SECOND YEAR MECHANICAL ENGINEERING SYLLABUS

SEMESTER III

Mathematics - III					
Course Code	**ME310**		**Credits**	**4**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	3	**1**	**0**	**(39 + 13) hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**25**	**100**	**0**	**0**

Course Objectives:

The course is intended at making students understand fundamentals of Mathematics necessary to formulate, solve and analyze engineering problems.

Course Outcomes:
On completing this course students will be able to:

CO 1	Understand the theory of matrices, Laplace transforms, Fourier Series, Probability theory and the formulation of one dimensional wave equation, heat flow equation and its solution.
CO 2	Compute the rank of matrix, eigen values and eigen vectors of a matrix, Laplace/ inverse transform of functions, Fourier Series of functions and Probability of events.
CO 3	Use rank of a matrix to analyze solutions of linear systems of equations. Solve differential /integral equations using Laplace transforms. Use Fourier series to find the solution of Partial differential equations such as wave equations and heat flow equations.
CO 4	Model real life problems with matrices, use probability for estimation. Propose a value to be substituted in a Fourier series to obtain the given real number series.

UNIT-1	**10 Hrs**
Matrices : Types of matrices, Determinant, inverse of matrix, Elementary transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation, Linear independence and dependence of vectors, System of the form AX = 0, and AX = B, and their solutions, Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, Diagonalization.	
UNIT-2	**09 Hrs**
Laplace Transforms: Definition. Existence conditions, properties, inverse Laplace transforms. Laplace transform of periodic functions, Convolution theorem, Laplace transform of Dirac-Delta function, Application of Laplace transforms in solving linear differential equations with initial conditions.	
UNIT-3	**10 Hrs**
Fourier Series : Periodic functions, Trigonometric series, Euler's formulae, Dirichlet's condition, Even and odd functions, Half range series, Parseval's identity. Partial Differential Equations: Derivation and solution of one dimensional wave equation using separation of variable method. Derivation and solution of one dimensional heat equation using separation of variable method.	

UNIT -4	10 Hrs
Probability: Definition, properties, Axioms of probability, conditional probability, theorem on total probability, Baye's theorem; Random variables-discrete & continuous; Expectation and Variance, Standard deviation, Moment Generating Function & properties, Standard distributions: discrete-Binomial, Geometric & Poisson; continuous- Uniform, Normal, exponential.	

TEXTBOOKS	
1	B. S. Grewal;Higher Engineering Mathematics; Khanna Publications, New Delhi
2	Veerarajan; Engineering Mathematics; Tata McGraw Hill Publications
3	Montgomery, D. C., Probability and Statistics for Engineers; Prentice Hall of India.
REFERENCES	
1	P. Kandasamy; Engineering Mathematics; Chand & Co., New Delhi.
2	Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press
3	Erwin Kreyzing; Advanced Engineering Mathematic; New International Limited.
4	D. S. Chandrasekhraiah;Engineering Mathematics- Part III ; Prism Books Pvt. Ltd

MECHANICS OF SOLIDS					
Course Code	**ME320**		**Credits**	**4**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	4	**0**	**0**	**52 hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**25**

Course Objectives:

To identify stress, strain and deformation due to external loads. To perform two dimensional stress and strain analysis. To understand the behavioural response of beams, struts, columns and trusses to forces. To apply various failure theories and energy methods.

Course Outcomes:
On completing this course students will be able to:

CO 1	Understand the basic concepts of Stress, Strain, Moment of Inertia, Shear Force and Bending Moment Diagram, Theories of Failure and Energy Methods.
CO 2	Remember the basic relations for Stress, Strain, Moment of Inertia, Pure Torsion, bending of beams, Theories of Failure & Energy Methods.
CO 3	Remember the basic relations for Stress, Strain, Moment of Inertia, Pure Torsion, bending of beams, Theories of Failure & Energy Methods.
CO 4	Analyze structural members and machine elements subjected to axial loads, lateral loads, bending and twisting moments for stresses, strains, and displacements and analyze statically determinate structures using Energy methods

UNIT-1	**14 Hrs**
Introduction: Review of engineering mechanics, static analysis of rigid systems. Introduction to Stress and Strain. Hooke's law, Poisson's ratio, Generalized Hooke's law, modulus of rigidity, bulk modulus, relation between material constants. **Uniaxial Deformation:** Uniaxial tension and compression, temperature stresses, statically indeterminate systems. **Two Dimensional Stress and Strain Analysis:** Analysis of two dimensional stress and strain, stress and strain analysis using Mohr's circle, strain gage rosettes.	
UNIT-2	**14 Hrs**
Properties of Areas: Review of Moments of inertia and polar moment of Inertia, Product of inertia, Principal axes, Principal moments of inertia, Mohr's circle for Moment of Inertia. **Beams:** Bending moment and shear force in beams, relation between them, sign convention, Bending stresses in beams- Flexure formula, Shear stresses in beams, deflection of beams (using double integration method, singularity functions method). **Statically Determinate Trusses:** Analysis by method of joints and method of sections in simple statically determinate trusses.	
UNIT-3	**14 Hrs**
Torsion: Torsion of solid and hollow circular shafts. Application of torsion to close and open coiled helical springs. **Theories of Failure:** Various theories of failures and their limitations comparison and applications.	

Combined Loading: Shafts subjected to bending moment and twisting moment, members subjected to bending and direct tension/ compression.	
UNIT -4	**14 Hrs**
Struts and Columns: Struts and core of section, stability of columns, Euler's critical load, for different end conditions of column, empirical formulae for buckling load. **Introduction to Energy Methods:** Strain energy under different loading conditions, Maxwell-Betti reciprocal theorem, Castigliano's theorems, deflection of structures using virtual load method. Theorem of minimum potential energy, complementary strain energy.	
ASSIGNMENTS Four assignments, one on each unit to be submitted within the given deadline.	

TEXTBOOKS	
1	S. Ramamrutham; Strength of Materials; Dhanpat Rai Publishing Co. (P) Ltd.
2	S. S. Bhavikatti; Strength of Materials; Vikas Publishing House Pvt Ltd.
REFERENCES	
1	S. P. Timoshenko, D. H. Young; Elements of Strength of Materials, East West.
2	Beer Ferdinand, Johnson E. Russel; Mechanics of Materials, Mc Graw Hill Books.
3	S. Sreenath; Strength of Materials; Tata McGraw-Hill Education.

ENGINEERING THERMODYNAMICS					
Course Code	**ME330**		**Credits**	**4**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	4	**0**	**0**	**52 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

To learn the principles of work and energy. To acquire knowledge about the fundamentals of thermodynamic laws, concepts and principles. To understand the principles of various cycles and to apply the thermodynamic concepts in various applications like IC engines and Air conditioning systems

Course Outcomes:
On completing this course students will be able to:

CO 1	Remember the basic concepts, properties, processes, laws, relations, and formulae of thermodynamic systems, pure substance, heat engines and basic energy conversion cycles.
CO 2	Understand the basic concepts, properties, processes, laws, relations, derivations, diagrams, charts and tables of thermodynamic systems, pure substance, heat engines and basic energy conversion cycles.
CO 3	Apply the knowledge of thermodynamics to various applications in engineering and real life.
CO 4	Analyze the various problems associated with thermodynamics in engineering and real life.

UNIT-1	**12 Hrs**
FIRST LAW OF THERMODYNAMICS Internal Energy, Law of Conservation of Energy, First Law of Thermodynamics, Application of First Law to a Process, Energy—A Property of System, Perpetual Motion Machine of the First Kind-PMM1, Energy of an Isolated System, Application of First Law of Thermodynamics to Non-flow or Closed System, Application of First Law to Steady Flow Process, Energy Relations for Flow Process, Engineering Applications of Steady Flow Energy Equation (S.F.E.E.)	
UNIT - 2	**12 Hrs**
SECOND LAW OF THERMODYNAMICS Limitations of First law of thermodynamics, Cyclic devices, Directional constraints, Thermal energy reservoirs. Heat engines, refrigerators/heat pump, Statements – Kelvin- Planck &Clausius, Mathematical interpretations with efficiency, COP, Ton of Refrigeration, Equivalence of statements with illustrations, Perpetual motion machine of second kind, Reversibility and irreversibility – causes and conditions. Carnot Theorems, Absolute temperature scale.	
UNIT-3	**14 Hrs**
ENTROPY Clausius Inequality, Entropy – property, Temperature entropy plane – all standard reversible processes (including polytropic process) with calculation for entropy change on T-S plane, Problem solving & solution procedure. Entropy change - irreversible process, flow processes, concept of lost work, entropy generation – applications, entropy as a measure of disorder.	

PROPERTIES OF PURE SUBSTANCE Definition, P-V-T surface, P-V, P-T diagram, T-S diagram of pure substance, h-s diagram or Mollier chart, Quality or Dryness Fraction, Steam tables – Reading and use of various tables & calculations, Measurement of steam quality.	
UNIT-4	**14 Hrs**
VAPOUR POWER CYCLE Simple steam power cycle, Basic Rankine cycle with derivation, mean temperature of heat addition, Work ratio, steam rate, heat rate, Carnot efficiency and comparative analysis, modified Rankine-reheat, regenerative (ideal & actual) with deviation of cycles, derivation & calculation – efficiency. **AIR STANDARD CYCLES** Air standard assumptions, Overview of reciprocating engines, Air standard cycles for reciprocating engines – Otto, Diesel & dual, Criteria for comparison & comparative analysis, Derivation for efficiency, Mean effective pressure (MEP) Brayton Cycle: Ideal cycle for gas turbine engines, Deviation of actual cycle, Enhancement – with regeneration, with reheating, with intercooling	

TEXTBOOKS	
1	Y. A. Cengel, M. A. Boles; Thermodynamics – An Engineering Approach; Tata McGraw Hill Education Pvt. Ltd. New Delhi.4th Ed; 2012.
2	P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008.
REFERENCES	
1	G. V. Wylen; R. Sonntag, C. Borgnakke; Fundamentals of Classical Thermodynamics; John Wiley & Sons, 4th Ed.; 1996.
2	J. B. Jones, R. E. Dungan; Engineering Thermodynamics; Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Ed.; 1996.
3	E. Radhakrishna; Fundamentals of Engineering Thermodynamics; Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Ed.; 2011.

ENGINEERING MATERIALS SCIENCE AND METALLURGY					
Course Code	**ME340**		**Credits**	**4**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**39 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

Provide a fundamental knowledge about common engineering materials - metals, ceramics, polymers and composites and the methods of observing, measuring and interpreting these properties, their usage, which are important in engineering design and manufacture. Give familiarity with various characteristics and structure - property relationships and also thermal processing of metals. Provide proficiency and confidence in making judicial material choices for engineering applications.

Course Outcomes:
On completing this course students will be able to:

CO 1	Describe crystal structures and understand the impacts of defects at the atomic and microstructure scales.
CO 2	Interpret phase diagrams, understand the concepts of solid solution and solubility limits, and be able to predict the development of microstructures and impacts of phase transformations.
CO 3	Understand heat treatment of materials and characterisation of material properties.
CO 4	Understand the choice of an alloy for a particular application.

UNIT-1	**11 Hrs**
Crystal Structure: Unit cell, Space lattices and Crystal structures, Packing efficiency, Miller indices for planes and directions, Linear and planar density. **Crystal Defects:** Point defects - vacancy, impurities, Schottky and Frenkel defects. Line defects - edge and screw dislocations, Burgers vector, Dislocation motion, Multiplication of dislocations. Surface defects - grain boundaries, twin boundaries, stacking faults. **Plastic Deformation:** Slip in a perfect lattice, Deformation by slip, Slip systems, Critical resolved shear stress for slip, Deformation by twinning, strain hardening, recovery- recrystallization-grain growth.	
UNIT-2	**10 Hrs**
Phase Diagrams: Solid solutions, Cooling curves, Binary phase diagrams, Gibb's phase rule, Interpretation of phase diagram, Lever rule. **Iron-Carbon Phase Diagrams:** Iron - Iron Carbide diagram, Phases, Structures, Invariant reactions in Fe-Fe_3C diagram, Critical temperature lines and Development of microstructure during slow cooling, Isothermal Transformation diagram and Continuous Cooling Transformation diagram for eutectoid steel. **Cast Irons**: Gray, White, Malleable and Spheroidal Cast Irons.	
UNIT-3	**9 Hrs**
Alloying of Steels: Effect of alloying elements, Classification, Properties and Typical Applications of	

Alloy steels, Tool steels & Stainless steels. **Heat treatment of steels:** Annealing – Full Annealing, Process annealing and spheroidizing anneal, Normalizing, Hardening, Tempering, Hardenability, Jominy End Quench test. Case hardening of steels - Carburizing, Nitriding, Induction and Flame hardening.	
UNIT -4	**9 Hrs**
Metallography: Sample preparation for micro-structural examination, construction and working of metallurgical microscope. **Mechanical Testing of Materials:** Tensile, Torsion, Impact, Hardness. **Non Destructive Testing of Materials:** X - Ray and Gamma Radiography, Magnetic particle inspection, Fluorescent penetrant test, Ultrasonic inspection, Eddy current inspection. **Other Engineering Materials**: Typical properties, classification and applications of –ceramics, polymers and composite materials.	

TEXTBOOKS	
1	V. Raghavan; Materials Science and Engineering; PHI; Sixth Edition, 2015.
2	William D. Callister Jr.; Materials Science and Engineering; John Wiley & Sons, New York; Sixth Edition, 2003.
REFERENCES	
1	Sydney H. Avner; Introduction to Physical Metallurgy; TMH; Second Edition, 1997.
2	George E. Dieter; Mechanical Metallurgy; TMH, Third edition, 2017.
3	R. A. Higgins; Engineering Metallurgy Part I: Applied Physical Metallurgy; Arnold Publishers; Sixth Edition, 1993.

ENGINEERING METROLOGY AND MACHINE DRAWING					
Course Code	**ME350**		**Credits**	**4**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	4	**0**	**0**	**52 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

To visualize mechanical component and convert it into a drawing. To understand conventional symbols used in machining and mechanical details as per IS. To assemble and disassemble the mechanical parts.

Course Outcomes:
On completing this course students will be able to:

CO 1	Understand basic principles and standards of engineering measurements
CO 2	Understand the use of limits, fits, tolerances, GD&T in Mechanical engineering
CO 3	Create assembly drawings and freehand sketches of mechanical joints / fasteners.
CO 4	Create disassembly drawings and freehand sketches of permanent joints.

UNIT-1	**12 Hrs**
Basic Principles of Engineering Measurement: Introduction to Metrology, Need for Inspection, Objectives of Metrology and Measurements, Process of Measurement, Accuracy and Precision, Calibration of Measuring Instruments, Errors in Measurements, Systematic and Random Errors, Methods of Measurement. **Standards of Measurement:** Introduction, Standards and their Roles, Systems of Measurement, Material Standard, Wavelength Standard, Line and End Standards of Measurements, their characteristics, advantages and disadvantages. **Linear Measurement:** Depth gauge, height gauge, Vernier Instruments, Micrometer Instruments, and Slip Gauges: Sizes and Grades, Wringing, building up of slip gauges for required dimension, care of slip gauges. **Angular Measurement:** Bevel Protractor, Sine Bars, Angle gauges and its combination to build the required angle	

UNIT-2	**14 Hrs**
Dial Indicators: Requirement of good dial indicator, classification, advantages and limitations. **Comparators:** Classification, need, essential characteristics of a good comparator, classification. Advantages, Limitations and Applications: Mechanical, Optical, Electrical, Electronic, Pneumatic. **Limits, Fits, and Tolerances:** Introduction, Tolerances, classification of tolerances, clearance, interference and transition Fits, allowance, System of Limits and Fits, Indian Standard limit fit system, Limit gauging, classification of gauges, Taylor's Principle of Gauge Design, Gauge Tolerance, Wear Allowance, Design of Plug and Snap gauges. **Geometric Tolerancing:** Introduction, types: form, orientation, positioning and run out, symbolic representation of geometric tolerances, symbols on a standard drawing and their interpretation. **Metrology of Screw Threads:** Measurement of Screw Thread elements: Major diameter, Minor diameter, measurement of Pitch. **Metrology of Surface Finish**: Concepts, Terminology, Analysis of Surface traces, surface texture symbols. Tomlinson Surface Meter, Taylor-Hobson Talysurf.	

UNIT-3	13 Hrs
Preliminaries: Introduction to machine drawing, conventional representation of machine components, materials, springs & gears. **Threaded Fasteners & Joints**: Screw thread nomenclature, types of threads, nut, bolt and washer, locking arrangements of nuts, foundation bolts (freehand sketches only) **Keys, Cotters & Pin Joints:** Keys, cotter joints, socket & spigot joint, sleeve & cotter joints, jib & cotter joint, knuckle joint (freehand sketches only) **Assembly Drawings with Sectioning and Bill of Materials (only front view):**Footstep bearing, Lathe tool post, screw jack, pipe vice.	
UNIT-4	**13 Hrs**
Part or Disassembly Drawings: Milling Machine Tail stock, crane hook, blow off cock, feed check valve.	

TEXTBOOKS	
1	R. K. Jain; Engineering Metrology; Khanna Publishers; 21e; 2015.
2	N. Siddheshwar, P. Kannaiah, V. V. S. Sastry; Machine Drawing; Tata-McGraw Hill.
3	K. C. John; A text book of Machine Drawing; PHI Learning Pvt. Ltd., New Delhi.
REFERENCES	
1	N. V. Raghavendra, L. Krishnamurthy; Engineering Metrology and Measurements; Oxford University Press; 2015.
2	P. S. Gill; Machine Drawing; SK Kataria& Sons, New Delhi.
3	N. D. Bhat; Machine Drawing; Charotar Publishing Company.

ENGINEERING MATERIALS SCIENCE AND METALLURGY LABORATORY					
Course Code	**ME360**		**Credits**	**1**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	0	**0**	**2**	**26 hrs/sem**	
Scheme of Examination TOTAL = 75 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**25**	**0**	**50**	**0**

Course Objectives:

To study the microstructure and mechanical properties of metallic materials, to check the presence cracks & flaws in materials and to conduct the heat treatment procedures on steel.

Course Outcomes:
On completing this course students will be able to:

CO 1	Determine the mechanical properties of a given material such as hardness, impact strength, tensile properties, creep and fatigue strength
CO 2	Analyse micrograph of given metallic material and correlate the effect of heat treatment on microstructure

LIST OF EXPERIMENTS	
Eight experiments to be conducted from the below given list of experiments. To draw the stress-strain curve and calculate the elastic limit, yield strength, ultimate tensile strength, percentage of elongation, percentage of reduction in area, toughness and resilience of the given metal. To measure the hardness of the given material using Brinell/Rockwell/Vicker's Hardness testing machine. To measure the impact strength and notch sensitivity of the given metal. To study the creep behavior and determine the steady state creep rate of the given specimen To determine the capacity of the material to withstand repeated cyclic stress through fatigue test. To determine the ductile - brittle transition temperature of the given metal. To determine the formability of the given metal using cupping test. To study the microstructure of (a) mild steel (b) brass (c) cast iron. To detect the presence of cracks/flaws in the given metal piece by magnetic particle crack detection method. To detect the presence of cracks/flaws in the given metal piece by dye penetrant test. To determine the hardenability of the given specimen using Jominy End Quench test. To study the change of microstructure and property during heat treatment of the given specimen. To determine the wear constant of the given material using wear testing machine To determine the torsional strength and angle of twist of the given specimen	

ENGINEERING METROLOGY AND MACHINE DRAWING LABORATORY					
Course Code	**ME370**		**Credits**	**1**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	0	**0**	**2**	**26hrs/sem**	
Scheme of Examination TOTAL = 75 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**25**	**0**	**50**	**0**

Course Objectives:

1. To inculcate in students the habit of giving importance to metrology and measurement and to apply measurement concepts in real-world situations.
2. To possess knowledge of the sources of measurement errors and how their influence may be reduced.
3. To read and understand the geometric representations and conventional symbols used in machining and mechanical details as per IS on the drawing.
4. To visualize mechanical component and convert it into a drawing.
5. To gain knowledge in two dimensional drafting and to assemble and disassemble the mechanical parts.

Course Outcomes:
On completing this course students will be able to:

CO 1: Remember the various standards of measurement, basic principles with applications of various measuring instruments &comparators and the geometric representations and conventional symbols as per IS used in machining drawing.

CO 2: Understand the sources of measurement errors and how their influence may be reduced, use of measuring instruments and comparators, limits, fits, tolerances, GD&T in Mechanical engineering and applications of threaded fasteners, keys & Joints.

CO 3: Apply the knowledge in doing various measurements and create assembly/disassembly drawings and freehand sketches of mechanical joints & fasteners.

CO 4: Analyze and interpret the readings, assembly/disassembly drawings and tolerances and conventional symbols as appearing on drawing sheets.

LIST OF DRAWING SHEETS	
Following should be completed and submitted within given deadline. **Two** sheets on assembly and **two** sheets on disassembly to be done. **One** drawing on assembly and disassembly to be done using AutoCAD or any other standard drafting software. Sketch book to comprise of free hand sketches. (Unit 3 and Unit 4) **(Term work marks allotted for the above = 15)**	
LIST OF EXPERIMENTS	

Five experimentsto be conducted from the below given list of experiments. MeasurementbyUsingVernierCalliper(Dial,DigitalandPlain). MeasurementofdimensionsusingVernierHeightGauge. MeasurementofdimensionsusingMicrometerScrewGuage(DigitalandPlain). Calibration of Vernier Calliper (Dial, Digital, Plain) by using Slip Gauges. Calibration of Micrometer (Digital, Plain) by using Slip Gauges. MeasurementofangleusingSinebar/Sinecenter. Measurement of Angle using BevelProtractor. Measurement of Angle using HeightGauge. Use of Dial GaugeasMechanicalComparator. MeasurementofSurfaceRoughnessusingSurfaceRoughnessTester. Measurement of various elements of screw thread using Tool Makers Microscope. MeasurementofScrewthreadparametersusingFloatingCarriageMicrometer. LinearandangularmeasurementusingProfileProjector. (Term work marks allotted for the above = 15) The Term Work marks to be awarded based on the assessment of the completed sheets, soft copy of drawing using drafting software, the sketch book and the assessment of the file containing minimum six experiment from the list of experiment given above	

TECHNICAL COMMUNICATION					
Course Code	**HM001**		**Credits**	**2**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	2	**0**	**0**	**26 hrs/sem**	
Scheme of Examination TOTAL = 75 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**75**	**0**	**0**	**0**

Course Objectives:

To acquaint the students with basic concepts, theories and barriers to communication. To enhance communication skills by giving adequate exposure in LSRW skills and interpersonal skill. To build multidisciplinary approach towards life tasks and life learning.

Course Outcomes:
On completing this course students will be able to:

CO 1	Demonstrate precise language skills with suitable vocabulary and apt style.
CO 2	Develop life skills/interpersonal skills to progress professionally
CO 3	Apply traits of suitable candidature for a job/higher education.
CO 4	Deliver formal presentations and effectively implementing the verbal and non-verbal skills.

UNIT -1	**7 Hrs**
Communication **Oral Communication** Listening, Speaking, Reading, Writing (LSRW), Conversational Dialogues, Role Play, Barriers to Oral Communication, Effective Oral Communication, Principles of Communication, Dos and Don'ts of Group Discussion **Global Communication** Social Media, People Analytics, Models of Culture, Cross-Cultural Communication, Compare Cultures of the World, Impact of Cultural Differences on Managerial Communication, Effective Communicator in a Cross-Cultural setting	
UNIT -2	**7 Hrs**
Personality Development Social Etiquette, Email Etiquette, Table Etiquette, Telephone Etiquette, SWOC Analysis, Life Coaching, Emotional Intelligence, Leadership, Time Management, Motivation, Goal Setting, Team Work and Collaboration, Critical Thinking and Problem Solving, Professional Attitude, Persuasion, Anxiety and Stress Management, Social Responsibility	
UNIT -3	**6 Hrs**
Career Development Resume Building, Interviewing Skills, Job Search, Personal Networking and Branding, Personal Finance, Build Professional Portfolio	

UNIT -4	6 Hrs
Public Speaking Methods to overcome anxiety, Build Confidence, Use of Media Aids, Craft an Impactful Speech, Design Impactful Presentations, Effective Presentation Delivery	

TEXTBOOKS	
1	Meenakshi Raman and Sangeeta Sharma; Technical Communication: Principles and Practice, 3rd ed; Oxford University Press
2	Meenakshi Raman, Prakash Singh; Business Communication; 2nd ed.; Oxford University Press
3	Dr. K. Alex; Soft Skills: Know Yourself and Know The World; 3rd ed; S. Chand Publishing
REFERENCES	
1	Nicky Stanton; Mastering Communication; 5th ed.; Palgrave Master Series; Red Globe Press
2	Ghosh, B. N.; Managing Soft Skills for Personality Development; Tata McGraw Hill; 2012
3	Wallace and Masters; Personal Development for Life and Work;10th edition; Thomson Learning
4	Lehman, Dufrene, Sinha; BCOM : A South-Asian Perspective with CourseMate; 2nd edition; Cengage Learning
5	Ashraf Rizvi; Effective Technical Communication; Tata McGraw-Hill; 2005
6	MolefiKete Asante, William B. Gudykunst, Bella Mody; Handbook of International and Intercultural Communication; 2nd ed.; Sage Publications

MATHEMATICS-I& II (BRIDGE COURSE)					
Course Code	**AC390**		**Credits**	**0**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	2	**0**	**0**	**26 hrs/sem**	
Scheme of Examination TOTAL = 0 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**0**	**0**	**0**	**0**

Course Outline:

This is an audit course.

This course is compulsory to direct second year/lateral entry students. It is introduced to reduce the knowledge gap in the students.

The syllabus is selected topics from FE110 Mathematics I and FE120 Mathematics II.

The Text books and References are same as shown in FE110 Mathematics I and FE120 Mathematics II.

SEMESTER IV

ENERGY CONVERSION					
Course Code	**ME410**		**Credits**	**5**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	4	**1**	**0**	**52 hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**25**	**100**	**0**	**0**

Course Objectives:

To study the air standard and actual engine cycles. Study of SI and CI engine components and processes involved along with engine performance characteristics and emissions. Study of alternate fuels for IC engines.

Course Outcomes:

On completing this course students will be able to:

CO 1	Understand the construction and operation of engine with alternate fuels used and modern trends in IC Engines
CO 2	Illustrate principle of combustion, concepts of fuel air and Actual Cycles
CO 3	Analyse Performance characteristics of the engine, supercharged and turbocharged engines.
CO 4	Evaluate performance and emissions of IC Engines

UNIT-1	**12 Hrs**
Engine Construction and Operation: Heat engines; Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines and their comparative study	

Actual Cycles & Their Analysis: Introduction, Comparison of thermodynamic & Actual Cycles, various losses. **Fuels:** Important qualités of the Engine fuels - (SI & CI engines), Alternate fuels (SI & CI engines)	
UNIT-2	**12 Hrs**
Spark Ignition Engines: Theory of Carburetion, Types of carburetors, Electronic fuel injection system, GDI, MPFI, Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion, Phenomenon of Detonation in SI engines, effect of engine variables on Detonation, . Rating of fuels in SI engines, Additives. **Compression Ignition Engines:** Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking, rating of fuels in CI engines. Dopes & Additives, Comparison of knocking in SI & CI engines.	
UNIT-3	**14 Hrs**
Super Charging/ Turbo-charging: Introduction, Objectives, Effect on power output and efficiency, Supercharging Systems, Turbo-charging, Characteristics of Supercharged Engines, Method of Super Charging, and Limits of Supercharging. Types of supercharging and turbo charging, relative Merits, Matching of turbocharger. . **Emission of I.C. Engines:** Air pollution due to IC engine, Engine emissions, Hydrocarbon emissions, (HC) & PPM & Carbon monoxide emissions (CO), oxides of Nitrogen (NOx) Euro norms , Bharat stage norms, Introduction to EDC and IDC , Introduction to carbon credit, Emission control methods for SI and CI engines, Electronic control unit, Cat con, EGR. Modern Trends in I.C. Engines	
UNIT -4	**14 Hrs**
Engine Testing and Performance: Introduction to Indian. Standards for testing of I.C. Engine, Mean effective pressure, indicated power, brake power, friction power, Methods to determine power and efficiencies Variables affecting performance of engine, characteristic curves, heat balance sheet, Methods of improving engine performance & simple numericals on super & turbocharged engines. **Alternative Potential Engines:** VCR engine, Dual fuel engines, Multi fuel engines, concept of hybrid vehicles, Modern Trends in I C Engines.	

TEXTBOOKS	
1	Internal Combustion Engine, V Ganesan - TataMcGraw Hill
2	Internal Combustion Engine, Mathur and Sharma
3	Power Plant Engineering, P.K.Nag, McGraw Hill Publications New Delhi.
REFERENCES	
1	Internal Combustion Engines, Willard W.Pulkrabek, Pearson Education.
2	Thermal Engineering, .R.K.Rajput, Laxmi Publications New Delhi.
3	Power Plant Engineering, Domkundwar& Arora, Dhanpat Rai & Sons, New Delhi.

MACHINE DESIGN					
Course Code	**ME420**		**Credits**	**5**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	4	**1**	**0**	**(52+13) hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**25**	**100**	**0**	**0**

Course Objectives:

The student will achieve an understanding of the design process in mechanical engineering and will be able to correlate design with manufacturing. Understand and be able to design various types of machine elements.

Course Outcomes:
On completing this course students will be able to:

CO 1	Understand the basic principles for designing machine elements and joints subjected to Static and Fatigue loading.
CO 2	Comprehend and apply mathematical relations for designing machine elements and joints.
CO 3	Calculate the dimensions of machine elements and joints subjected to static and dynamic loading
CO 4	Analyze the problems related to static and fatigue loading of machine components and selection of drives for given applications.

UNIT-1	**14 Hrs**
Introduction to Design Process: Process of Machine Design, Design considerations in machine parts, use of standard codes, factor of Safety, preferred numbers and preferred series. **Static Considerations in Design:** Design of simple parts subjected to direct and combined stresses. Design of socket and spigot type of cotter joint and knuckle joint. Design of levers viz. hand / foot lever, bell crank lever, lever for safety valve. Design of curved members with rectangular, circular, trapezoidal and I sections. **Design for Fatigue:** Stress concentration, reasons, effects and methods to reduce stress concentration, fluctuating stresses, failure due to fatigue, S-N curve, endurance limit, endurance strength modifying factors, Design for finite and infinite life, Miner's equation, Soderberg, Goodman and Gerber criteria in designing for alternating stresses. Modified Goodman diagram. Design of components for fatigue under combined stresses.	
UNIT-2	**14 Hrs**
Design of Shafts, Keys & Couplings: Design of shaft based on strength, torsional rigidity and lateral rigidity. Design of shaft based on A.S.M.E. code. Classification of keys, Design of Parallel, Taper Sunk keys, Woodruff key and Splines. Classification and objectives of couplings, Design of rigid Flanged Coupling and Flexible Bushed Pin Coupling. **Design of Threaded Joints:** Threaded connections: screw fastener classification, Terminology of ISO metric threads, Bolted joint in tension, Eccentrically loaded threaded joints. **Design of Welded Joints**: Stresses in fillet & Butt welds. Strength of Parallel & Transverse fillet weld, Eccentrically loaded welded joints, Weld joints subjected to bending and twisting moments.	
UNIT-3	**14 Hrs**

Springs: Types, application and material for springs, Design equations for helical compression springs, styles of ends, Design of Helical Compression and Tension Springs, helical concentric springs. **Flexible Power Drives:** Classification and comparison of flexible drives. Belt Drives: Flat belt and V belt drives, open and crossed belt drives, length of open and crossed belt drive, stresses in flat and V-belts, selection of flat and V-belts for industrial applications using Data Book/manufacturer's catalogue. Power transmission using Wire ropes (theoretical treatment only), types of chains, Power transmission using Chains (theoretical treatment only)	
UNIT -4	**10 Hrs**
Gear Design: Classification of gears, selection of Gears, Law of Gearing. Spur Gears: Terminology, Interference, Backlash, Force Analysis, Gear Tooth failures, Beam strength, and Wear Strength of Gear Tooth based on Buckingham's approach and Spott's approach, Estimation of module based on beam and wear strength, heat treatment of gears, Gear lubrication.	

TEXTBOOKS	
Design of Machine Elements, Bhandari V. B., Tata McGraw-Hill Education. Mechanical engineering Design, Shigley J. E., McGraw-Hill Publication.	
REFERENCE BOOKS	
Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series. C.S.Sharma and KamleshPurohit, Design of Machine Elements, PHI Learning Pvt. Ltd. D.K.Aggarwal&P.C.Sharma, Machine Design, S.K Kataria and Sons Design Data - P.S.G. College of Technology, Coimbatore. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers. Design of Machine Elements, Spotts M. F., Shoup T. E., Prentice Hall International. Peter Childs, Mechancial Engineering Design R.L.Norton, Machine Design, Pearson Education. **Note:** Only Reference Books at No. 4 and 5 to be used as data books in semester examination. These reference books (Data Books) at 4 and 5 above are to be provided by the College Examination Cell. Students should not be allowed to carry their own data books in the examination hall.	

FLUID MECHANICS					
Course Code	**ME430**		**Credits**	**4**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	3	**1**	**0**	**(39+13) hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**25**	**100**	**0**	**0**

Course Objectives:

To understand fluids, its properties and fluid statics.To analyze Kinematics and Dynamics of fluid flow.To understand the concept of buoyancy and viscous flow.To study boundary layer concept.

Course Outcomes:
On completing this course students will be able to:

CO 1	**Understand** the basic concept of fluid flow and properties of fluids
CO 2	**Understand** the principles of fluid statics, kinematics and dynamics
CO 3	**Analyse** fluid flow problems with the application of the momentum and energy equations. Understand concept of buoyancy, viscosity and importance of viscosity in real flows
CO 4	Perform dimensional analysis for problems in fluid mechanics. **Understand** the concept of boundary layer formation.

UNIT-1	**10 Hrs**
Properties of Fluids: Basic concepts and definitions, Classification and properties of fluids, Surface tension and capillarity, Compressibility and bulk modulus. **Fluid Statics:** Liquid pressure and its types, Pascal's law, Pressure variation in a static fluid, Measurement of pressure, Manometers (simple), Differential manometers, Mechanical gauges **Hydrostatic Forces on Surfaces:** Total pressure, Center of pressure on vertical submerged surfaces in liquid, Total pressure, Center of pressure on horizontal & inclined submerged surfaces in liquid, Hydrostatic paradox.	
UNIT-2	**10 Hrs**
Fluid Kinematics & Dynamics: Types of fluid flow, Discharge, continuity equation, Continuity equation in 3D, Equations of motion, Euler's equation, Bernoulli's equation, Practical application of Bernoulli's equation, Impulse momentum equation, Kinetic energy and momentum correction factor. **Flow through Pipes:** Loss of head in pipes, major, minor losses, Darcy's Weisbach equation, Hydraulic gradient and total energy line, Flow through siphon , Equivalent pipe -series & parallel pipes, Flow through nozzle, Water hammer in pipes.	
UNIT-3	**09 Hrs**
Buoyancy: Buoyancy, Centre of Buoyancy, Conditions of equilibrium of floating & submerged bodies, Meta-centre and Metacentric height. **Viscous Flow**: Introduction, Reynold's experiment, Flow of viscous fluid through circular pipe-Hagen Poiseuille formula, Flow of viscous fluid between two parallel plates, Power absorbed in viscous flow: Viscous resistance of journal bearing, Foot-step bearings, Collar bearings, Loss of head due to friction in viscous flow	

UNIT -4	10 Hrs
Dimensional Analysis: Dimensions of physical properties, Dimensional homogeneity, Buckingham's pi theorem, Raleigh's method, Important dimensionless numbers. **Boundary layer:** Laminar and turbulent boundary, Laminar sub layer, Boundary layer thickness, Energy thickness and momentum thickness, Drag force on a flat plate due to boundary layer, Total drag due to laminar and turbulent layers, Boundary layer separation and its control.	

TEXTBOOKS	
1	R. K. Bansal; A textbook of Fluid Mechanics & Hydraulic machines; Laxmi Publications (p) Ltd; 2012.
2	D. S. Kumar; Fluid Mechanics & Fluid Power Engineering; S. K. Kataria& sons, New Delhi; 2008.
3	P. N. Modi, S. M. Seth; Hydraulics & Fluid Mechanics including Hydraulic Machines; Standard Book House, New Delhi; 2009.
REFERENCES	
1	Y. A. Cengel, J. M. Cimbala; Fluid Mechanics: Fundamentals & Applications; TMH, New Delhi; 2/e.
2	R. W. Fox, P. J. Pritchard, A. T. McDonald; Introduction to Fluid Mechanics; Wiley India; 7/e.

ANALYSIS AND SYNTHESIS OF MECHANISMS					
Course Code	**ME440**		**Credits**	**5**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	4	**0**	**2**	**(52+26) hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**25**	**100**	**0**	**0**

Course Objectives:

Aims at initiating, Mechanical Engineering students, in the area of synthesis and analysis of the mechanisms. To analyse mechanical systems, in general. Familiarize basic concepts of toothed gearing and kinematics of gear trains.

Course Outcomes:
On completing this course students will be able to:

CO 1	Understand fundamental concepts in the study of mechanisms and analyse the motion of commonly used linkages.
CO 2	Analyse linkages for position, velocity and acceleration using analytical and graphical methods.
CO 3	Synthesize linkages to produce predetermined motion using analytical and graphical methods.
CO 4	Design and analyse cams, gears, and gear trains.

UNIT-1	**13 Hrs**
Classification of Mechanisms: Basic kinematic concepts and definitions, degree of freedom, mobility, Kutzbach's criterion, Gruebler's criterion, Grashof's Law, kinematic inversions of four-bar chain and slider crank chains, limit positions, mechanical advantage, transmission angle. **Description of some Common Linkages:** Exact and approximate straight-line mechanisms, steering gear mechanisms, Geneva wheel mechanism, ratchet and pawl mechanism, toggle mechanism, pantograph and universal joint. **Kinematics of Rigid Body:** Mathematical preliminaries on vectors & matrices, fixed and moving reference frames, coordinate transformations, displacement, time derivatives, angular velocity and acceleration, velocity and acceleration analysis using moving reference frame, Chasles' theorem.	
UNIT-2	**13 Hrs**
Velocity and Acceleration Analysis of Mechanisms: Displacement, velocity and acceleration analysis of mechanisms having higher and lower pairs, by graphical and analytical methods, instantaneous centre of velocity, Aranhold Kennedy theorem, angular velocity ratio theorem, kinematic analysis by algebraic methods, vector approach, Klein's construction, Coriolis acceleration.	
UNIT-3	**13 Hrs**
Kinematic Synthesis of Planar Mechanisms: Task of synthesis and it's classification, synthesis of mechanism for three accuracy points using graphical and analytical	

techniques, Freudenstein's equation, Four bar coupler curves, Cognate linkages, Bloch's synthesis method, Practical consideration in mechanism synthesis. **Cams:** Different types of Cams and followers and terminology for Cam- follower Mechanisms: follower motions : uniform velocity, uniform acceleration and retardation , SHM and cycloidal, their comparison, graphical synthesis of cam profile for a given follower and it's motion, 3-4-5 polynomial cams.	
UNIT -4	**13 Hrs**
Spur Gears: Introduction, classification of gears, gear terminology, law of gearing, velocity of sliding, forms of teeth, cycloidal profile teeth, involute profile teeth, path of contact, arc of the contact, numbers of pairs of teeth in contact, interference in involutes gears, minimum number of teeth to avoid interference, interference between rack and pinion, under cutting, method of avoiding interference, non- standard gears, comparison of cycloidal and involute tooth forms. **Gear Trains:** Analysis of simple, compound and epicyclic gear trains.	

ASSIGNMENTS	
Four assignments, one on each unit to be submitted within the given deadline.	

TEXTBOOKS	
1	S.S. Rattan; Theory of Machines; McGraw-Hill Education (India) Pvt Ltd.
2	J. S. Rao, R. V. Dukkipati; Mechanism and Machine Theory; Wiley Eastern Limited
3	Irving H. Shames; Engineering Mechanics; Prentice Hall of India Pvt. Ltd.
REFERENCES	
1	Jospeh E. Shigley, John J. Uicker Jr.; Theory of machines and Mechanisms; McGraw Hill International.
2	Hamilton H. Mabie, F. Charles F. Reinholtz; Mechanism and Dynamics of Machinery; John Wiley & Sons.
3	George H. Martin; Kinematics and Dynamics of Machines; McGraw-Hill International.
4	Waldron, Kenneth J., Gary L. Kinzel, and Sunil K. Agrawal. Kinematics, dynamics, and design of machinery. John Wiley & Sons, 2016.

THERMAL LABORATORY-I					
Course Code	**ME450**		**Credits**	**1**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	0	**0**	**2**	**26 hrs/sem**	
Scheme of Examination TOTAL =100 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**50**	**0**	**50**	**0**

Course Objectives:

1. This course aims to provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation.
2. To prepare them to carry out experimental investigation and analysis at later stages of graduation.

Course Outcomes:

On completing this course students will be able to:

CO 1	Understand the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon
CO 2	Apply the knowledge of mathematics, science and engineering fundamentals to study Internal Combustion Engines and Turbomachines
CO 3	Analyze performance of Internal Combustion Engines, Turbomachines and Boiler
CO 4	Evaluate performance parameters of Internal Combustion Engines and Turbomachines

LIST OF EXPERIMENTS	
Part A: Study of physical systems in terms of constructional details and functions 1] 2 Stroke and 4 Stroke Engines 2] Carburetor. 3] Ignition system. 4] Fuel injection system. 5] Reciprocating Compressor 6] Boilers **Part B: Students shall perform at least 5 experiments from the list** Performance Test on Four stroke Petrol Engine Performance Test on Four stroke Diesel Engine Emission Analysis of Petrol Engine Emission/ smoke Analysis of Diesel Engine Performance Test on Reciprocating Compressor Operating/main characteristics of Kaplan Turbine. Operating/main characteristics of Pelton Wheel. Operating/main characteristics of Francis Turbine Performance Analysis of Boiler.	

FLUID MECHANICS LABORATORY					
Course Code	**ME460**		**Credits**	**1**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	0	**0**	**2**	**26 hrs/sem**	
Scheme of Examination TOTAL =100 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**50**	**0**	**50**	**0**

Course Objectives:

The students will learn to conduct experiments to verify fundamental principles of fluid mechanics, calibrate measuring devices, analyze experimental data and develop empirical relations when appropriate.

Course Outcomes:
On completing this course students will be able to:

CO 1	Understand working and principle of flow rate measuring devices in closed conduit. Distinguish the constructional differences between orifice meter and venturimeter.
CO 2	Understand working and principle of flow rate measuring devices in open channels.
CO 3	Experimental measurement of coefficient of friction and losses in fluid system.
CO 4	Understand effect of metacentric height on stability of Floating body and forces on submerged body.

LIST OF EXPERIMENTS	
Eight experiments to be conducted from the below given list of experiments. Verification of Bernoulli's Theorem To determine the coefficient of discharge of a venturimeter To determine the coefficient of discharge of a orifice meter Calibration of a rotameter To determine the coefficient of discharge of a mouthpiece To determine the coefficient of discharge of a V- notch To determine the coefficient of discharge of a Rectangular- notch To calculate friction factor in Helical coil To determine coefficient of friction in pipe set-up To find minor losses in pipes To determine the coefficient of discharge of a flow nozzle Demonstration of Reynold's Experiment Determination of metacentric height of a ship model Determination of the centre of pressure of a plane surface being subjected to hydrostatic thrust Experimental verification of momentum equation Study of boundary layer velocity profile	

ECONOMICS FOR ENGINEERS					
Course Code	**HM003**		**Credits**	**3**	
Scheme of Instructions (Hours / week)	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**39 hrs/sem**	
Scheme of Examination TOTAL = 150 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**25**

Course Objectives:

1. To expose students to basic Economic concepts and apply economic reasoning to problems of business.
2. To familiarize the students with the microeconomics principles of economics.
3. To enhance students understanding of macroeconomic issues and problems.
4. To acquaint the students with standard concepts that they are likely to find useful in their profession when employed.

Course Outcomes:

On completing this course students will be able to:

CO1	Understand the basic principles of economics, micro behaviour of consumer & firms in different market structures, various macroeconomic policies, aspects of financial market & measures of Economic Growth and Development.
CO2	Apply the basics of economics, costs concepts in decision making.
CO3	Analyze the macroeconomic concepts & their relation to microeconomic concept & how they affect the business and economy. Assess the measures of Economic Growth and Development
CO4	Evaluate economic theories, principles of economics, cost concepts, market structures, measures of National Income and assess its impact on economic growth and development. Make economically sound decision.

UNIT 1	
Central concepts of Economics- Definitions of Economics , Scarcity and Efficiency, Nature of Economics: Positive and normative economics, Microeconomics and Macroeconomics Basic Elements of Supply and Demand- The Demand Schedule, The Demand Curve, Market Demand , Forces behind the Demand Curve, Shifts in Demand. The Supply Schedule The Supply Curve, Forces behind the Supply Curve , Shifts in Supply. Equilibrium of Supply and Demand, Effect of a Shift in Supply or Demand. Supply and Demand: Elasticity and Applications to major economic issues **Estimation/Forecasting of Demand:** Meaning, importance, methods – trend, exponential smoothing, regression analysis	**11 Hours**
UNIT 2	
Microeconomics: Demand & Consumer Behaviour- Choice & Utility Theory. Production and Business Organization, Theory of Production and Marginal Products Basic Concepts, The Nature of the Firm, Big, Small, and Infinitesimal Businesses. Economic Analysis of Costs, Total Cost: Fixed and Variable. Production, Cost Theory, and Decisions of the Firm.	**09 Hours**
UNIT 3	

Macroeconomics: Key Concepts of Macroeconomics. Objectives and Instruments of Macroeconomics. Aggregate Supply and Demand. **National Income Terms:** -Gross Domestic Product: The Yardstick of an Economy's Performance. Real vs. Nominal GDP. Net Domestic Product, GNP, National Income, Per capita income, Disposable Income, Price Index, Inflation. Monetary Policy and the Economy .Government Control of the Economy- The Tools of Government Policy	**09 Hours**
UNIT 4	
Economic Growth and Development: Economic Growth- The Long-Term Significance of Growth, The Four Wheels of Growth. Economic Development- meaning, criteria, measures of development- Per Capita Income, Index of Human Development . Financial markets- Structure, Participants, functions. Capital market- Instruments, Players, trading - Primary and secondary market - Role of stock exchanges and stock indices. Money market	**10 Hours**

TEXTBOOKS	
1	P.A. Samuelson & W.D. Nordhaus, Economics, 19th Edition McGraw Hill, New York, 1995.
2	A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975.
3	O.P. Khanna , Economics for Engineers,VK Global Publications Private Limited.
REFERENCES	
1	Chandra P., Fundamentals of Financial Management, Tata McGraw Hill Education Private Limited, New Delhi