Vignana Bharathi Institute of Technology, Aushapur, Ghatkesar
B.Tech Mechanical Engineering Regulations- R22

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	22MB3113	Business economics and Financial analysis	3	0	0	3
2.	22ME3111	Dynamics of Machinery	3	0	0	3
3	22ME3112	Design of Machine Elements	3	0	0	3
4	22ME3113	Metrology & Machine Tools	3	0	0	3
5	22ME3114	Steam Power & Jet Propulsion	3	0	0	3
6	22ME3115	CAD/CAM	2	0	0	2
7	22ME3151	Thermal Engineering Laboratory	0	0	2	1
8	22ME3152	Metrology & Machine Tools Laboratory	0	0	2	1
9	22ME3153	Kinematics & Dynamics Laboratory	0	0	2	1
10	22MC0005	Intellectual Property Rights	3	0	0	0
		Total Credits	**20**	**0**	**6**	**20**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	22ME3211	Machine Design	3	0	0	3
2	22ME3212	Heat Transfer	3	1	0	4
3	22ME3213	Industrial Management	2	0	0	2
4		**Open Elective - I**	3	0	0	3
5		**Professional Elective – I**	3	0	0	3
	22ME3271	Unconventional Machining Processes				
	22ME3272	Power Plant Engineering				
	22ME3273	Lean Manufacturing				
	22ME3274	Microprocessors in Automation				
6		**Professional Elective – II**	3	0	0	3
	22ME3275	Artificial Intelligence in Mechanical Engineering				
	22ME3276	Automobile Engineering				
	22ME3277	Industrial Robotics				
	22ME3278	Mechatronics				
7	22ME3251	Heat Transfer Laboratory	0	0	2	1
8	22HS3251	Advanced English Communication Skills Lab	0	0	2	1
9	* 22MC0002	Environmental Science	3	0	0	0
		Total Credits	**20**	**1**	**4**	**20**

***22MC0002- Environmental Science – Environmental science in III yr II sem Should be registered by lateral Entry Students only**

22MB3113: BUSINESS ECONOMICS & FINANCIAL ANALYSIS

B.Tech. III Year, I Sem.

L	T	P	C
3	0	0	3

Pre Requisites- Nil

Course Objectives:

1. To understand the concepts of business economics, objectives, scope, role& Responsibilities of a manager of a business undertaking
2. To analyze the market dynamics namely demand, elasticity of demand, demand forecasting and supply
3. To gain the knowledge on the production theories and cost analysis while dealing with the production
4. To explain the process &principles of accounting and to maintain Journal, Ledger, Trial Balance.
5. To acquire the basics of how to analyze and interpret the financial statements through ratio analysis.

Course Out comes: At the end of this course, students will demonstrates the ability to

1. Determine the objectives, role & responsibilities of a manager of a business undertaking.
2. Understand the demand for a product of a company, to analyze various factors influencing Demand elasticity and forecast & compute the future sales level of a product.
3. Examine optimum production &cost functions with the help of mathematical equations, Assess the cost behavior, costs useful for managerial decision making.
4. Apply the principle of double entry to the maintenance of books of records and explain the significance and objectives of trial balance and final accounts.
5. Analyze, interpret &comment on the financial statements of a business enterprise by Using ratios analysis

UNIT– I

Introduction to Business and Economics:

Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Sources of Capital for a Company, Non-Conventional Sources of Finance.

Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT– II

Demand and Supply Analysis:

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function & Law of Supply.

UNIT-III

Production, Cost, Market Structures & Pricing:

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.
Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, and Monopolistic Competition.
Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, and Cost Volume Profit Analysis.

UNIT-IV

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts (Simple Problems).

UNIT–V

Financial Ratios Analysis : Concept of Ratio Analysis, Importance and Types of Ratios, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

TEXTBOOKS:

1. D.D.Chaturvedi,S.L.Gupta,"BusinessEconomics-TheoryandApplications", International Book House Pvt.Ltd. 2013.
2. Dhanesh K Khatri, "Financial Accounting", Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, "Managerial Economics", 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

REFERENCES:

1. Paresh Shah, "Financial Accounting for Management" 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, "Financial Accounting", 5e, Vikas Publications, 2013.

22ME3111: DYNAMICS OF MACHINERY

B.Tech. III Year, I Sem.

L	T	P	C
3	0	0	3

Pre-requisite: Kinematics of Machinery

Course Objectives:

1. To study the inertia forces, torques and energy involved in different machine members
2. To learn the theory involved in the analysis of clutches, brakes, dynamometers, governors and flywheels
3. To Understand the balancing of reciprocating and rotary parts
4. To be Aware of situations like speed fluctuations, rotor imbalance and machine vibrations in industries
5. To Understand the importance of resonance and critical speed

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

1. Analyze the effect of a gyroscope on ships, aeroplanes and automobile
2. Explain the inertia forces in the working of important machine elements like flywheels, connecting rod etc.
3. Understand the types of brakes and the roll of friction
4. Understand the working of governors and estimate the unbalanced forces in a multi-cylinder reciprocating engine.
5. Estimate the longitudinal, transverse and Torsional vibrations so as to avoid resonance

UNIT – I:

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

UNIT – II:

Turning Moment Diagram and Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines – crank effort and torque diagrams.-.

UNIT – III:

Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches. **Brakes and Dynamometers:** Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT – IV:

Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors — Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort and power of the governors.

Balancing: Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

UNIT – V:

Vibrations: Free Vibration of mass attached to vertical spring- Damped free vibrations– Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

TEXT BOOKS:

1. Theory of Machines,S. S. Rattan ,Mc Graw Hill, 2017
2. Theory of Machines /Sadhu Singh/ Pearson.

REFERENCE BOOKS:

1. Theory of Machines and Mechanisms, Joseph E. Shigley, Fifth Edition, Oxford University Press
2. Mechanism and Machine Theory, Rao, J.S & R.V. Duggipati, New Age
3. Bansal R.K, Brar J.S, Theory of Machines, Lakshmi Publications (P) Ltd, 2016 Edition

22ME3112: DESIGN OF MACHINE ELEMENTS

B.Tech. III Year, I Sem.

L	T	P	C
3	0	0	3

Note: Design Data books are not permitted in the Examinations. The design must not only satisfystrength criteria but also rigidity criteria.

Pre-requisites: Engineering mechanics, mechanics of solids, manufacturing processes, metallurgyand material science.

Course Objectives:

1. To understand the general design procedures and principles in the design of machine elements.
2. To introduce basic concepts of design processes and design considerations.
3. To study the construction of different materials and their properties and factors determining the selection of material for various applications.
4. To determine stresses under different static and dynamic loading conditions.
5. To learn the design procedure of different fasteners, joints, shafts and couplings.

Course Outcomes:

1. Select the proper material for the machine component based on theories of failure and estimate the factor of safety.
2. Analyze the stress concentration and fatigue loads induced in a machine element.
3. Analyze the riveted and welded joints with normal and eccentric load conditions.
4. Analyze the keys, flywheel designs for different power transmissions.
5. Analyze shafts and shaft couplings under various load conditions and their selection.

UNIT – I:

Introduction: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.

Design for Static Strength: Simple stresses – Combined stresses – Torsional and Bending stresses– Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion andcombined situations.

UNIT – II:

Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor–Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Goodman's line– Soderberg's line.

UNIT – III:

Riveted, Welded and Bolted Joints: Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

Welded joints-Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices — bolts of uniform strength.

UNIT – IV:

Keys, Cotters and Knuckle Joints: Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

UNIT – V:

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. - Gaskets and seals (stationary & rotary)

Shaft Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

TEXT BOOKS:

1. Design of Machine Elements, V B Bhandari, Fifth Edition, McGraw-Hill
2. Machine Design, Jindal, Pearson

REFERENCE BOOKS:

1. Design of Machine Elements, V. M. Faires, Macmillan.
2. Design of Machine Elements-I, Annaiah, M.H, New Age International Publishers

22ME3113: METROLOGY & MACHINE TOOLS

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Pre requisite – Nil

Course Objectives:

1. To impart the fundamental aspects of the metal cutting principles and their application instudying the behavior of various machining processes.
2. To train in knowing the fundamental parts of various machine tools and their kinematicschemes.
3. To improve problem solving skills by determining the machining time of various machiningprocesses.
4. To provide technical understanding of basic concepts of engineering metrology and its practicein the industry.
5. To make the student to improve applications aspect in the measurements and control of aprocess in manufacturing.

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

1. Explain the principles of metal cutting and working of lathe machine tools.
2. Understand working of drilling, boring, shaping, slotting, planning machine tools and estimationof machining time.
3. Describe the Principles of working and operations performed on milling and grinding machines.
4. Explain the use of various measuring instruments, gauges and system of limits, fits andtolerances.
5. Describe the process of measuring the surface roughness, screw thread parameters &principles of coordinate measuring machines.

UNIT – I:

Metal cutting: Introduction, elements of cutting process – Geometry of single point tool, Chip formationand types of chips, tool materials, tool life, tool wear, cutting fluids, Analysis of orthogonal cutting- Merchant's force diagram, Machinability.Engine lathe – Principle of working, types of lathes, specifications, operations on lathe, Taper turning methods, Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes — tool layouts.

UNIT – II:

Drilling and Boring Machines – Geometry of twist drill, Principles of working, specifications, types, operations performed, machining time calculations, Types of Boring machines and applications. Shaping, slotting and planing machines –Principles of working, specifications, types of operations performed, applications, quick return mechanisms, machining time calculations.

UNIT – III:

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations

UNIT – IV:

Introduction to Metrology: Need, Types, Terminology, Methods of measurements, Selection of measuring Instruments Linear Measurement: Line and end standard, slip gauges, micrometers, spirit level.

Limits, fits and tolerances- Types of Fits - Unilateral and bilateral tolerance system, hole and shaftbasis system. Interchangeability and selective assembly.

Limit Gauges: Taylor's principle, Design of GO and NO-GO gauges.

Measurement of angles using Bevel protractor and Sine bar. Measurement of flatness using straightedges, surface plates, optical flat and auto collimator.

UNIT – V:

Surface Roughness Measurement: Factors affecting the surface roughness, reasons for controlling the surface texture, elements of surface texture-Roughness, Waviness, evaluation of surface roughness-CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Types and Applications of CMM.

TEXT BOOKS:

1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
2. Engineering Metrology/ R.K. Jain/ Khanna Publishers.

REFERENCE BOOKS:

1. Gupta I.C., Engineering Metrology, Dhanpat Rai Publications (P) Ltd, 2021 Edition.
2. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.

22ME3114: STEAM POWER & JET PROPULSION

B.Tech. III Year, I Sem.

L	T	P	C
3	0	0	3

Note: Steam Table book Permitted.

Pre-requisite: Thermodynamics

Course Objective:

1. To Study Steam power plant and understand the Rankine cycle.
2. To understand the flow of steam through nozzles.
3. To apply Laws of Thermodynamics to different steam turbines
4. To Analyze steam condenser and its efficiencies.
5. To Analyze Jet and Rocket engines and different propellants.

Course Outcomes:

1. To understand Rankine cycle for steam power plant and methods for improving it's efficiency
2. To Understand the flow of steam through Nozzles.
3. To apply Laws of thermodynamics for different Steam turbines.
4. To Analyze the Steam condensers for different condenser efficiencies.
5. To Analyze Jet and Rocket Engines and different Propellants for Rocket Engines.

UNIT – I:

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

Boilers – Classification – Working principles with sketches including H.P. Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

UNIT – II:

Steam Nozzles: Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

UNIT – III:

Steam Turbines: Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocitycompounded impulse turbine.

Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency.

UNIT – IV:

Steam Condensers: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump-Cooling water requirement.

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Meritsand Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts, combined cycle.

UNIT – V:

Jet Propulsion: Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

TEXT BOOKS:

1. Thermal Engineering / Mahesh M Rathore/ Tata Mc Graw Hill
2. Gas Turbines – V. Ganesan /Tata Mc Graw Hill

REFERENCE BOOKS:

1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers, Straznicky, Nix / Pearson
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI.
3. Thermal Engineering/ R.K. Rajput/ Lakshmi Publications

22ME3115: CAD/CAM

B.Tech. III Year, I Sem.

L	T	P	C
2	0	0	2

Pre-requisites: To learn the importance and use of computer in design and manufacture

Course objectives:

1. To illustrate the basics of CAD/CAM concepts.
2. To explain computer graphics, wire and surface modeling techniques.
3. To explain the solid modeling techniques.
4. To demonstrate part programs and group technology techniques.
5. To discuss latest advances in the manufacturing perspectives.

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

1. Understand geometric transformation techniques in CAD.
2. Develop mathematical models to represent curves and surfaces.
3. Model engineering components using solid modeling techniques.
4. Develop programs for CNC to manufacture industrial components.
5. Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT – I:

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure. **Geometric Modeling:** Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT – II:

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III:

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV:

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

UNIT – V:

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.**Computer aided quality control**: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill

REFERENCE BOOKS:

1.CAD/CAM : Computer Aided Design and manufacturing , Groover M.P., Zimmers / Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanyam / New Age
3. Mastering CAD/CAM /Ibrahim Zeid/ McGraw Hill, New Edition, 2020
3. Computer Integrated Manufacturing/ James A. Rehg, Henry W. Kraebber/ Pearson Education, 2012

22ME3151 THERMAL ENGINEERING LABORATORY

B.Tech. III Year - I Sem.

L	T	P	C
0	0	2	1

Pre-Requisite: Thermodynamics & IC Engines

Course Objectives: To learn

1. Understand the working principles of IC Engines
2. Understand the working principles of Reciprocating Air Compressors.
3. Understand the mechanism of valve and ports in IC Engines.
4. Understand various Heat energy losses in IC Engines.
5. Study Different types of Boilers.

Course Outcomes: At the end of the laboratory Student will be able to:

1. Determine the valve timing and port timing of four stroke and two stroke engines
2. Conduct constant speed tests on internal combustion engines and interpret their performance.
3. Analyze the reciprocating air compressor characteristics.
4. Apply the concept of Morse test and Retardation test to determine frictional power.
5. Demonstrate the different parameters of Boilers.

List of Experiments:

1. I.C. Engines Valve / Port Timing Diagrams.
2. I.C. Engines Performance Test for 2 Stroke SI engines.
3. I.C. Engines Morse Test on 4 stroke Multi Cylinder engine
4. I.C. Engine Heat Balance on 4 stroke single cylinder CI Engines.
5. I.C. Engines Retardation Test on 4 stroke single cylinder CI engine
6. IC engine Performance Test on a 4 Stroke CI engine.
7. I.C. Engines Performance Test on 4 Stroke SI engine
8. Volumetric efficiency of Air – Compressor Unit.
9. Dis-assembly / Assembly of Engines.
10. Study of Boilers.

22ME3152 METROLOGY AND MACHINE TOOLS LABORATORY

B.Tech. III Year - I Sem. **L T P C**
0 0 2 1

Prerequisites: Theoretical exposure to Machine tools.

Course Objectives:

1. Understand the parts of various machine tools and operate them.
2. Import practical exposure to use Machine Tools.
3. Understanding the basic characteristics of a typical instrument.
4. Identifying errors and their types that would occur in an instrument
5. Understand the working principles of conventional machines.

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

1. Demonstrate the configuration, function and working principle of lathe, drilling machine, milling machine, shaper, planning machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
2. Use the Lathe machine to perform various operations on it.
3. Operate drilling machine.
4. Characterize and calibrate measuring devices.
5. Identify and analyze errors in measurement.

List of Experiments:

1. Step turning on lathe machine.
2. Taper turning and Knurling on lathe machine.
3. Thread cutting and grooving on lathe machine.
4. Preparation of Single point Cutting tool on Tool and Cutter Grinder
5. Performing of drilling operations using Drilling machine.
6. Spur Gear cutting on milling machine.
7. Grinding of Flat Surfaces Using Surface Grinder.
8. Grinding of Cylindrical Surfaces Using Cylindrical Grinder.
9. .Key way cutting on Slotting Machining.
10. Grooving and dovetail cutting on Shaper.
11. Alignment test on Lathe.
12. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
13. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
14. Angle and taper measurements by bevel protractor and sine bar.
15. Thread measurement by 2-wire and 3-wire method.
16. Surface roughness measurement by Tally Surf.

22ME3153 KINEMATICS & DYNAMICS LABORATORY

B.Tech. III Year - I Sem

L	T	P	C
0	0	2	1

Pre-requisites: Kinematics of machinery & Theoretical exposure to Dynamics of machinery

Course Objective:

1. Understand types of motion for Gyroscope
2. Analyze forces and torque of components in linkages.
3. Illustrate how to balance forces and moments produced by machine members.
4. Understand concept of whirling of shafts to determine critical speed.
5. Interpret various governors, cam and followers

Course Outcomes: After completion of the laboratory, the students will be able to:

1. Understand Gyroscope motions for different loads
2. Determine the Time period and natural frequency of Simple and Compound pendulum.
3. Understand static and dynamic balance of several masses using single rotating mass
4. Understand Free vibrations with and without damping.
5. Understand the working of Porter and Proell Governor.

Experiments:

1. To determine the frequency of torsional vibration of a given rod.
2. Find the motion of the follower for the given profile of the cam.
3. Determine the effect of varying mass on the centre of sleeve in porter and proell governor.
4. To balance the masses statically and dynamically for single rotating mass systems.
5. Determine the critical speed of a given shaft for different conditions.
6. For a simple pendulum determine time period and its natural frequency.
7. For a compound pendulum determine time period and its natural frequency.
8. Determine the effect of gyroscope for varying masses.
9. Determine time period and natural frequency of undamped free longitudinal vibration of single degree spring mass systems.
10. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing.
11. Determine time period and natural frequency of damped free longitudinal vibration of single degree spring mass systems.

22MC0005: INTELLECTUAL PROPERTY RIGHTS

III B.Tech I Semester

L	T	P	C
3	0	0	0

Course Objectives:

- To know the concept of intellectual property
- To study about trade marks
- To study about law of copyrights and law of patents.
- To impart the knowledge on trade secrets
- To know new developments in IPR laws at national and international level.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- . Distinguish and Explain various forms of IPRs
- . Identify criteria to fit one's own intellectual work in particular form of IPRs
- Apply statutory provisions to protect particular form of IPRs.
- .Explain about trade secrets
- Appraise new developments in IPR laws at national and international level

UNIT – I:
INTRODUCTION TO INTELLECTUAL PROPERTY: Introduction, types of intellectual proper international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II:
TRADE MARKS: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes**.**

UNIT – III:
LAW OF COPYRIGHTS: Fundamental of copyright law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, copyright registration, notice of copyright, International copyright law.
LAW OF PATENTS: Foundation of patent law, patent searching process, ownership rights and tran

UNIT – IV:
TRADE SECRETS: Trade secret law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secret litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V:
NEW DEVELOPMENT OF INTELLECTUAL PROPERTY: new developments in trade mark law; copyright law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copyright law, international patent law, and international development in trade secrets law.

TEXT BOOK:
1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.

REFERENCE BOOK:
1. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd

22ME3211: MACHINE DESIGN

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Note: Design Data Book is permitted. Design of all components should include design for strength andrigidity apart from engineering performance requirements.

Pre-requisites: Study of engineering mechanics, design of machine members-I and theory ofmachines.

Course objectives:

1. To understand the general design procedures and principles in the design of machine elements.
2. To design the components using the data available in design data books.
3. To understand the design ethics, BIS, ISI, ABMA, AGMA and other standards for design of machine parts.
4. To determine stresses under different static and dynamic loading conditions.
5. To design the commonly used important machine members such as bearings, engine parts, springs, belts, gears etc.

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

1. Analysis of Journal bearings under various lubricating conditions with respect to loads for strength and rigidity using ABMA.
2. Select Rolling contact bearings under static and dynamic loads, bearing life.
3. Design and evaluation of IC engine parts Piston, Connecting rod, Stress analysis under loads.
4. Design and evaluation of Gears by AGMA, Stress analyses, wear strength.
5. Design and evaluation of springs and Belt drives and Stress analysis and load calculations.

UNIT – I:

Sliding contact bearings: Types of Journal bearings – Lubrication – Bearing Modulus – Full and partialbearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

UNIT – II:

Rolling contact bearings: Ball and roller bearings – Static load – dynamic load – equivalent radial load design and selection of ball & roller bearings.

UNIT – III:

Engine Parts: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

UNIT – IV:

Mechanical Springs: Stresses and deflections of helical springs – Extension and compression springs

– Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity

– helical torsion springs – Design of co-axial springs, Design of leaf springs.

Belts & Pulleys: Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts –Flat and V types – Ropes - pulleys for belt and rope drives.

UNIT – V:

Gears: Spur gears& Helical gears- Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

TEXT BOOKS:

1. Design of Machine Elements / Spotts/ Pearson
2. Machine Design / Pandya & Shah, 21st Edition, 2022 / Charothar

REFERENCE BOOKS:

1. Design of Machine Elements-II / Annaiah, Suresh kumar, chandrappa / New Age
2. Design of Machine Elements / Sharma and Purohit/PHI
3. Design Data Book/ P.V. Ramana Murti & M. Vidyasagar/ B.S. Publications.
4. Design Data Handbook/ S. Md. Jalaludeen/ Anuradha Publishers.

22ME3212: HEAT TRANSFER

B.Tech. III Year, II Sem.

L	T	P	C
3	1	0	4

Note: Heat Transfer Data Book is permitted.

Pre-requisite: Thermodynamics.

Course Objectives:

1. Provide knowledge about applications of conduction, convection, and radiation
2. Discuss the fundamental principles and laws of heat transfer
3. Explore the implications of these principles for system behavior; to formulate the models necessary
4. Study, analyze and design heat transfer systems through the application of these principles
5. Develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications.

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

1. Demonstrate the heat transfer through basic geometric elements and composite systems and able to formulate heat transfer equations.
2. Demonstrate the heat transfer through unsteady state, extended surface and geometric shapes of variable thermal conductivity and able to formulate heat transfer equations.
3. Explain about concept of continuity, momentum and energy equations and analyze natural and forced convection heat transfer and interpret forced convective heat transfer.
4. Design the Heat exchangers using LMTD and NTU methods for Parallel and counter flow Heat Exchangers
5. Explain and Analyze the Basic principles of boiling, condensation and radiation heat transfer.

UNIT – I:

Introduction: Modes and mechanisms of heat transfer — Basic laws of heat transfer –General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II:

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer — Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

UNIT – III:

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation

– Buckingham Theorem and method, application for developing semi — empirical non- dimensional correlation for convection heat transfer — Significance of non-dimensional numbers — Concepts of Continuity, Momentum and Energy Equations — Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

- **Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.
- **Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

UNIT – IV:

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT – V:

Heat Transfer with Phase Change:

Boiling: Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation – Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien,

Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

TEXT BOOKS:

1. Fundamentals of Engineering Heat and Mass Transfer, R.C. Sachdeva, New Age
2. Heat Transfer, J.P. Holman , Tenth Edition, Mc Graw Hill

REFERENCE BOOKS:

1. Heat Transfer by a Practical Approach, Yunus Cengel, Boles, TMH
2. Heat transfer, A conceptual Approach, P. K. Sarma, Rama Krishna, New Age
3. Heat and mass Transfer, Dr. D. S. Kumar, S. K. Kataria & Sons
4. Essential Heat Transfer - Christopher A Long / Pearson.
5. Heat and Mass Transfer data book, CP Kodanda Raman, Subramanyan, New Age

22ME3213: INDUSTRIAL MANAGEMENT

B.Tech. III Year, II Sem.

L	T	P	C
2	0	0	2

Prerequisites: None

Course objectives:

1. Understand the philosophies of management gurus.
2. Understand the various types of organization structures and their features, and their advantages and disadvantages.
3. Learning various Industrial Engineering Practices like Operations Management techniques.
4. Understand the work study, statistical quality control techniques.
5. Apply Job evaluation techniques and network analysis techniques.

Course outcomes: At the end of the course, the student would be able to

1. Explain the concepts of management and explore the management practices in their domain area within society. design the organization structure
2. Evaluate different types of organizational structures and Design them.
3. Explain about product design process and Design product layout.
4. Explain about method study and Use various work measurement methods.
5. Draw various statistical quality control charts and Interpret them & Apply the techniques of PERT/CPM in project

UNIT – I:

Introduction to Management: Entrepreneurship and organization — Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT – II:

Designing Organizational Structures: Departmentalization and Decentralization, Types of Organization structures — Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT – III:

Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Typesof Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition- types of values- Objectives- Phases of value analysis- Fast diagram

UNIT - IV:

Work Study: Introduction — definition — objectives — steps in work study — Method study —definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — worksampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves

UNIT – V:

Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. **Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS:

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.

REFERENCE BOOKS:

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Production & Operation Management /Paneer Selvam/PHI.
3. Industrial Engineering Management/NVS Raju/Cengage Learning.
4. Industrial Engineering Hand Book/Maynard.
5. Industrial Engineering Management I Ravi Shankar/Galgotia.

22ME3271: UNCONVENTIONAL MACHINING PROCESSES
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Production Technology,Machine Tools

Course Objectives:

1. To differentiate conventional and Unconventional Machining Processes and UltrasonicMachining.
2. To understand the process capabilities of abrasive, water jet and electro-chemical machiningprocesses.
3. To understand the working principle & important features of electrical discharge machiningprocess.
4. To understand the process parameters, accuracy and surface finish of electron beam & laserbeam machining Processes.
5. To understand the working principle & metal removal rate of plasma arc machining and abrasivefinishing process.

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

1. Study the need for unconventional machining processes and explain ultrasonic machiningprocess.
2. Describe Abrasive jet, Water jet, and Abrasive water jet machining and electrochemicalmachining process.
3. Describe working principle and process variables of EDM process.
4. Explain the process capabilities and process parameters of Electron Beam machining andLaser Beam machining.
5. Describe the working of Plasma Arc machining, chemical machining and Abrasive Finishingprocesses.

UNIT – I:

Introduction – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

UNIT – II:

Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations.

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM — Simple problems for estimation of metal removal rate.

UNIT – III:

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes — Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT – IV:

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT – V:

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications.

Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

TEXT BOOKS:

1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill

REFERENCE BOOKS:

1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers
2. Advanced Methods of Machining/ J.A. McGeough/ Springer International
3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

22ME3272: POWER PLANT ENGINEERING

(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: None

Course Objectives. The learning objectives include

1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cyclepower plants.
2. A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle,hydro, wind, geothermal, solar, and alternate power plants.
3. Awareness of the economic, environmental, and regulatory issues related to power generation.
4. Knowledge on nuclear power generations
5. Awareness on various pollution control methods

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

1. Understand the concept of Rankine cycle.
2. Understand working of boilers including water tube, fire tube and high-pressure boilers anddetermine efficiencies.
3. Analyze the flow of steam through nozzles.
4. Evaluate the performance of condensers and steam turbines.
5. Evaluate the performance of gas turbines.

UNIT – I:

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

Combustion Process: Properties of coal — overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needsand draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II:

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system — super charging.

Gas Turbine Plant: Introduction – classification - construction – Layout with

auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT – III:

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumpedstorage plants.

UNIT – IV:

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding — radioactive waste disposal.

UNIT – V:

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants andpollution standards – Methods of Pollution control.

TEXT BOOKS:

1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill
2. Power Plant Engineering / Hegde / Pearson.

REFERENCES BOOKS:

1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New age

22ME3273: LEAN MANUFACTURING
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year - II Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Nil.

Course Objectives: To learn

1. Concepts of Lean Manufacturing
2. Different layouts and JIT,TPM concepts etc 3 To get an idea about 5S & TQM
3. Concepts of Six sigma
4. Details about manufacturing companies where lean manufacturing concepts are implemented.
5. About Limitations of Lean Manufacturing

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

1. Understand the difference between conventional manufacturing versus lean manufacturing & apply the principles of lean manufacturing.
2. Explain Lean Manufacturing Tools.
3. Classify the of layouts and apply JIT, TPM Principles.
4. Understand and Practice TQM, 5S principles.
5. Explain the concept of six sigma and Practice.

UNIT I

INTRODUCTION TO LEAN MANUFACTURING: Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II

CELLULAR MANUFACTURING, JIT, TPM: Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III

SET UP TIME REDUCTION, TQM, 5S, VSM: Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV

SIX SIGMA: Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.

UNIT V

CASE STUDIES: Various case studies of implementation of lean manufacturing at industries.

TEXT BOOKS:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin& Jeffrey B. Goldberg, John Wiley & Sons, 2003.
2. Mikell P. Groover (2002) _Automation, Production Systems and CIM.

REFERENCES:

1. Rother M. and Shook J, 1999 _Learning to See: Value Stream Mapping to Add Value and Eliminate Muda,, , Lean Enterprise Institute, Brookline, MA.
2. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities By S.R. Devadasan,V. Mohan Sivakumar, R. Murugesh& P.R. ShalijDevadasan S.R PHI Learning Pvt. Ltd., 12-Jun-2012.
3. The Toyota Way: 14 Management Principles from the World's Greatest **M**anufacturer Hardcover – January 7, 2004**,**byJeffrey Liker.
4. Kaizen Express: Fundamentals for Your Lean Journey , 2009,by Toshiko Narusawa.

22ME3274 MICROPROCESSORS IN AUTOMATION
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Nil.

Course Objectives:

1. To learn about Basic concepts of Digital Circuits
2. To Understand Architecture of Microprocessor
3. To write Assembly language programming
4. To understand about memory and I/O device Interfacing
5. To Understand Architecture of Microcontroller

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

1. Explain about Digital Circuits
2. Demonstrate the Architecture of Microprocessor
3. Write the Assembly language Programming
4. Explain about Memory and Device Interfacing
5. Demonstrate the Architecture of Microcontroller

UNIT - I: Basic Concepts of Digital Circuits

Number Systems, Logic Gates, Combinational Circuits, Flip-flops, Sequential Logic Circuits: Counters, Shift Registers.
Basic components and computer architecture- CPU, Memory and Peripherals

UNIT - II: Architecture of Microprocessor

Introduction, Origin, Historical Developments, Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus Systems, Timing and Control Signals, PIN diagram, Machine Cycles, Instruction Cycle and Timing States, Instruction Timing Diagrams, Addressing Modes. Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller

UNIT - III: Assembly Language Programming

Instruction Set, Simple programs in 8085 mainly on Addition, Subtraction, Multiplication, Rotation, Ascending and Descending of the given data

UNIT - IV: Memory and I/O Device Interfacing

Memory Interfacing - Memory structure and its requirements, Basic Concept in Memory Interfacing, Address Decoding, Interfacing Circuits, Address Decoding and Memory Addresses, Typical Examples on Memory interfacing: Interface (2k x 8) ROM, (8k x 8) EPROM, and (1k x 8) RAM with 8085.

IO Interfacing – Basic Interfacing Concepts-Peripheral I/O instructions, I/O Execution, Device Selection and data transfer, absolute vs. Partial Decoding, Input Interfacing, Interfacing I/Os using Decoders

UNIT - V: Architecture of Microcontroller

Introduction to Microcontrollers and how they differ from microprocessors, Block diagram of Microcontrollers, Architecture of 8051 microcontroller, Pin Diagram, Instruction set, simple 8051 programming, introduction to ARM microcontroller and its applications.

TEXT BOOKS:

1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D, Mckinlay, 2nd Edition, Pearson publication, 2007.

REFERENCE BOOKS:

1. Microprocessors and Interfacing: Programming and Hardware, Douglas V. Hall
2. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall
3. Introduction to Microprocessors, Aditya P Mathur, Tata McGraw-Hill, Europe; 3rd Edition, 1990.
4. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHILearning Private Limited.
5. Digital and microprocessor technology, Patrick J O'Connor, Prentice-Hall, 1983.

22ME3275: ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING (PROFESSIONAL ELECTIVE – II)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Nil.

Course Objectives:

1. To learn about Basic concepts of Artificial Intelligence
2. To Understand about Problem Solving Methods
3. To understand about neural networks
4. To learn about applications of machine learning
5. To Understand about Ensemble Learning Techniques

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

1. Explain about Basic concepts of Artificial Intelligence
2. Apply AI for solving the Problems
3. Understand and Explain about applications of neural networks
4. Apply Machine learning concepts for solving Mechanical Engineering domain problems
5. Explain about Ensemble Learning Techniques

UNIT - I: **Introduction to Artificial Intelligence**

Definition, History, Present state of Artificial Intelligence (AI), Phases of AI, Approaches to AI - Hard or Strong AI, Soft or Weak AI, Applied AI, Cognitive AI, and Applications domains focused on mechanical engineering,

UNIT - II: Problem Solving Methods

Problem solving methods-1. Uninformed search includes Depth First Search (DFS), Breadth First Search (BFS), Uniform Cost Search (UCS), Depth Limited Search, Iterative Deepening Depth First Search (IDDFS) and bidirectional search. 2. Informed Search (heuristic search) includes greedy best first search, A* search, memory bounded heuristic search, learning to search better, Simple problems

UNIT - III: Neural Networks

Introduction to Perceptron and Neural Networks, Activation and Loss functions, Single Neuron of Human and Human Brain Modelling, ANN architecture-Input layer, Hidden layer and output layer, Types of Neural Networks- Single layer feed-forward network, Multilayer feed-forward network, Multi-Layer Perceptron (MLP), Recurrent networks or feedback ANN, Characteristics of Neural Networks, Simple problems on Back Propagation Algorithms to minimize the error

UNIT - IV: Machine Learning

Unsupervised learning- Definition, basic concepts, applications, K-means Clustering, hierarchical Clustering, Dimension Reduction-PCA, Simple Examples Supervised Learning - Definition, basic concepts, applications, Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, k-NN Classification, Support Vector Machine, Simple Examples.Reinforcement Learning (RL) - Framework, Component of RL Framework, Types of RL Systems. Q- learning, Examples of RL Systems, Simple Examples

UNIT - V: Ensemble Learning Techniques

Introduction on ensemble methods, Decision Trees, Bagging, Random Forests, Boostin, Simple Examples

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Prentice-Hall, Third Edition (2009).

REFERENCE BOOKS:

1. Artificial Intelligence, Ela Kumar, Wiley, 2021
2. Artificial Intelligence: Concepts and Applications, Lavika Goel, Kindle Edition, Wiley, 2021.
3. Nature-Inspired Optimization in Advanced Manufacturing Processes and Systems, Edited by Ganesh M. Kakandikar and Dinesh G. Thakur, CRC press, First edition, 2021.

22ME3276: AUTOMOBILE ENGINEERING
(PROFESSIONAL ELECTIVE – II)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Nil.

Course Objectives: The Objective of this course is to provide the student to

1. Elaborate the Systems of Automobile, Components of Engine, fuel & Lubrication system andits requirements
2. Explain the significance and features of Cooling, Ignition and Electrical Systems
3. Illustrate the working of transmission system and Suspension systems and its components
4. Elaborate the function of each accessory of steering and braking system and their role foreffective performance of automobile
5. Discuss the particulates of combustion in CI and SI engines, reasons for formation ofparticulates and methods adopted to control the pollution

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

1. Illustrate the function of each and every system of an automobiles including fuel system and injection approaches
2. Explain the Cooling, ignition and electrical system of the Automobile
3. Describe each component of transmission system of an automobile viz clutch, gear box, propeller shaft and differential and suspension system and the effect of the same on tyre performance and other components of an automobile
4. Analyze the geometry of the steering mechanism and braking system
5. Demonstrate about emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future.

UNIT – I:

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobileengines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing,

testing of fuel pumps. Introduction to CRDI and TDI Systems.

UNIT – II:

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling
– pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers — spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT – III:

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT – IV:

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – V:

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives
– Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

TEXT BOOKS:

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, FrontlinePublications.

REFERENCE BOOKS:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan.
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International

22ME3277: INDUSTRIAL ROBOTICS
(PROFESSIONAL ELECTIVE –II)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Kinematics of Machines, Dynamics of Machinery

Course Objectives:.

1. To Make the students acquainted with the theoretical aspects of Robotics
2. To enable the students to acquire practical experience in the field of Robotics through designprojects and case studies.
3. To make the students to understand the importance of robots in various fields of engineering.
4. To understand about Robot actuators and Feedback components
5. To expose the students to various robots and their operational details.

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

1. Understand the basic components of robots.
2. Differentiate types of robot grippers with forward/inverse kinematics of robot manipulators.
3. Analyze transformation of manipulators of a robot.
4. Understand the Robot actuators and Feedback components.
5. Analyze the robot applications at industry.

UNIT – I:

Introduction: Automation and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, numberof degrees of freedom — Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II:

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

UNIT – III:

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton — Euler formations — Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion straight line motion.

UNIT – IV:

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

UNIT V:

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science.
3. Robotics – Fu et al / TMH Publications.

22ME3278: MECHATRONICS

(PROFESSIONAL ELECTIVE – II)

B.Tech. III Year, II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: NIL

Course Objectives:

- To understand key elements of Mechatronics system, representation into block diagram
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application
- To understand about digital electronics and signal conditioning
- To illustrate the usage of techniques, skills, and modern engineering tools necessary for engineering practice.

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

- To understand key components of electro-mechanical systems and their control system.
- To understand the concepts of sensor interfacing, use of transducers and actuators in mechatronic systems
- To explain the concepts of various elcctro-mechanical drives including micro processors and micro controllers
- To understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial applications.
- To apply PID control implementation on real time systems

UNIT - I:

Introduction: Overview, History of mechatronics, Scope and significance of Mechatronics systems, elements of= Mechatronic systems, Needs and benefits of Mechatronics in manufacturing.

Sensors: Classification of sensors basic working principles, displacement sensor – linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders, Proximity and range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, hall Effect sensor, inductive Proximity switch, Light sensors – Photodiodes, Phototransistors, Flow Sensors – ultrasonic Sensor, Laser Doppler Anemometer, Tactile Sensors – PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, Vision Sensor.

UNIT - II:

Actuators: Electrical Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT,FET, DC motor, Servo Motor, BLDC Motor, AC Motor, Stepper Motor, Hydraulic & pneumatic devices – Power supplies, valves, Cylinder sequencing, Design of hydraulic & pneumatic circuits. Piezo Electric Actuators, Shapememory alloys.

UNIT - III:

Basic System models & Analysis: Modeling of one & two degrees of freedom Mechanical, Electrical, fluid and thermal systems, block diagram representations of these systems. Dynamic Responses of System: Transfer function, modeling dynamic systems, first order systems, second order systems.

UNIT - IV:

Digital Electronics: Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh Map, Design of combinational circuits, design of arithmetic circuits, Design of code converters, encoders and decoders. **Signal Conditioning:** Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, multiplexer, Pulse width modulation counters, decoders. Data acquisition — Quantizing theory, Analog to digital conversion, digital to analog conversion.

Controllers: Classification of Control systems, Feedback, Closed loop and open loop systems **PLC**

UNIT - V:

Programming: PLC Principles of operation, PLC sizes, PLC hardware components, I/O section Analog I/O section, Analog I/O modules, digital I/O modules, CPU processor memory, module programming, Ladder Programming, ladder diagrams, Timers, Internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems.

Advanced Applications in Mechatronics: Sensors for condition monitoring, mechatronic control in automated manufacturing, Artificial intelligence in Mechatronics, micro sensors in mechatronics, Application of Washing machine as mechatronic device.

TEXT BOOKS:

1. W. Boton, "Mechatronics", 5th edition, Adison Wesley Longman ltd, 2010.
2. Mechatronics system design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishingcompany, 2001.

REFERENCE BOOKS

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers. 3. Mechatronics System Design / Devdas shetty/Richard/Thomson. 4.
3. Alciatore David G & Histand Michael B, "Introduction to Mechatronics and Measurementsystems", 4th edition, Tata McGraw Hill, 2006

22ME3251 HEAT TRANSFER LABORATORY

B.Tech. III Year II Sem **L T P C**
0 0 2 1

Pre-requisite: Thermodynamics

Course Objectives:

- To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications.

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

1. Perform steady state conduction experiments to estimate thermal conductivity of different materials
2. Perform transient heat conduction experiment
3. Estimate heat transfer coefficients in forced convection, free convection, Condensation and correlate with theoretical values
4. Obtain variation of temperature along the length of the pin fin under forced and free Convection.
5. Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann‟s constant and compare with theoretical value

List of Experiments

1. Heat Transfer Through composite Materials
2. Thermal Conductivity of a Metal Rod
3. Parallel and Counter Flow Heat Exchanger
4. Stefan Boltzmann`s Constant Apparatus
5. Transient Heat Conduction
6. Heat Pipe Demonstration Apparatus
7. Thermal Conductivity of Insulating Material
8. Heat Transfer Through Lagged Pipe
9. Heat Transfer in Forced Convection
10. Heat Transfer Through Natural Convection
11. Measurement of Surface Emissivity
12. Heat Transfer Through Pin-Fin
13. Critical Heat Flux Apparatus
14. Boiling & condensation Apparatus

Note: Perform any 12 out of the 14 Exercises)

22HS3251: ADVANCED ENGLISH COMMUNICATION SKILLS LAB

B.Tech. III Year II Sem

L	T	P	C
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Course Objectives

This lab focuses on using Multi-media instruction as well as stimulating peer group activities for language development to meet the following targets:

1. To improve students fluency in spoken English.
2. To enable them to listen to English spoken at normal conversational speed.
3. To help students develop their vocabulary.
4. To read and comprehend texts in different contexts.
5. To communicate their ideas relevantly and coherently in writing.

Course Outcomes: Students will be able to

1. Acquire vocabulary and Grammar and use them contextually.
2. Listen and speak effectively, and present themselves effectively.
3. Develop proficiency in academic reading and writing.
4. Communicate confidently in formal and informal contexts.
5. Increase their job opportunities.

Syllabus

The following course activities will be conducted as part of the *Advanced English Communication Skills (AECS) Lab:*

Unit I

Vocabulary and Grammar: Vocabulary Building– Word Formation: Prefixes and Suffixes - Synonyms, and Antonyms, One-word Substitutes, Idioms, Phrases, Collocations, and Compound Words.

Grammar– Articles, Prepositions, Tenses,Subject-Verb Agreement, Voice and Speech-SpottingErrors - Correction of Sentences,

Unit II

Advanced Reading Comprehension: Argumentative Analysis of (with reference to) GRE, TOEFL, IELTS – Jumbled Sentences and Sentence Completion.

Unit III

Writing Skills– Structure and Different Types of Writings– Argumentative Writing – Letter Writing - Resume Writing - Technical Report Writing

Creating and Using LinkedIn Profile- Netiquette- Statement of Purpose (SOP)-Letter of Recommendation

Unit IV

Presentation Skills -_Oral Presentations (Group/Individual) and Written Presentations – PPTs/Posters (Virtual/Offline) – Projects, Reports and Assignments- Introducing Oneself Virtually (Making a Video on Oneself and Analyzing it critically).

Unit V

Group Dynamics &Interviews: Group Discussion - Dos and Don'ts - Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas– Debate: Concept and Process - Difference between Group Discussions and Debates- Rubrics of Evaluation - Interviews and Types of Interviews - Pre-interview Planning, Opening Strategies, Answering Strategies -Introducing Self - OralInterviews (face-to-face)–Virtual Interviews -Mock Interviews - Handling Technical Glitches.

References

- Kumar,Sanjay and Pushp Lata. *English for Effective Communication*, Oxford University Press, 2015.
- Konal, Nira. *English Language Laboratories- A Comprehensive Manual*, PHI Learning Pvt. Ltd. 2011.
- *The Official Guide to the GRE General Test*. Tamil Nadu: McGra Hills Education (India) 3rd Edition, 2017.

22MC0002: ENVIRONMENTAL SCIENCE

III B.Tech II Semester

L	T	P	C
3	0	0	0

Course Objectives:

- To study and Understand the importance of ecosystems.
- To impart knowledge on various natural resources.
- To know about biodiversity and biotic resources
- To impart knowledge on environmental pollution and control technologies
- To study and understand the environmental policies and regulations.

Course Outcomes: At the end of this course students will demonstrate the ability to

- Explain the importance of ecosystems.
- Discuss about various natural resources.
- Describe the importance biodiversity and biotic resources
- Discuss about environmental pollution and control technologies
- Explain the environmental policies and regulations.

UNIT - I

ECOSYSTEMS: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

NATURAL RESOURCES: Classification of Resources: Living and Non-Living resources,
Water Resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems.
Mineral Resources: use and exploitation, environmental effects of extracting and using mineral resources, **Land Resources:** Forest resources
Energy Resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III

BIODIVERSITY AND BIOTIC RESOURCES: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity:habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES:
Environmental Pollution: Classification of pollution
Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards.
Water Pollution: Sources and types of pollution, drinking water quality standards.
Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil.
Noise Pollution: Sources and Health hazards, standards
Solid Waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management.

Pollution Control Technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation.
Global Environmental Problems and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT - V
ENVIRONMENTAL POLICY, LEGISLATION & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. **EIA:** EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socioeconomical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP).
Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

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

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