and acquire knowledge of boiling and condensation phenomenon**.**

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
CO1	3	2	2	1	2	-	-	-	-	-	-	1	1	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	1	1	-	1
CO3	2	3	2	1	1	-	-	-	-	-	-	1	1	-	1
CO4	2	3	2	1	1	-	-	-	-	-	-	1	1	-	2
CO5	3	2	2	1	1	-	-	-	-	-	-	1	1	-	2

UNIT I

Modes of heat transfer: Laws of heat transfer - Fourier, Newton, Stefan-Boltzmann General conduction equation in cartesian and cylindrical coordinates, One dimensional steady state conduction through slabs, hollow cylinders with and without heat generation, steady state heat transfer through composite slabs and cylinders, critical radius of insulation.

UNIT II

Fins: Heat transfer analysis of fins with heat dissipation environment rectangular straight and pin fins, unsteady state conduction, Lumped parameter analysis of a body with negligible internal temperature gradients, Use of Heisler charts for solving problems of infinite slabs and cylinders.

UNIT III

Convection: Dimensional analysis and its use in free and forced convection, Buckingham pi theorem, Physical significance of different dimensionless numbers, Concepts of velocity and thermal boundary layers, Reynold's analogy for flow over plane surfaces, Calculation of heat transfer coefficient for flow over plates, cylinders and for flow through tubes in free and forced convection using empirical formulae.

UNIT IV

Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's law , Wien's and Steffan Boltzmann law, Monochromatic and total emissive power, radiant heat exchange between two gray surfaces, Shape factor, Thermal circuit for radiant heat exchange between infinite parallel plates and between concentric cylinders, Radiation shields

UNIT V

Heat Exchangers: Classification, analysis of parallel flow and counter flow heat exchangers using LMTD and NTU methods, effectiveness, simple problems.

Boiling: Boiling curve and critical heat flux for nucleate pool boiling.

Condensation: Types of condensation, convective heat transfer coefficient for Laminar Film Condensation on a Vertical Plate.

TEXT BOOKS:

1. Sachdeva,R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International (P) Ltd Publishers, New Delhi, 2010
2. Yunus A Cengel, "Heat Transfer A Practical Approach", Second Edition, Mc.Graw-Hill, 2002.

SUGGESTED READING:

1. Rajput, R.K., "Heat and Mass Transfer", S. Chand & Company Ltd, New Delhi, 2004.
2. Holman, J.P., "Heat Transfer", Tenth Edition, McGraw Hill Publication, New Delhi, 2010
3. Sukhatme,S.P., "A Text Book on Heat Transfer,", University Press, 2005.

DATA BOOK:

1. C.P. Kothandaraman, Heat Transfer Data Book, TMH

22EEM01

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY
(B.E/B. TECH - COMMON TO ALL BRANCHES)

Instruction	1Tutorial Hour per Week
CIE	50Marks
Credits	1

INTRODUCTION:

This course discusses the role of human values in one's family, in society and in nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

COURSE OBJECTIVES: This course aims to

1. Understand the concept of universal human values
2. Cultivate empathy and respect for diversity
3. Inspire the social responsibility and global citizenship

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

1. Become familiar about themselves, and their surroundings (family, society, nature).
2. Develop empathy and respect for diversity by gaining an appreciation for different cultures, perspectives, and identities
3. Exhibit responsible and ethical behavior by adhering to principles of integrity, honesty, compassion, and justice.
4. Recognize their role as global citizens.
5. Exhibit a sense of social responsibility.

CO-PO ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	1	-	-	1	-	-	1	0	0	1
CO2	-	-	1	-	-	1	1	-	1	-	1	1	0	0	1
CO3	--	-	-	-	-	1	-	-	-	1	-	-	0	0	1
CO4	-	-	-	-	-	1	1	1	-	-	-	-	0	0	1
CO5	-	-	-	-	-	1	1	1	-	-	-	-	0	0	1

MODULE -1:

COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and
- Experiential Validation- as the process for self-exploration.
- Natural acceptance of human values.
- Definitiveness of Ethical Human Conduct.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario.
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE- 2:

UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'

- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE-3:

UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN- HUMAN RELATIONSHIP

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
- Understanding the meaning of Trust; Difference between intention and competence.
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals.
- Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers.

b. At the level of society: as mutually enriching institutions and organizations.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.

MODULE -4:

UNDERSTANDING HARMONY IN NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE.

- Understanding the harmony in Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature.
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
- Holistic perception of harmony at all levels of existence.
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

MODE OF CONDUCT (L-T-P-C 0-1-0-0)

- While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection, and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentors, in a group sitting.
- Tutorials (experiments or practical) are important for this course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.

- The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to the development of commitment, namely behaving and working based on basic human values.
- It is advised to share the experience of the Faculty to the class in a capsule form.
- Involve more in evaluating the student by different activities with proper RUBRCCS

ASSESSMENT: This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

Example:

Module-1:	10 M
Module -2:	10 M
Module- 3:	10 M
Module-4:	10 M
Attendance & Attitude:	10 M

The overall pass percentage is 50%. In case the student fails, he/she must repeat the course.

TEXTBOOKS:

1. "A Foundation Course in Human Values and Professional Ethics" by R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2022.
2. "Teacher's Manual for A Foundation Course in Human Values and Professional Ethics" by R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2022.

REFERENCE BOOKS:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth – by Mohandas Karamchand Gandhi

22CEM01

ENVIRONMENTAL SCIENCE (MANDATORY COURSE)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	--

COURSE OBJECTIVES: This course aims to

1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems.
3. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
4. To enable the students become aware of pollution of various environmental segments including their causes, effects, and control measures.
5. To create awareness about environmental legislations in the context of national conventions

COURSE OUTCOMES: After completion of this course, student will be 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.

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
CO1	1	-	-	-	-	-	3	-	-	-	-	1	-	-	1
CO2	1	-	-	-	-	-	2	1	-	-	-	1	-	-	1
CO3	1	-	-	-	-	-	2	1	-	-	-	1	-	-	1
CO4	1	-	-	-	-	1	2	1	-	-	-	1	-	-	1
CO5	1	-	-	-	-	1	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

22MEC06

MATERIAL SCIENCE AND METALLURGY LAB

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

COURSE OBJECTIVES: This course aims to:

1. Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heat treatment operations.
4. Understand differences between different heat treatment methods.
5. Understand the relation between micro structure and properties

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

1. Identify crystal structure of various metals.
2. Measure hardness and can correlate with microstructure.
3. Perform a suitable heat treatment operation based on desired properties.
4. Underlines the importance of grain size in evaluating the desired mechanical properties.
5. Correlate the heat treatment methods and the mechanical properties obtained.

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	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1	-	-	-	-	-	-	2	1	2	1
CO2	1	1	1	-	1	1	1	1	-	1	-	2	2	2	3
CO3	2	2	2	2	2	1	1	1	1	-	-	-	1	1	1
CO4	2	2	2	2	2	-	-	1	-	1	-	-	2	2	2
CO5	2	2	2	2	2	1	1	1	1	1	-	-	3	3	3

LIST OF THE EXPERIMENTS:

1. Study of metallurgical microscope.
2. Observing the microstructure of low carbon steel, medium carbon steel and high carbon steel specimens.
3. Observing the microstructure of austenitic stainless steel, high speed steel and case carburized steel specimens.
4. Observing the microstructure of grey cast iron, white cast iron and spheroidal cast iron specimens.
5. Observing the microstructure of Al-Si alloy, and malleable cast iron specimens.
6. Preparation of α-β brass and normalized steel specimens for micro structural observation
7. Preparation of medium carbon steel and mild steel specimens for micro structural observation.
8. Preparation of nodular cast iron and grey cast iron specimens for micro structural observation.
9. Determination of grain size using image analyzer.
10. Annealing and preparation of the given Steel specimen for microstructural observation.
11. Normalizing and preparation of the given Steel specimen for microstructural observation.
12. Hardening and preparation of the given Steel specimen for microstructural observation.
13. Comparative study on the influence of heat treatments (annealing, normalizing and hardening) on the microstructure and hardness of the given Steel specimen.

Note: A minimum of 12 experiments need to be conducted

SUGGESTED READING:

1. V. Raghavan, Materials Science and Engineering, 4th edition, Prentice Hall of India Ltd., New Delhi, 2005.
2. S. H. Avner, Introduction to Physical Metallurgy, 2nd edition, Tata McGraw Hill Publishers, New Delhi, 2005.
3. Virtual labs – Physical Metallurgy Lab, NITK Surathkal

22MEC07

STRENGTH OF MATERIALS LAB

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

COURSE OBJECTIVES: This course aims to

1. Demonstrate an understanding of tension, and the relationship between stress, strain and application of Hooke's law.
2. Demonstrate an understanding of types of beams, deflections and measurement of material property through deflections.
3. Demonstrate an understanding of torsion and deformations resulting from torsion.
4. Demonstrate the understanding of hardness and its measurement using different scales like Brinnel and Rockwell.
5. Demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

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

1. Draw stress-strain curve for an isotropic material and understand the salient features of it.
2. Determine the Young's modulus of various beam materials and leaf spring by conducting load-deflection test.
3. Rigidity modulus of a given shaft specimen by torsion test and shear modulus of closely coiled helical spring.
4. Evaluate hardness of different materials using different scales
5. Find the compressive and crushing strengths of concrete cubes and bricks**.**

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	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	-	-	-	-	2	-	3	2	1	1
CO2	3	3	2	1	-	-	-	-	-	2	-	3	2	1	1
CO3	3	3	2	1	-	-	-	-	-	2	-	3	2	1	1
CO4	3	3	2	1	-	-	-	-	-	2	-	3	2	1	1
CO5	3	3	2	1	-	-	-	-	-	2	-	3	2	1	1

LIST OF THE EXPERIMENTS:

1. Tension test on mild steel.
2. Compression test on mild steel.
3. Tension test on cast iron.
4. Compression test on cast iron.
5. Brinell's and Rockwell's hardness tests.
6. Izod Impact test.
7. Load-deflection test on a leaf spring to find out the Young's modulus of leaf material.
8. Deflection test on a helical spring to determine the rigidity modulus.
9. Torsion of shaft to determine the rigidity modulus of shaft material.
10. Defection test on a cantilever beam to determine the Young's modulus.
11. Deflection test on a simply supported beam to determine the Young's modulus.
12. Deflection test on propped cantilever to determine the Young's modulus.
13. Deflection test on continuous beam to determine the Young's modulus.
14. Crushing and compression test on bricks and concrete cubes.
15. Look at each component (arm, leg, seat, back, etc.) of a chair in a classroom and decide what type of familiar structure it is and what type of loads act on it during normal use.
16. List each component, state where and how the load acts and select the theory which you would have to consider when analyzing the stresses in the chair

Note: A minimum of 12 experiments need to be conducted.

SUGGESTED READING:

1. S.S. Rattan., Strength of Materials, 3rd edition, Tata Mc-Graw Hill, 2017.
2. R. C. Hibbler, Mechanics of Mechanics of Materials, 9th Pearson, 2018.
3. Virtual labs – Strength of Materials Lab, NITK Surathkal

22CSC36

DATA STRUCTURES USING PYTHON LAB

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

COURSE OBJECTIVES: This course aims to
1. Introduce data structures in python.
2. Familiarize with visualization techniques and tools in python.
3. Implement ADT for linear and non-linear structures.
4. Analyze the performance of sorting and searching techniques.
5. Gain knowledge on applying data structures in real world problems.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Demonstrate Classes, Objects, linear data structures, nonlinear data structures.
2. Store, retrieve and visualize datasets using Python built-in packages.
3. Evaluate the performance of sorting techniques.
4. Build optimal solutions using linear data structures, nonlinear data structures and hashing.
5. Apply pattern matching algorithms for real time problems.

CO-PO-PSO ARTICULATION MATRIX

PO/PSO /CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

LIST OF EXPERIMENTS:
1. Demonstration of class and objects.
2. Read a dataset, describe, visualize and provide inference.
3. Implement the Sorting algorithms: Selection Sort, Merge Sort, Quick Sort, Radix Sort.
4. Define Single Linked List ADT: Insertions, Deletions, Display
5. Define Doubly Linked List ADT and perform all standard operations.
6. Define Stack and Queue ADTs and implement standard operations
7. Implementation of Binary Search Tree: Insertion, Deletion, Traversal
8. Implementation of Graph traversal techniques.
9. Implementation of Hashing.
10. Implementation of Rabin-Karp algorithm

TEXT BOOKS:
1. NarasimhaKarumanchi,"DataStructuresandAlgorithmicThinkingWithPython",CareerMonkPublications, 2016
2. Jake VanderPlas, Python Data Science Handbook, OReilly, 2017

SUGGESTED READING:
1. Michael T.Goodrich,Roberto Tamassia, Michael H.Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2013.
2. KennethA.Lambert, "Fundamentals of Python: Data Structures", Cengage Learning, 2018.
3. Narasimha Karumanchi, “Data Structures and Algorithms for GATE”, CareerMonk Publications, 2011.
4. Wes McKinney, “Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython”, 2nd Ed, OReilly, 2018.

ONLINE RESOURCES:
1. https://www.geeksforgeeks.org/data-structures/
2. https://www.coursera.org/specializations/data-structures-algorithms3.
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms

22MEC08

HEAT TRANSFER LAB

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

COURSE OBJECTIVES: This course aims to

1. The concepts of thermal conductivities and thermal resistances; significance of insulating and conducting materials.
2. The procedure of determining the heat transfer coefficients under natural and forced convection phenomena
3. Method of measuring the emissivity of a given plate and determining Stefan-Boltzmann constant.
4. The procedure of determining the heat transfer coefficient of a heat exchanger.
5. The concepts of phase change heat transfer.

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

1. Determine thermal conductivities, thermal resistances of conducting and insulating materials.
2. Determine the experimental value of heat transfer coefficients in natural and forced convection modes and compare the results with analytical values.
3. Determine the Stefan-Boltzmann constant and the value of emissivity of a grey plate.
4. Calculate the heat transfer coefficient of heat exchanger for various configurations.
5. Calculate the heat transfer coefficient in boiling and condensation heat transfer.

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	PO1 0	PO1 1	PO1 2	PS O 1	PS O 2	PS O 3
CO1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO2	1	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO3	1	1	2	1	-	-	-	-	-	-	-	1	1	1	1
CO4	1	1	1	1	-	-	-	-	1	1	-	1	1	1	1
CO5	1	1	2	1	1	1	-	-	1	1	-	1	1	1	1

LIST OF THE EXPERIMENTS:

1. Determination of thermal conductivity of Insulating Powder.
2. Determination of thermal conductivity of composite wall.
3. Determination of thermal conductivity of metal rod.
4. Determination of convective heat transfer coefficient under Natural convection phenomena.
5. Determination of convective heat transfer coefficient under Forced convection phenomena.
6. Determination of Emissivity of a given plate.
7. Determination of the value of Stefan-Boltzmann constant.
8. Determination of Heat transfer coefficient in parallel flow heat exchanger.
9. Determination of Heat transfer coefficient in counter flow heat exchanger.
10. Determination of heat transfer coefficient in Film wise and Drop wise condensation
11. To determine the effectiveness of Cross flow Heat Exchanger.
12. Heat Pipe Demonstration.
13. Determination of thermal capacity of solid and liquid.
14. Determination of critical heat flux for copper wire in water.

Note: A minimum of 10 experiments need to be done.

TEXT BOOKS:

1. J.P. Holman, Heat Transfer, McGraw Hill Publication, New Delhi, 2009.

SUGGESTED READING:

1. D.S. Kumar, Heat Transfer, S K Kataria Publishers, 2015.

22MEI01

MOOCs/TRAINING/INTERNSHIP

Instruction / Demonstration /Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	--
SEE	--
CIE	50 Marks
Credits	2

PREREQUISITE: Knowledge of Basic Sciences and Engineering Science.

COURSE OBJECTIVES: This course aims to
1. Exposing the students to the industrial environment.
2. Create awareness with the current industrial technological developments relevant to program domain.
3. Provide opportunity to understand the social, economic and administrative considerations in organizations.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Understand Engineer's responsibilities and ethics.
2. Use various materials, processes, products and quality control.
3. Provide innovative solutions to solve real world problems.
4. Acquire knowledge in technical reports writing and presentation.
5. Apply technical knowledge to real world industrial/rural situations

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	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1	3	3	1	3	1	3	3	1	1	3
CO2	1	1	1	3	3	1	2	1	1	1	1	1	3	3	1
CO3	2	3	3	3	3	2	3	1	1	1	1	1	3	3	1
CO4	1	1	1	1	1	3	1	1	3	3	1	1	1	1	3
CO5	1	3	3	3	3	2	3	1	1	1	1	1	3	3	3

For implementation procedures and letter formats, Annexures I and III of Internship document may be referred.

EVALUATION OF INTERNSHIP:
The Industrial training / Internship of the students will be evaluated in three stages:
1. Evaluation by the Industry (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent).
2. Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks).
3. Evaluation through seminar presentation/Viva-Voce at the Institute by the constituted committee (25 marks).

EVALUATION THROUGH SEMINAR PRESENTATION / VIVA-VOCE AT THE INSTITUTE:
Students shall give a seminar before an Expert Committee constituted by college (Director, HoD/Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out.

The evaluation will be based on the following criteria:
1. Quality of content presented.
2. Proper planning for presentation.
3. Effectiveness of presentation.
4. Depth of knowledge and skills.
5. Attendance record, daily diary, departmental reports shall be analyzed along with the Internship report.

MONITORING / SURPRISE VISITS:
During the internship program, the faculty mentor makes a surprise visit to the intern- ship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training / internship may be cancelled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

B.E. (MECHANICAL ENGINEERING)

SEMESTER – IV

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hrs	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MEC09	Kinematics of Machines	3	1	--	3	40	60	4
2	22MEC10	Applied Thermodynamics	2	--	--	3	40	60	2
3	22MEC11	Fluid Mechanics and Hydraulic Machines	3	-	--	3	40	60	3
4	22MEC12	Manufacturing Processes	3	-	--	3	40	60	3
5		Professional Elective - I	3	--	--	3	40	60	3
6	22EGM01	Indian Constitution and Fundamental Principles	2	--	--	2	--	50	*Non Credit
PRACTICALS									
7	22MEC13	Computer Aided Machine drawing	--	1	2	3	50	50	2
8	22MEC14	Fluid Mechanics and Hydraulic Machines Lab	--	--	2	3	50	50	1
9	22MEC15	Manufacturing Processes Lab	--	--	2	3	50	50	1
10	22MEC16	Applied Thermodynamics Lab	--	--	2	3	50	50	1
TOTAL			**16**	**02**	**08**	--	**400**	**550**	**20**
Clock Hours Per Week: 26									

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

Professional Elective – I		
S. No	**Course Code**	**Title of the Course**
1	22MEE01	Power Plant Engineering
2	22MEE02	Production and Operations Management
3	22MEE03	Entrepreneurship
4	22MEE04	Mechatronics and Automation

22MEC09

KINEMATICS OF MACHINES

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

COURSE OBJECTIVES: This course aims to

1. Basic elements of mechanisms and their motion characteristics, DOF
2. Velocity and Acceleration analysis of various mechanisms.
3. Principles involved in functioning of pivots, collars, clutches, belts, brakes and dynamometers
4. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Selecting gear and gear train depending on application**.**

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

1. Understand basic elements of mechanisms and their motion characteristics, DOF.
2. Analyze Velocity and Acceleration of various mechanisms.
3. Understand and Evaluate Principles involved in functioning of pivots, collars, clutches, belts, brakes and dynamometers.
4. Design displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Select gear and gear train depending on application.

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	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	2	-	1	-	-	-	-	1	-	2	-
CO2	3	3	2	1	2	-	1	-	-	-	-	1	-	2	-
CO3	3	3	2	1	1	-	1	-	-	-	-	1	-	2	-
CO4	3	3	2	1	2	-	1	-	-	-	-	1	-	2	-
CO5	3	3	2	1	1	-	1	-	-	-	-	1	-	2	-

UNIT I

Basics of Mechanisms: Definition of kinematic link, Pair, Kinematic chain, Mechanism and machine, Degrees of freedom, Grubler's criterion, Inversions of four bar mechanism, Inversions of single and double slider crank chains.

Mechanism with Lower Pairs and Straight Line Motion Mechanism: Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT II

Velocity and Acceleration of Mechanisms: Velocities of mechanisms by instantaneous centre, Body centrode, Space centrode, Kennedy's theorem, Determination of velocity and acceleration of Four bar, Single slider crank and Slotted lever mechanisms by relative velocity method including Coriolis component of acceleration, Freudenstein's method for synthesis of four bar linkage.

UNIT III

Friction: Friction in pivots, Collars. Clutches - Single and Multi-plate, Cone and centrifugal clutches.

Brakes and Dynamometers: Block or shoe, Band, Band and block, Internal expanding shoe brakes. Prony brake, Rope brake, Belt transmission and torsion dynamometers.

UNIT IV

Cams: Types of cams and followers, Displacement diagrams for followers, Uniform motion, Parabolic motion, Simple harmonic motion, Cycloidal motion, Drawing cam profile with knife edge follower, Translating roller follower and translating flat follower, Cams of specified contours, Tangent cam with roller follower, Circular arc (convex) cam with roller follower.

UNIT V

Gears: Classification of gears, Spur gears, Nomenclature, Law of gear tooth action, Involute as gear tooth profile, Interference of involute gears, Minimum number of teeth to avoid interference, Contact ratio, Cycloidal tooth profile, Comparison of involute and cycloidal tooth profile.

Gear Trains: Gear trains, Simple, Compound, Reverted and epicyclic gear trains, Differential of an automobile.

TEXT BOOKS:

1. Thomas Bevan., Theory of Machines, CBS Publishers, 2009.
2. S.S. Rattan., Theory of Machines, 4th edition, Tata McGraw Hill Publishers, 2017.

SUGGESTED READING:

1. C.S. Sharma and Kamlesh Purohit., Theory of Mechanisms and Machines, PHI Learning Pvt. Limited, 2006.
2. Amitabh Ghosh and A.K.Mallik., Theory of Machines, 3rd edition, East West Publications, 2009.
3. J.E. Shigley, Theory of Machines, 3rd edition, Tata Mc.Graw Hill Publishers, New Delhi, 2014

22MEC10

APPLIED THERMODYNAMICS

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

COURSE OBJECTIVES: This course aims to
1. The working principle of single and multi-stage reciprocating air compressor.
2. The working principle of diesel and petrol engines.
3. The combustion phenomena in IC Engines, parameters leading to abnormal combustion; cooling, lubrication and ignition systems.
4. The working principles of steam boilers.
5. The efficiency improvement methods of Rankine cycle and functioning of nozzles.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Estimate the power required and efficiency of reciprocating air compressor using the principles of thermodynamics.
2. Understand the working principle of I.C engines and their performance evaluation.
3. Understand the concepts of normal, abnormal combustion and the functioning of engine systems like cooling, lubrication and ignition.
4. Understand the types of boilers and their performance.
5. Determine the efficiency of Rankine cycle with performance improvement techniques; understand the nozzle performance and the condition for the maximum discharge.

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	PSO 1	PSO 2	PSO 3
CO1	2	1	2	-	1	-	-	-	-	-	-	1	1	-	1
CO2	2	2	2	-	1	1	-	-	-	-	-	1	1	-	1
CO3	2	2	2	1	1	1	-	1	-	-	-	1	1	-	1
CO4	2	1	2	-	1	-	-	-	-	-	-	1	1	-	2
CO5	2	1	-	-	-	-	-	-	-	-	-	1	1	-	2

UNIT I

Reciprocating Air Compressors: Classification of compressors, applications of compressed air, working principle of reciprocating compressors - single stage and multi stage compressors with and without clearance, concept of optimum pressure ratio, minimum work input, various efficiencies of multi stage compressors, simple problems on reciprocating compressors.

UNIT II

Internal Combustion Engines: Classification, working principles of 2-stroke, 4-stroke SI and CI engines, valve and port timing diagrams, performance of IC engines, Morse test, various methods of determining frictional power, various efficiencies, heat balance sheet.

UNIT III

Combustion Phenomena: Stages of combustion in SI and CI engines, factors affecting, normal and abnormal combustion phenomenon in SI and CI engines, octane and cetane number, cooling systems, lubrication systems, battery and magneto ignition systems of IC engines.

UNIT IV

Steam Boilers: Classification of boilers-Fire tube boilers- Cochran boiler, Locomotive boiler and Lancashire boiler, Water tube boilers- Babcock and Wilcox boiler. Boiler mountings and accessories. Boiler performance, Types of condensers- Jet and Surface condensers.

UNIT V

Steam power plant: Modified Rankine cycle, Cycle efficiency improvement methods, Reheating, Regeneration and Cogeneration.

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity of steam flowing through the nozzle, Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio, Diameters of nozzle throat and exit for maximum discharge

TEXT BOOKS:

1. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2016.
2. V. Ganeshan, Internal Combustion Engines, Tata McGraw Hill Publishing, New Delhi,2015
3. R.K. Rajput., Thermal Engineering, Laxmi Publishers, New Delhi, 2014

SUGGESTED READINGS:

1. Heywood, J.B. "Internal Combustion Engine Fundamentals", TMH, New York, 2004
2. Soman, Thermal Engineering, PHI, 2011.
3. Kulshrestha S.K., 'Thermal Engineering', Vikas Publishing, 2nd Edition, 2011

22MEC11

FLUID MECHANICS AND HYDRAULIC MACHINES

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

COURSE OBJECTIVES: This course aims to
1. Learn the fluid statics and properties of fluids.
2. Understand the laws related to fluid flow and their applications
3. Understand various principles and performance characteristics related to Reciprocating pumps.
4. Learn the working principle and efficiencies of hydraulic turbines
5. Come to know the working principles and performance characteristics of Centrifugal pumps.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Determine the various properties of fluids
2. Understand the laws related to fluid flow and their applications
3. Acquire the knowledge of the functionality and performance of reciprocating pumps.
4. Acquire knowledge in the functionality, performance and testing of hydraulic turbines
5. Estimate the performance and testing of centrifugal pumps.

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	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	2	-	3	-	3	-	-	-
CO2	2	-	-	-	-	-	-	2	-	3	-	3	-	-	-
CO3	2	-	-	-	-	-	-	2	-	3	-	3	2	-	-
CO4	2	-	-	-	-	-	-	2	-	3	-	3	2	-	-
CO5	2	-	-	-	-	3	3	2	3	3	3	3	2	-	3

UNIT I

Static Forces on Surface and Buoyancy:

Fluids, ideal and real fluids, incompressible and compressible fluids, stream lines, path lines, stream function and velocity potential, fluid statics, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure, Equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, determination of the position of the metacenter relative to the center of buoyancy.

Properties of fluids: Density, specific weight, specific gravity, specific volume, viscosity, Newton's law of viscosity, dynamic and kinematic viscosity, pressure

UNIT II

Laws of Fluid Flow: Continuity theorem, Bernoulli's theorem, applications of Bernoulli's theorem, Pitot tube theoretical discharge, actual discharge and coefficient of discharge of Venturimeter, notches-rectangular, triangular, trapezoidal and stepped notches

Viscous Flow: Nature of flow-laminar, turbulent and transient flows, Reynolds number and its significance

Flow through Pipes: Head losses in pipes, pipe bends, major energy losses, loss of head due to friction in the pipe, Darcy-Weisbach equation, hydraulic gradient and total energy lines, pipes in series and parallel.

UNIT III

Reciprocating Pumps: Classification and working principle, discharge, slip, coefficient of discharge, power required to drive the pump and efficiency, variation of pressure head due to acceleration of piston and pipe friction, ideal and actual indicator diagrams, separation, safe speed to avoid separation, air vessels, work saved, quantity of water entering into or coming out of air vessels and performance characteristic curves.

UNIT IV

Hydraulic machines and impact of jet on vanes: Types of hydraulic machines, impulse-momentum equation and its applications, layout of hydraulic power plant-working principle, velocity triangles, impact force exerted, power developed and efficiency of jet striking at the center and at one end of a single and series of unsymmetrical moving curved vanes

Hydraulic Turbines: Classification and working, Velocity triangles, Power developed and efficiencies of Pelton wheel, Francis turbine and Kaplan turbines, Design of hydraulic turbines, Specific speed, Physical significance, Unit testing, Unit quantities, Model testing, Conditions for similarity and performance characteristic curves.

UNIT V

Centrifugal Pumps: Classification and working principle, Comparison over reciprocating pumps, Velocity triangles, Head equivalent of work done, Efficiencies, Pressure rise, Minimum starting speed, Specific speed, Physical significance, Model testing, Conditions of similarity, Priming, Performance characteristic curves, Common operational problems (troubles), reasons and remedies.

TEXT BOOKS:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015.

SUGGESTED READING:

1. R.S. Khurmi and N. Khurmi., Hydraulics, Fluid Mechanics and Hydraulic Machines, 20th edition, S.Chand publishing, 2014
2. S. Ramamrutham., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., Fluid Mechanics and Turbomachines, PHI Learning Private Limited, New Delhi, 2009.

22MEC12

MANUFACTURING PROCESSES

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

COURSE OBJECTIVES: This course aims to
1. Understand various terms related to manufacturing processes
2. Understand various manufacturing processes
3. Provide the ability to solve simple problems such as riser design and sheet metal calculations
4. Compare various Manufacturing processes
5. Select suitable manufacturing process for a given component.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Define various terms related to manufacturing processes
2. Demonstrate the understanding of various manufacturing processes
3. Solve simple problems such as riser design and sheet metal calculations
4. Compare various manufacturing processes
5. Choose suitable manufacturing process for a given component

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	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	-	-	-	-	-	1	-	-	3	2	-
CO2	1	2	1	1	-	-	-	-	-	-	-	1	3	1	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	1	2	-	-	-	-	1	-	-	-	-	-	1	3	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	1	3	-

UNIT I

Manufacturing Processes: Classification and importance.

Casting: Introduction, Classification of casting processes, Merits and demerits of casting process. Pattern materials, Pattern allowances, Elements of gating system, Types of gates: top gate, bottom gate, parting gate and step gate. Gating ratio and choke. Application of Bernouli principle and continuity equation to the flow in gating system. Mould filling time calculations, Pressurised and unsurprised gating systems.

UNIT II

Riser design: Purpose and requirements of riser, Chvorinov's rule, Optimum shape and dimensions of riser, Riser design by Modulus method.

Special Casting Processes: Pressure die casting, Centrifugal casting, shell moulding, Investment casting.

UNIT III

Arc Welding: Introduction to welding, Classification of welding processes, shielded metal arc welding, submerged arc welding, Gas Tungsten arc welding, gas metal arc welding and cold metal transfer.

Resistance Welding: Principle, Spot, Projection, Seam, Butt and percussion welding processes.

Solid State Welding: Friction welding, Ultrasonic welding and explosive welding

Other Welding Processes: Laser beam welding, Electron beam welding, Soldering and brazing.

UNIT IV

Bulk Deformation Processes: Open die, closed die and isothermal forging processes, Rolling process, Nomenclature of rolling, Geometric relationships in rolling, direct, indirect, hydrostatic and impact extrusion processes, Wire drawing process

Sheet Metal Operations: Shearing process, Shearing load, Energy required, Types of shearing processes, Cup drawing process, Calculation of blank diameter for a given cup, Drawing load, Sheet bending process and bend allowance.

UNIT V

Additive Manufacturing: Introduction, Stereo lithography, fused deposition modeling, Selective laser melting, Powder bed fusion, Direct metal deposition and applications of additive manufacturing

Powder Processing: Introduction, Production of powders, Mixing, Blending, Compacting and Sintering, Merits, Demerits and application of powder metallurgy products.
Processing of Plastics, Ceramics and Composites: Injection moulding, Blow moulding and thermoforming of plastics, Injection moulding and slip casting of ceramics, Roll bending and filament winding of composites.

TEXT BOOKS:
1. G.K. Lal and S.K. Choudhury., Fundamentals of Manufacturing Processes, Alpha science International Ltd., 2005.
2. Mikell P.Grover., Principle of Modern Manufacturing, 5th edition, Wiley, 2014,

SUGGESTED READING:
1. P.N. Rao., Manufacturing Technology, Vol.1, 3rd edition, Tata McGraw Hill Publ., 2011.
2. John Schey., Introduction to Manufacturing Processes, 2nd edition, McGraw Hill Education, 1999
3. Amitabh Ghosh and Mallick, Manufacturing Science, 4th edition, Assoc. East West Press Pvt. Ltd., 2011.

22MEE01

POWER PLANT ENGINEERING

(Professional Elective - I)

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

COURSE OBJECTIVES: This course aims to

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plants, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics, environmental and safety aspects of power plant operation.

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

1. Identify different handling equipment used in steam plant.
2. Understand various coal combustion methods.
3. Recognize different types of dams, spill ways and hydroelectric power plants.
4. Classify nuclear power plants based on moderator and coolant.
5. Analyze economics related to power plants and effect of pollutants

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	PSO 1	PSO 2	PSO 3
CO1	1	-	1	-	-	3	2	-	-	2	-	3	1	1	2
CO2	1	-	1	-	-	3	2	-	-	2	-	3	1	1	2
CO3	1	-	1	-	-	3	2	-	-	2	-	3	1	2	1
CO4	1	-	1	-	-	3	2	-	-	2	-	3	0	1	2
CO5	0	1	0	-	-	3	2	1	-	2	1	3	1	2	2

UNIT I

Introduction: Energy and power, Sources of energy, Classification of power plants, Power development in India.

Steam power plant: Plant Layout, Site selection factors, Types of coal, Requirements of good coal handling plant, Coal and ash handling systems, Removal of dust and dust collectors.

UNIT II

Coal Combustion and Firing Methods: Overfeed stoker, Chain grate and spreader stokers, Underfeed stoker, Multi-retort stoker, Unit system, Central bin system, Pulverized fuel burners, Cyclone burner, Fluidized bed combustion.

UNIT III

Hydro Electric Power Plant: Hydrological cycle, Recording and non-recording rain gauges, Run-off flow measurement, Flow and mass duration curves, Site selection, Components and layout of hydro power plant, Types of dams and spillways, Classification of hydroelectric plants.

UNIT IV

Nuclear Power Plant: Breeding and fertile materials, Comparison of fission and fusion processes, Essential components of a nuclear reactor, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, Liquid metal cooled reactors, Breeder reactor, Radioactive waste disposal.

UNIT V

Power Plant Economics: Terms and definitions, Types of loads, Load curve, Load duration curve, Fixed and operating costs, methods to find depreciation cost, various types of tariffs.

Environmental considerations: Effluents from power plants and impact on environment.

TEXT BOOKS:

1. R.K. Rajput, A Text Book of Power Plant Engineering, 5th edition, Laxmi Publications (P) Ltd, New Delhi, 2016.
2. P.K. Nag, Power Plant Engineering, 4th edition, McGra Hill Education (India) Private Limited, New Delhi, 2014.

SUGGESTED READING:

1. R. Yadav, Fundamentals of Power Plant Engineering, Central Publishing House, Allahabad, 2012.
2. R.K. Hegde, Power Plant Engineering, Pearson Education India, 2015.
3. P.C. Sharma, A Text Book of Power Plant Engineering, S.K. Kataria & sons, New Delhi, 2016.

22MEE02

PRODUCTION AND OPERATIONS MANAGEMENT

(Professional Elective - I)

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

COURSE OBJECTIVES: This course aims to

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
3. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
4. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
5. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

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

1. Understand the role of production system and its design in production and operations management.
2. Apply forecasting techniques for predicting demand
3. Use aggregate planning, master scheduling and materials requirement planning in a production system
4. Compare various inventory control techniques used in production system.
5. Apply the quality control tools to improve performance of production system.

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	PSO 1	PSO 2	PSO 3
CO1	0	1	3	1	0	3	2	0	0	0	1	0	1	2	0
CO2	2	3	0	1	0	0	0	0	0	0	1	0	1	1	0
CO3	1	3	1	2	0	0	0	0	0	1	1	0	1	1	0
CO4	1	2	1	2	0	0	0	0	0	0	0	0	1	1	0
CO5	2	2	0	3	0	3	0	0	0	0	0	0	1	1	0

UNIT I

Introduction: Production systems, Classification and characterisation

Plant Location and Layout: Factors affecting plant location, Objectives of plant layout, Types of layouts, Merits and demerits.

Work Study: Productivity, Introduction to method study and work measurement, Standard time calculations, Work sampling.

UNIT II

Forecasting: Introduction, Forecasting objectives and uses, Demand patterns, Qualitative models, Market survey, Delphi method, Quantitative models, Moving average, Weighted moving average, Simple exponential smoothing, Trend adjusted exponential smoothing, Simple regression.

Forecast Errors: Mean absolute deviation, Mean square error, Mean forecast error, Mean absolute percentage error

UNIT III

Aggregate Planning and Master Scheduling: Introduction, Objectives of aggregate planning, Cost in aggregate planning, Strategies in aggregate planning, Master production scheduling.

Materials Requirement Planning: Importance, MRP system, Inputs and outputs, Bill of materials.

UNIT IV

Inventory Control: Importance, Inventory control systems, Types of Inventories, Inventory costs, Deterministic Inventory models, Basic purchase model, Purchase model with instantaneous replenishment and with shortages, Basic production model, Production model with shortages, Inventory model with price breaks, Just-in-time system evolution and its characteristics.

UNIT V

Quality Control: Introduction, Quality gurus and their contributions, Quality tools, Process capability, Quality control by control charts, Sampling plans, Operating characteristic curve, Introduction to total quality management and six-sigma.

TEXT BOOKS:

1. Joseph G. Monks., Operations Management: Theory and Problems, 3rd edition, McGraw Hill International Edition, 1987.
2. William J. Stevenson., Operations Management, 8th edition, Tata McGraw Hill Edition, 2005.

SUGGESTED READING:

1. Everrete E. Adam and Ronald J. Ebert., Production & Operations Management, 5th edition, Prentice Hall of India, 2005.
2. R. Panneerselvam., Production and Operations Management, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. Elwood S. Buffa., Modern Production/Operations Management, 5th edition, John Wiley Publishers, Singapore, 2002

22MEE03

ENTREPRENEURSHIP
(Professional Elective - I)

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

COURSE OBJECTIVES: This course aims to
1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and it's procedure.
4. Project management and its techniques.
5. Behavioural issues and Time management.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

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	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	1	2	1	1	2	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	3	3	3	-	-	-
CO3	1	-	-	1	-	-	1	2	3	3	3	3	1	-	-
CO4	2	-	-	-	-	-	1	2	1	3	3	3	2	-	-
CO5	-	-	-	-	-	-	2	2	1	2	1	3	-	-	-

UNIT I

Entrepreneurship: Definition, Functions of entrepreneurs, Qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, Women entrepreneurs, Innovation, Creativity, Intellectual property in entrepreneurial journey, Conception and evaluation of ideas and their sources, Need and importance of start-ups and incubation centers.

UNIT II

Indian Industrial Environment: Competence, Opportunities and challenges, Entrepreneurship and economic growth, Small scale industry in India, Objectives, Linkage among small, medium and large scale industries, Types of enterprises, corporate social responsibility.

UNIT III

Formulation of Business Plan: Introduction, Business model canvas, Elements of business plan and its salient features, Technical analysis, Profitability and financial analysis, Marketing analysis, Executive summary. Choice of technology and collaborative interactions, Sources of finance and Incentives for entrepreneurs. Business firm registration procedures.

UNIT IV

Project Management: Meaning and definition of project, Project organization, Project planning, Execution and control using CPM and PERT techniques, Human aspects of project management, Assessment of tax burden, Environmental issues

UNIT V

Behavioral Aspects of Entrepreneurs: Personality determinants, Maslow's hierarchy of needs, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior.

Time Management: Approaches of time management, Strengths and weaknesses, Time management matrix and the urgency addiction

TEXT BOOKS:

1. Vasant Desai., Dynamics of Entrepreneurial Development and Management, 6th edition, Himalaya Publishing House, Mumbai, 1997.
2. Prasanna Chandra., Projects: Planning, Analysis, Selection, Implementation and Review, 8th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.

SUGGESTED READING:

1. Robert D. Hisrich and Michael P. Peters., Entrepreneurship, 5th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2005.
2. Stephen R. Covey., First Things First, 1st edition, Free press, New York, 2003.
3. S.S. Khanka., Entrepreneurial Development, 4th edition, S. Chand & Co. Pvt. Ltd., New Delhi, 2012.

22MEE04

MECHATRONICS AND AUTOMATION

(Professional Elective - I)

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

COURSE OBJECTIVES: This course aims to

1. Understand the elements of mechatronics systems and their interconnection with sensors and transducers
2. Understand the concept of mechanical and electrical actuators
3. Interfacing of a microcontroller and microprocessor with its constituents and study of various controllers
4. Study of various automated systems for industrial applications
5. Study of robotic automated systems using AI and IOT for various industrial applications

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

1. Apply the methodology of choosing the suitable sensor for a mechatronics system.
2. Select the suitable actuator for various electrical and mechanical systems.
3. Design a microcontroller and microprocessor with emphasis on process controllers (P, PD, PI and PID) for a mechatronics system
4. Design an automated system for industrial applications.
5. Integrate the concepts of AI and IOT while designing a robotic automated system for various industrial applications.

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	PSO 1	PSO 2	PSO 3
CO1	2	2	3	1	2	1	1	1	2	2	1	1	3	1	2
CO2	2	2	3	1	2	1	-	1	2	1	1	1	3	1	2
CO3	2	2	3	1	2	2	-	2	2	1	2	2	3	1	2
CO4	2	2	3	1	2	1	-	1	2	2	2	2	3	1	3
CO5	2	2	3	1	2	2	1	2	2	2	2	2	3	1	3

UNIT I

Introduction to Mechatronics Systems: Need of interface of electrical & electronic devices with mechanical elements, Concept of mechatronics, Flow chart of mechatronics system, Elements of mechatronics system, Drive mechanisms, Actuators, Feedback devices and control system application in industries and systems development.

Sensors and Transducers: Sensors for displacement, Position and proximity, Velocity, Motion, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, (thermistor, thermocouple), Light sensors and selection of sensors.

UNIT II

Pneumatic and Hydraulic Actuation Systems: Valves, Pumps and accessories, Hydraulic circuits, Mechanical servo control circuits, Electro-hydraulic servo control and hydro pneumatic circuits with examples.

Mechanical Actuation Systems: Cams, Gear trains, Ratchet and pawl.

Electrical Actuation Systems: Mechanical switches, Solenoids, DC motors, AC motors, Stepper motors and servo motors.

UNIT III

Microprocessor Technology: Introduction, Architecture, Configuration, Programming and using of 8051 controller with 'C' language, Interfacing input and output devices for various applications.

Process Controllers: Controllers, Uses of controllers, Open loop and closed loop control, Proportional, PD, PI, PID controllers, Analog and digital methods of control.

UNIT IV

Introduction to Automation: Importance of automation, Use of mechatronics, Systems required, Purpose of automatic control, Implementation of industrial control system, Introduction to automatic control theory

Design of an Automated System: Building blocks of an automated system, Working principle, Selection of various components of an automated system, Specifications of various elements, Use of design data books and catalogues.

UNIT V

Case Studies of Mechatronics Systems; Pick and place robot, Automatic car park systems, Automatic washing machine and engine management systems.

Introduction to robotic automation: Artificial Intelligence (AI) based systems, IOT in manufacturing industries.

TEXT BOOKS:

1. William Bolton., Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education, 2015
2. Ronald P. Hunter., Automated process control systems – concepts and Hardware, 2nd edition, PHI, 1987.

SUGGESTED READING:

1. Devdas Shetty and Richard A. Kolk., Mechatronics System Design, Cengage Learning, 2010.
2. A.K Sawhney., A course on Electrical and Electronic Measurements and Instrumentation, Dhanapatrai & co, 2015

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/B.Tech - Common to all branches)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	--

PREREQUISITE: Basic Awareness of Indian Constitution and Government.

COURSE OBJECTIVES: This course aims to

1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

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

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

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	PSO 1	PSO 2	PSO 3
CO1	-	-	1	-	-	1	1	1	1	-	-	-	-	-	-
CO2	-	-	2	-	-	3	2	2	1	-	-	-	-	-	2
CO3	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO4	-	-	1	-	-	1	1	-	-	-	-	-	-	-	2
CO5	-	-	2	-	-	3	2	1	1	-	-	-	-	-	2

UNIT I

Constitutional History and Framing of Indian Constitution: East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. **Framing of the Indian Constitution:** Constituent Assembly, Preamble and Salient Features.

UNIT II

Fundamental Rights, Duties and Directive Principles of State Policy: The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

UNIT III

Union Government and its Administration: Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

UNIT IV

Union Legislature and Judiciary: Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

UNIT V

Local Self Governments: Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

TEXT BOOKS:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Akademy, 2nd edition, 2018.
2. "Indian Constitution at Work", NCERT, First edition 2006, Reprinted in 2022.

SUGGESTED READING:

1. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. Granville Austin, "The Indian Constitution: The Cornerstone of a Nation", OUP, 2nd Edition, 1999.
4. M.V. Pylee, "India's Constitution", S. Chand Publishing, 16th Edition, 2017.
5. Rajeev Bhargava (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.

22MEC13

COMPUTER AIDED MACHINE DRAWING

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

COURSE OBJECTIVES: This course aims to
1. The conventions and rules to be followed by engineers for making accurate Drawings.
2. The Modeling of different machine components using CAD software.
3. Shape and structure of different types of screws, keys, couplings, and rivets.
4. Modeling of the assemblies of the machine components
5. To prepare the process sheets for the components.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Understand the representation of materials and conventions used in machine drawing
2. Draw the orthographic projections and sectional views of machine parts.
3. Draw the different types of fasteners.
4. Construct an assembly drawing using part drawings of machine components.
5. Represent tolerances and the levels of surface finish of machine elements and prepare the process sheet.

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	PSO 1	PSO 2	PSO 3
CO1	2	2	1	-	3	-	-	-	2	2	-	2	2	2	3
CO2	2	3	2	-	3	-	-	-	2	3	-	2	2	2	3
CO3	2	3	2	-	3	-	-	-	2	3	-	2	2	2	3
CO4	2	2	2	-	3	-	-	-	2	3	-	2	2	2	3
CO5	2	2	2	-	3	-	-	-	2	3	-	2	2	2	3

1. MACHINE DRAWING: Format of drawing sheet, title block, conventions of drawing lines and dimensions, First and third angles projections, Conventional representation of Engineering materials and various machine components, methods of indicating notes on drawing, conversion of Pictorial view to orthographic views, convention for sectional views. Orthographic projections including sectional views of simple machine elements. Study of various commands/ tool bars using solid modelling package (solid works). Component Drawings Of Fasteners, Joints And Couplings - Bolts and Nuts, Keys and Cotter joints, Knuckle Joint, Riveted joints, Shaft Couplings and Bearings. Assembly drawings of Connecting rod, Stuffing box, Screw jack, Lathe single Tool Post, Pedestal bearing (Plummer block). Revolving centre, Steam Engine Cross Head

2. PRODUCTION DRAWING: Introduction to production drawing- importance and need in industries , limit system and types of fits, geometrical tolerances, form and positional tolerances, surface roughness and its indication, process sheet preparation.

LIST OF EXERCISES:
1. Part Modelling of machine components and finding their mass properties
2. Drawing the view from the front, top and left of the objects.
3. Drawing the sectional views of a components
4. Part Modelling of threaded fasteners
5. Creation of a double row chain type riveted lap joint from parts and views of the assembly
6. Creation of cotter joint assembly model from parts and views of the assembly
7. Creation of flange coupling assembly model from parts and views of the assembly
8. Creation of Stuffing box assembly model from parts and views of the assembly
9. Creation of Screw Jack assembly model from parts and views of the assembly
10. Creation of component drawings with suitable tolerances and fits, surface roughness, bill of materials etc., for Foot step bearing assembly
11. Creation of component drawings with suitable tolerances and fits, surface roughness, bill of materials etc., for Revolving center assembly

12. Creation of component drawings with suitable tolerances and fits, surface roughness, bill of materials etc., for Square tool post assembly

Note: Students should complete minimum of 10 drawings

TEXT BOOKS:

1. K.L. Narayan, P. Kanniah, K. Venkat Reddy, *Machine Drawing*, New Age International (P) Ltd., 4th edition 2018.
2. K.L. Narayan, P. Kanniah, K. Venkat Reddy, *Production Drawing*, New Age International (P) Ltd., 4th edition 2018.
3. N. Siddeshwar, *Machine Drawing*, Tata McGraw Hill Publishing Co., Ltd., 5th edition, 2004.

SUGGESTED READING:

1. K.C. John, *Text book of Machine Drawing*, PHI Learning, 2010.
2. Ajeet Singh, *Machine Drawing*, Galgotia Publications, 2010.
3. N. D. Bhatt, V. M. Panchal Machine drawing [including computer aided drafting first-angle projection method], Charotar publishing house, 50th edition, 2016

22MEC14

FLUID MECHANICS AND HYDRAULIC MACHINES LAB

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

COURSE OBJECTIVES: This course aims to

1. Determine discharge of fluid flow.
2. Verify fluid laws like Bernoulli's equation and determine losses through pipes.
3. Determine impact force of jet on the vanes
4. Evaluate the performance characteristics of turbines
5. Demonstrate knowledge in evaluating performance characteristics of pumps

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

1. Carry out discharge measurements
2. Determine the energy loss in conduits.
3. Calculate forces and work done by a jet on fixed or moving, flat and curved blades.
4. Demonstrate the characteristics curves of turbines.
5. Evaluate the performance characteristics of pumps.

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	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	2	3	3	-	3	-	-	-
CO2	2	-	-	-	-	-	-	2	3	3	-	3	-	-	-
CO3	2	-	-	-	-	-	-	2	3	3	-	3	-	-	-
CO4	2	-	-	-	-	-	-	2	3	3	-	3	2	-	-
CO5	2	-	-	-	-	3	3	2	3	3	3	3	-	-	3

LIST OF THE EXPERIMENTS:

1. Verification of Bernoulli's equation.
2. Determination of Darcy's friction factor and nature of water flow through pipes
3. Determination of coefficient of discharge for Venturi meter
4. Determination of coefficient of discharge for V- notch
5. Performance and characteristic curves of Reciprocating pump
6. Determination of impact force of jet on fixed flat and fixed curved vanes
7. Performance and characteristic curves of Pelton wheel
8. Performance and characteristic curves of Francis Turbine
9. Performance and characteristic curves of Kaplan turbine
10. Performance and characteristic curves of Centrifugal pump
11. Performance and characteristic curves of Self priming pump.
12. Performance and characteristic curves of Gear pump.

Note: A minimum of 10 experiments need to be conducted.

SUGGESTED READING:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015
3. Virtual labs – Fluid Machinery Lab, NITK Surathkal

22MEC15

MANUFACTURING PROCESSES LAB

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

COURSE OBJECTIVES: This course aims to
1. Test the moulding sand and analyze the same.
2. Test the bead geometry and correlate the results to the input parameters.
3. Use TIG, MIG and Spot welding machines and experiment with them.
4. Test the formability characteristics of a given sheet metal and study different types of dies.
5. Understand the various type of sheet metal forming dies

COURSE OUTCOMES: After completion of this course, students will be able to
1. Test the moulding sand and analyze the same.
2. Test the bead geometry and correlate the results to the input parameters.
3. Use TIG, MIG and spot welding machines and experiment with them.
4. Test the formability characteristics of a given sheet metal.
5. Demonstrate the understanding of various types of dies.

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	PSO 1	PSO 2	PSO 3
CO1	1	-	-	1	-	-	-	-	2	-	-	-	1	1	-
CO2	1	-	-	1	-	-	-	-	2	-	-	-	1	1	-
CO3	1	-	-	1	-	-	-	-	2	-	-	-	1	1	-
CO4	1	-	-	1	-	-	-	-	2	-	-	-	1	1	-
CO5	1	-	-	1	-	-	-	-	2	-	-	-	1	1	-

LIST OF THE EXPERIMENTS:

CASTING:
1. Study of Ingredients of moulding sand and mould preparation for single piece
2. Study of core, core prints and moulding for split pattern.
3. Design of a simple pattern with various allowances.
4. Study of required properties of moulding sand and testing the properties of moulding sand
5. Study on the effect of the effect of grain fineness on moulding sand properties and Finding out the GFN of a given sand sample.
6. Demonstration of Melting and Pouring of Aluminium.

WELDING:
1. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
2. Study of Gas Welding process, types of flames and making a butt joint with gas welding.
3. Study of resistance welding process and spot welding of MS Sheets.
4. Study of TIG welding process and plotting cooling curve in TIG welding process
5. Study of SAW Welding process and finding out deposition efficiency of the process.
6. Study of MIG welding process and testing of weld bead formed by MIG welding.

METAL FORMING:
1. Evaluation of Formability of a given sheet material using Erichsen cupping test.
2. Study of cup drawing process, estimation of blank size for given cup and drawing a cup using simple die.
3. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity 6 Tons) and estimation of forces.
4. Study of Compound die design and manufacturing of washer components using the same on double body fly press (capacity 8 Tons) and estimation of forces.
5. Study of Combination die design and manufacturing of cylindrical cups using the same on a hydraulic power press (capacity 50 Tons) and estimation of drawing force.
6. Study of extrusion dies and demonstration of extruding lead material

Note: A minimum of 12 experiments need to be conducted.

SUGGESTED READING:

1. P.N. Rao., Manufacturing Technology, Vol.1, 3rd edition, Tata McGraw Hill Publ., 2011.
2. Amitabh Ghosh and Mallick, Manufacturing Science, 4th edition, Assoc. East West Press Pvt. Ltd., 2011.
3. Metal Forming Virtual Simulation Lab, Dayalbagh Educational Institute, Agra

22MEC16

APPLIED THERMODY NAMICS LAB

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

COURSE OBJECTIVES: This course aims to
1. To demonstrate basic knowledge and exposure to determine valve and port diagram and also to evaluate the performance of the petrol engine and diesel engine.
2. Student will know the importance of heat balance sheet of IC engine.
3. Students will acquire knowledge in evaluating the performance of multi-stage reciprocating compressor.
4. Student will acquire knowledge in determination of fuel properties
5. Student will acquire knowledge regarding pollution levels of various alternative fuels

COURSE OUTCOMES: After completion of this course, students will be able to
1. Evaluate the performance of petrol and diesel engines.
2. Estimate the conversion of heat supplied by the fuel to various other forms of energy in an I.C engine.
3. Determine the performance of multi stage reciprocating air compressor.
4. Determination of fuel properties of liquids fuels
5. Determination of performance parameters and pollution levels of an alternative fuel.

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	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	-	1	1	-	-	-	-	1	1	-	1
CO2	2	1	2	1	-	1	1	-	-	-	-	1	1	-	1
CO3	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-
CO4	2	1	1	-	-	1	-	-	-	-	-	1	1	-	-
CO5	2	1	2	1	-	2	2	-	-	1	-	1	1	-	1

LIST OF THE EXPERIMENTS: APPLIED THERMODYNAMICS
1. Determination of Valve timing diagram and Port timing diagram of IC engine.
2. Determination of Performance characteristics of a multi-cylinder petrol engine.
3. To conduct Morse test on multi cylinder petrol engine.
4. To conduct performance test on a variable compression ratio petrol engine.
5. To conduct performance test on single cylinder diesel engine
6. To conduct heat balance test on single cylinder diesel engine.
7. To conduct heat balance test on multi cylinder I.C. engine.
8. To determine volumetric efficiency, isothermal efficiency of multi-stage reciprocating air compressor.
9. Determination of Fuel properties like Flash point and Fire point of fuels.
10. Determination of Viscosity of fuels.
11. Determination of Calorific value of fuel by Bomb calorimeter.
12. To conduct performance test on Homogeneous Charge Compression Ignition (HCCI) Engine.
13. Evaluate the performance parameters and pollution levels of an alternative fuel on a four stroke single cylinder diesel engine.

Note: A Minimum of 10 experiments need to be done.

TEXT BOOKS:
1. Mahesh M. Rathore, ―Thermal Engineering, TMH, New Delhi, 2010
2. V. Ganeshan,―Internal Combustion Engines, Tata Mcgraw Hill Publishing, New Delhi, 2015

SUGGESTED READING:
1. R.K. Rajput., Thermal Engineering, Laxmi Publishers, New Delhi, 2014.

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1979

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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