

CONTROL ENGINEERING

Sub Code: 06ME71
Hrs/week: 04
Lecture Hrs: 52

IA Marks : 25
Exam Hrs: 03
Exam Marks: 100

PART – A

Unit - 1

INTRODUCTION: Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system. Types of controllers – Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers.

06 Hrs

Unit - 2

MATHEMATICAL MODELS: Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems. Pneumatic system. Analogous Systems: Force-voltage, force-current.

06 Hrs

Unit - 3

BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS: Transfer Functions definition, function, block representation of system elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula.

07 Hrs

Unit - 4

TRANSIENT AND STEADY STATE RESPONSE ANALYSIS: Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz Criterion.

07 Hrs

PART – B

Unit - 5

FREQUENCY RESPONSE ANALYSIS: Polar plots, Nyquist Stability Criterion, Stability Criterion, Stability, Analysis, Relative stability concepts, phase and gain margin, M & N circles.

07 Hrs

Unit - 6

FREQUENCY RESPONSE ANALYSIS USING BODE PLOTS: Bode attenuation diagrams, Stability Analysis using Bode plots, Simplified Bode Diagrams.

07 Hrs

Unit - 7

ROOT LOCUS PLOTS: Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.

07 Hrs

Unit - 8

CONTROL ACTION AND SYSTEM COMPENSATION: Series and feedback compensation, Physical devices for system compensation.

05 Hrs

TEXT BOOKS:

1. **Modern Control Engineering:** Katsuhiko Ogata, Pearson Education, 2003.
2. **Control Systems Principles and Design:** M. Gopal, TMH, 2000.

REFERENCE BOOKS:

1. **Feedback Control Systems:** Schaum's series 2001.
2. **Control systems:** I.J. Nagarath & M. Gopal, New age International publishers 2002.
3. **Automatic Control Systems** – B.C. Kuo, F. Golnaraghi, John Wiley & Sons, 2003.

HYDRAULICS AND PNEUMATICS

Sub Code: P08ME72
Hrs/week: 04
Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

INTRODUCTION TO HYDRAULIC POWER: Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps.

8 Hrs

Unit - 2

HYDRAULIC ACTUATORS AND MOTORS: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.

6 Hrs

Unit - 3

CONTROL COMPONENTS IN HYDRAULIC SYSTEMS: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.

5 Hrs

Unit - 4

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS: Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

7 Hrs

PART – B

Unit - 5

MAINTENANCE OF HYDRAULIC SYSTEMS : Hydraulic oils – Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

6 Hrs

Unit - 6

INTRODUCTION TO PNEUMATIC CONTROL: Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod – less cylinders – types, working advantages. Rotary cylinder types construction and application. Design parameters – selection .

6 Hrs

Unit - 7:

DIRECTIONAL CONTROL VALVES: Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the sue of logic gates. Pressure dependent controls types construction –practical applications. Time dependent controls – Principle, construction, practical applications.

7 Hrs

Unit - 8

MULTI-CYLINDER APPLICATIONS: Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). Electro-Pneumatic control: Principles-signal input and out put pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout.

7 Hrs

TEXT BOOKS:

1. **Fluid Power with applications:** Anthony Esposito, Fifth edition pearson education, Inc. 2000.
2. **Pneumatics and Hydraulics:** Andrew Parr. Jaico Publishing Co. 2000.

REFERENCE BOOKS:

1. **Oil Hydraulic Systems – Principles and Maintenance:** S.R. 2002 Majumdar, Tata Mc Graw Hill publishing company Ltd. 2001.
2. **Pneumatic systems** by S.R.Majumdar, Tata Mc Graw Hill publishing Co., 1995.
3. **Industrial Hydraulics:** Pippenger, Hicks, McGraw Hill, New York.

FINITE ELEMENT METHODS

Sub Code: P08ME73
Hrs/week: 04
Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit – 1

INTRODUCTION TO FEM – Need for use of FEM – Advantages and Disadvantages of FEM Matrix algebra – Terminologies relating to matrices. Methods of solution of linear algebraic equations. Eigen values and eigen vectors, Simple numeric gaussian Quadrature- 1 pt, 2pt and 3pt formula **8 Hrs**

Unit – 2

BASICS OF THEORY OF ELASTICITY – Definition of stress and Strain, Stress – strain relations; strain – displacement Relations in 2D and 3D Cartesian and polar coordinates. Continuum methods- Variational methods Rayleigh-Ritz methods applied to simple problems on axially loaded members, cantilever, simply supported and fixed beam, with point loads and UDL Galerkin method as applied to simple elasticity problem. **14 Hrs**

Unit - 3

FEM – basic definitions – displacement method Nodal degrees of freedom-different coordinate systems Shape functions- Lagrangian polynomial;complete Formulation of bar-truss-beam- triangular-quadrilateral Tetrahedral –hexahedral elements- boundary conditions- SPC and MPC. Methods of handling boundary conditions- elimination method-penalty method. Simple numericals, Iso parametric- sub parametric-super parametric elements. Tetrahedral and hexahedral elements (no Formulation)-Pascal triangle-pascal pyramid. Introduction to axis symmetric problems-formulation of axis symmetric triangular element. **18 Hrs**

PART - B

Unit – 4

DYNAMIC ANALYSIS: Formulation-element mass matrices for 1D element, computation of eigen value and vector for simple one Dimensional analysis. **4 Hrs**

Unit – 5

One dimensional steady state heat conduction Formulation of ID element-simple numerical using ID Element. **4 Hrs**

Unit – 6

Structure of a commercial FE package Preprocessor- Solver – post processor.

4 Hrs**TEXT BOOKS:**

1. J. N. Reddy – Finite Element Method – Tata Mc Graw Hill edition 2002
2. Introduction to Finite elements in Engineering by Chandrupatla and Belegundu – Pearson education, 2002

REFERENCE BOOKS:

1. Optimization concepts and applications in engineering Chandrupatla and Belegundu – Pearson education, 2002.
2. A First Course in Finite Element methods by Daryl.L..Logon, Thomson Learning 3rd edi.,2001.
3. Fundamentals of Finite Element method by Hutton – Mc Graw Hill, 2004
4. Concepts & applications of FEA by Robert Cook et.al – Honh wiley & sons 2002.
5. Finite element analysis by chandrupatla, University Press, 2002

Scheme of Examination:

Chapter No.	1	2	3	4	5&6
Questions	1	2	3	1	1

Students have to answer any FIVE questions.

PROJECT MANAGEMENT

Sub Code: P08ME76

Hrs/week: 04

Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50

Exam Hrs: 03

SEE Marks: 50

PART – A

Unit - 1

CONCEPTS OF PROJECT MANAGEMENT: Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management.

5 Hours

Unit - 2

PROJECT PLANNING AND ESTIMATING: Feasibility report, phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability.

7 Hours

Unit - 3

ORGANIZING AND STAFFING: The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution, controls, tendering and selection of contractors

7 Hours

Unit - 4

PROJECT SCHEDULING: Project implementation scheduling, different scheduling techniques bar (GANTT) charts, Bar charts for combined activities. Project evaluation and Review Techniques, PERT, planning. Simple Numerical Problems.

7 Hours

PART - B

Unit - 5

CO-ORDINATION AND CONTROL: Project direction communication in a project, Role of MIS in project control, performance control, schedule control, cost Control Examples.

7 Hours

Unit - 6

PERFORMANCE MEASURES IN PROJECT MANAGEMENT: Performance indicators, Performance improvement for the CM & DM companies for better project management.

7 Hours

Unit - 7

CLOSING OF PROJECT: Types of project termination, strategic implications, project in trouble, termination strategies, evaluation of termination possibilities

6 Hours

Unit - 8

PROJECT INVENTORY MANAGEMENT: nature of project inventory, supply and transportation of materials.

6 Hours

TEXT BOOKS:

1. **Project Management a System approach to Planning Scheduling & Controlling,** Harold Kerzner, CBS Publishers and Distributors.2002
2. **Project Management:** Benington Lawrence- Mc-Graw hill 1970

REFERENCE BOOKS:

1. **Project Management with PERT and CPM,** Moder Josep and Phillips cerel R., 2nd edition, New York V AN Nostrand, Reinhold- 1976.
2. **Project planning, Scheduling & control,** James P. Lewis, Meo Publishing company. 2001
3. **Project Management,** Bhavesh M Patel, Vikas Publishing House, ISBN 81-259-0777-7 2002

DESIGN LABORATORY

Sub Code: P08ME77
Hrs/week: 03
Lecture Hrs: 42

L:T:P: 4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photoelastic material using.
 - a) Circular disc subjected to diametral compression.
 - b) Pure bending specimen (four point bending)
5. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

PART – B

6. Determination of equilibrium speed, sensitiveness, power and effort of porter/proell Governor.
7. Determination of a Pressure distribution in Journal bearing.
8. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
9. Determination of stresses in Curved beam using strain gauge.
10. Experiments on Gyroscope (Demonstration only)

Scheme of Examination:

One question from Part A	-	20 Marks (05 Writeup + 15)
One question from Part B	-	20 Marks (05 Writeup + 15)
Viva – Voce	-	10 Marks

Total		50 Marks

CIM & AUTOMATION & LAB

Sub Code: P08ME78

Hrs/week: 03

Lecture Hrs: 42

L:T:P: 4:0:0

CIE Marks : 50

Exam Hrs: 03

SEE Marks: 50

PART – A

CNC part programming using Cam packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master – CAM, or any equivalent software.

PART – B

(Only for demo/ Viva voce)

1. FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.
2. Robot programming : Using Teach Pendant & Offline programming to perform pick and place, stacking of objects, 2 programs.

PART – C

(Only for demo/ Viva voce)

Pneumatics and Hydraulics, Electro-Pneumatics : 3 typical experiments on Basic of these topics to be conducted.

Scheme of Examinations :

Two questions from Part A	–	40 Marks (10 Write up + 30)
Viva Voce	–	10 Marks

Total	–	50 Marks

Elective – II
INTERNAL COMBUSTION ENGINES

Sub Code: P08ME71Y
Hrs/week: 04
Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

THERMODYNAMIC CYCLE ANALYSIS : Deviation from ideal processes. Effect of chemical equilibrium and variable specific heats, Effect of air fuel ratio and exhaust gas dilution. Calculation of combustion temperatures. Use of combustion charts. Simple. Numerical problems. **07 Hrs**

Unit- 2

CARBURATION AND COMBUSTION PROCESS IN S.I. ENGINES : Mixture requirements in S.I. engine. Simple Carburetor and its limitations. Knock free and knocking combustion- Theories of combustion process in S.I. engines. Effect of operating variables on knocking. Knock rating of fuels-octane number. HUCR values. Anti Knock agents – Pre ignition – Post ignition. **08 Hrs**

Unit - 3

COMBUSTION IN C. I. ENGINES : Ricardo's three stages of combustion process in C.I. engines. Delay period & factors affecting delay period. Diesel knock- Methods of controlling diesel knock. Knock rating of Diesel fuels. **06 Hrs**

Unit - 4

COMBUSTION CHAMBERS : Requirements of combustion chambers, Features of different types of combustion chambers system for S.I. engine. I-head, F-head combustion chambers. C.I. engine combustion chambers- Air swirl turbulence –M. type combustion chamber. Comparison of various types of combustion chambers. **06 Hrs**

PART –B

Unit - 5

FUELS : Hydro carbons – chemical structure-influence of chemical structure on knock alternative fuels –Alcohols – vegetable oils- Bio gas as Diesel engine fuels. **05 Hrs**

Unit - 6

FUEL INJECTION SYSTEMS: Diesel injection systems-jerk pump injectors Nozzles of different types-Petrol injection systems for S.I. engines- Electronic fuel injection system. Cooling system-Water cooling, air cooling & liquid cooling -role of thermostats-radiator construction. **07**

Hrs

Unit - 7

MODERN DEVELOPMENTS : Turbo charging and super charging of I.C. engines, Stratified charge engines (Lean burned SI engine) Multi fuel engines. Rotary piston engine. Two injector engines Pilot ignition engine, all ceramic swirl chamber engines. **07 Hrs**

Unit - 8

EMISSION REGULATION AND CONTROL SYSTEMS: Mechanism of pollutant formation. Total emission control package thermal reactor package-catalytic converter package-control of NO_x-Exhaust gas recirculation- Water injection. **06 Hrs**

Text Books :

1. A course in I.C. Engines, M.L. Mathur and R.P. Sharma 2001.
2. Internal Combustion Engines, Colin R. Ferguson C. John Wiley & sons, 1986.

REFERENCE BOOKS :

1. I.C. Engines, Edward. F. Obert, arper International Edition, 1973.
2. Internal Combustion Engine, Ganeshan, Tata McGraw Hill, 2nd Edition, 2003.
3. Engineering Fundamentals of the I.C. Engine, Willard W. Pulkrabek. 1998.
Combustion Engine Process, Lichty, Judge 2000.

TRIBIOLOGY

Sub Code: P08ME72Y
Hrs/week: 04
Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

INTRODUCTION TO TRIBIOLOGY: Properties of oils and equation of flow: Viscosity, Newton's of viscosity, Hagen- Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants.

06 Hrs

Unit - 2

HYDRODYNAMICS LUBRICATION: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings. **06 Hrs**

Unit - 3

MECHANISM OF PRESSURE DEVELOPMENT IN AN OIL FILM: Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems. **07 Hrs**

Unit - 4

SLIDER / PAD BEARING WITH A FIXED AND PIVOTED SHOE: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples. **07**

Hrs

PART-B

Unit - 5

OIL FLOW AND THERMAL EQUILIBRIUM OF JOURNAL BEARING: Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings. **06 Hrs**

Unit - 6

HYDROSTATIC LUBRICATION: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.

06 Hrs

Unit - 7

BEARING MATERIALS: Commonly used bearings materials, properties of typical bearing materials. **Wear:** Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure. **07 Hrs**

Unit - 8

BEHAVIOR OF TRIBOLOGICAL COMPONENTS: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures: Material selection, improved design, surface engineering

07 Hrs

TEXT BOOKS:

1. **Fundamentals of Tribiology** , Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006
2. **Introduction to Tribiology bearings**, Mujumdar B. C., Wheelers and company pvt.

Ltd 2001.

REFERENC BOOKS:

1. **Theory and Practice of Lubrication for Engineers**, Fuller, D., New York company 1998
2. **Principles and Applications of Tribology**, Moore, Pergamon press 1998
3. **Tribology in Industries**, Srivastava S., S Chand and Company limited, Delhi 2002
4. **Lubrication of bearings – theoretical principles and design**, Redzimoskay E I., Oxford press company 2000

INDUSTRIAL AUTOMATION

Sub Code: P08ME73Y

Hrs/week: 04

Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50

Exam Hrs: 03

SEE Marks: 50

PART – A

Unit - 1

INTRODUCTION: Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies

05Hrs

Unit - 2

MANUFACTURING OPERATIONS: Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations **07Hrs**

Unit - 3

INDUSTRIAL CONTROL SYSTEM: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

07Hrs

UNIT - 4

AUTOMATED MANUFACTURING SYSTEMS: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells. **07Hrs**

PART – B

Unit - 5

GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues.

08Hrs

Unit - 6

QUALITY CONTROL SYSTEMS: Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering, Introduction to SQC tools.

04Hrs

Unit - 7

INSPECTION TECHNOLOGIES: Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Noncontact Nonoptical Inspection Technologies

06Hrs

Unit - 8

MANUFACTURING SUPPORT SYSTEM: Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing. Basic Concepts of lean and Agile Manufacturing, Comparisons of Lean & Agile Manufacturing

08Hrs

TEXT BOOKS:

1. **Automation, Production Systems and Computer Integrated Manufacturing,** M.P.Groover, Pearson education. Third Edition, 2008
2. Principle of CIM, Vajpayee, PHI.

REFERENCE BOOKS:

1. **Anatomy of Automation,** Amber G.H & P. S. Amber, Prentice Hall.
2. **Principles of CIM by Vajpayee,** PHI.
3. **Performance Modeling of Automated Manufacturing Systems,** Viswanandham, PHI
4. **Computer Based Industrial Control,** Krishna Kant, EEE-PHI

GAS DYNAMICS

Sub Code: P08ME74Y
Hrs/week: 04
Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

FUNDAMENTAL EQUATIONS OF STEADY FLOW: Continuity and momentum equations, The thrust function, The dynamic equation and Euler's Equation. Bernoulli's Equation. Steady flow energy equation.

08 Hrs

Unit - 2

ISENTROPIC FLOW: Acoustic velocity, Mach number, Mach line and Mach angle. Flow parameters, stagnation temperature and pressure.

06 Hrs

Unit – 3

ADIABATIC FLOW: Stagnation temperature change. Rayleigh line, Pressure ratio and temperature ratio, Entropy considerations, maximum heat transfer, Detonation and deflagration.

06 Hrs

Unit - 4

FLOW WITH FRICTION: The fanning equation, Friction factor and friction parameter, Fanno line, Fanno equations.

06 Hrs

PART - B

Unit - 5

WAVE PHENOMENA: Classification of wave phenomena, analysis of shock phenomena, Hugoniot equation. Weak waves, compression waves, oblique shock, Normal shock waves, Entropy considerations, Rayleigh Pilot equations.

06 Hrs

Unit - 6

VARIABLE AREA FLOW: Velocity variation with Isentropic flow, Criteria for acceleration and deceleration. Effect of pressure ratio on Nozzle operation. Convergent nozzle and convergent divergent nozzle. Effect of back pressure on nozzle flow. Isothermal flow functions. Comparison of flow in nozzle. Generalized one dimensional flow. **08 Hrs**

Unit - 7

APPLICATIONS OF dimensional analysis and similitude to gas dynamic problems.

05 Hrs

Unit - 8

INTRODUCTION TO FLAMES AND COMBUSTION: Flame propagation, diffusion flames, premixed flames, flame velocity, theories of flame propagation, ignition for combustible mixture, flame stabilization.

07 Hrs

TEXT BOOKS:

1. **Fundamentals of Compressible flow:** Yahya, 2nd Edn. 1991; Wiley Eastern.
2. **Gas Dynamics:** Cambell and Jennings, McGraw Hill. 1994.

REFERENCE BOOKS:

1. **Introduction to Gas Dynamics:** Roly, wiley 1998.
2. **Elements of Gas Dynamics:** Liepmann and roshko, Wiley 1994.
3. **The dynamiacs and thermodynamics of compressible fluid flow:** Shapiro Ronold press. 1994.

AUTOMOTIVE ENGINEERING

Sub Code: P08ME75Y

Hrs/week: 04

Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50

Exam Hrs: 03

SEE Marks: 50

PART – A

Unit - 1

ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS: SI & CI engines, cylinder – arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S.I.Engine and C.I.Engines, Compression ratio, methods of a Swirl generation, choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements.

07 Hrs

Unit - 2

FUELS, FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Conventional fuels, alternative fuels, thermodynamic cycles, normal and abnormal combustion, cetane and

octane numbers, Fuel mixture requirements for SI engines, types of carburetors, C.D.& G.C. carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors. **07 Hrs**

Unit - 3

SUPERCHARGERS AND TURBOCHARGERS: Naturally aspirated engines, Forced Induction, Types of superchargers, Roots supercharger, Spiral (Scroll) supercharger, Turbocharger construction and operation, Intercooler, Turbocharger lag. **06 Hrs**

Unit - 4

IGNITION SYSTEMS: Battery Ignition systems, magneto Ignition system, Transistor assist contacts. Electronic Ignition, Automatic Ignition advance systems. **06 Hrs**

PART – B

Unit - 5

POWER TRAINS: General arrangement of clutch, Principle of friction clutches, Torque transmitted, Constructional details, Fluid flywheel, Single plate, multi-plate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, synchromesh gear boxes, 3,4 and 5 speed gear boxes . Free wheeling mechanism, planetary gears systems, over drives, fluid coupling and torque converters, Epicyclic gear box, principle of automatic transmission, calculation of gear ratios, Numerical calculations for torque transmission by clutches. **08 Hrs**

Unit - 6

DRIVE TO WHEELS: Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer, numerical problems, types of chassis frames. **06 Hrs**

Unit - 7

SUSPENSION, SPRINGS AND BRAKES: Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilockbraking system, ABS Hydraulic Unit, Rear-wheel antilock **06 Hrs**

Unit - 8

AUTOMOTIVE EMISSION CONTROL SYSTEMS: Automotive emission controls, Controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator system, Catalytic converter, Emission standards- Euro I, II, III and IV norms, Bharat Stage II, III norms.

TEXT BOOKS:

1. **Automotive mechanics**, William H Crouse & Donald L Anglin, 10th Edition Tata McGraw Hill Publishing Company Ltd., 2007
2. **Automotive Mechanics** by S.Srinivasan, Tata McGraw Hill 2003.

REFERENCE BOOKS:

1. **Automotive mechanics: Principles and Practices**, Joseph Heitner, D Van Nostrand Company, Inc
2. **Fundamentals of Automobile Engineering**, K.K.Ramalingam, Scitech Publications (India) Pvt. Ltd.
3. **Automobile Engineering**, R.B.Gupta, Satya prakashan, 4th edn. 1984.
4. **Automobile engineering**, Kirpal Singh. Vol I and II 2002.

Scheme of Examination:

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

PRODUCT DESIGN AND MANUFACTURING

Sub Code: P08ME76Y

Hrs/week: 04

Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50

Exam Hrs: 03

SEE Marks: 50

PART – A

Unit - 1

INTRODUCTION TO PRODUCT DESIGN: Asimow's model: Definition of product design, Design by Evolution, Design by Innovation, Essential Factors of Product design, Production-Consumption Cycle, Flow and Value Addition in the Production- Consumption Cycle, The Morphology of Design (The seven phases), Primary Design Phases and Flowcharting, Role of Allowance, Process Capability and Tolerance in Detailed Design & Assembly.

06 Hrs

Unit - 2

PRODUCT DESIGN PRACTICE AND INDUSTRY: Introduction, Product Strategies, Time to Market, Analysis of the Product, The S's Standardization, Renard Series, Simplification, Role of Aesthetics in Product Design, Functional Design Practice.

06 Hrs

Unit - 3

REVIEW OF STRENGTH, STIFFNESS AND RIGIDITY CONSIDERATIONS IN PRODUCT DESIGN: Principal Stress Trajectories (Force-Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience Designing for Uniform Strength, Tension vi-avis Compression. Review of Production Process: Introduction, Primary Processes, Machining Process, Non-traditional Machining Processes.

07 Hrs

Unit - 4

DESIGN FOR PRODUCTION – METAL PARTS: Producibility requirements in the Design of machine Components, Forging Design, Pressed components Design, Casting Design, and Design for Machining Ease, The Role of Process Engineer, Ease of Location Casting and Special Casting. Designing with Plastic, rubber, ceramics and wood: Approach to design with plastics, plastic bush bearings, gears in plastics, rubber parts, design recommendations for rubber parts, ceramic and glass parts.

07 Hrs

PART – B

Unit - 5

OPTIMIZATION IN DESIGN: Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method of Optimum Design. **06 Hrs**

Unit - 6

ECONOMIC FACTOR INFLUENCING DESIGN: Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break – even Analysis, Economic of a New Product Design.

06 Hrs

Unit - 7

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Introduction, Human being as Applicator of Forces, Anthropometry; Man as occupant of Space, The Design of Controls, of controls, the Design of Displays, Man/Machine Information Exchange.

06 Hrs

Unit- 8

VALUE ENGINEERING AND PRODUCT DESIGN: Introduction, Historical Perspective, What is Value? Nature and Measurement of Value, Value Normal Degree of Value, Importance of Value,

The Value analysis Job Plan, Creativity, Steps to Problems-solving and Value Analysis, Value Analysis Test, Value Engineering Idea Generation Check-list Cost Reduction through value engineering case study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering Modern Approaches to Product Design: Concurrent Design and Quality Function Deployment (QFD). **08 Hrs**

TEXT BOOKS:

1. **Product Design and Manufacturing** by A.C. Chitale and R.C. Gupta, PHI 4th edition 2007.
2. **Product Design & Development** – Karl T. Ulrich & Steven D, Epinge, Tata Mc.Graw Hill, 3rd Edition, 2003

REFERENCE BOOKS:

1. **New Product Development** by Tim Jones, Butterworth Heinmann, Oxford, mc1997.
2. **New Product Development: Design & Analysis** by Roland Engene Kinetovicz, John Wiley and Sosn Inc., N.Y. 1990.
3. **Product Design for Manufacture and Assembly** by Geoffery Boothroyd, Peter Dewhurst and Winston Knight. 1998.
4. **Successful Product Design** by Bill Hollins, Stwout Pugh, Butterworth, London1990.

COMPUTER INTEGRATED MANUFACTURING

Sub Code: 06ME72
Hrs/week: 04
Lecture Hrs: 52

IA Marks : 25
Exam Hrs: 03
Exam Marks: 100

PART – A

Unit - 1

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. **08 Hrs**

Unit - 2

HIGH VOLUME PRODUCTION SYSTEM: Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Ratchet & Pawl,

Geneva wheel, Buffer storage, control functions-sequence, safety, Quality, Automation for machining operation. **06 Hrs**

Unit – 3

ANALYSIS OF AUTOMATED FLOW LINE & LINE BALANCING : General terminology and analysis, Analysis of Transfer Line with Out storage-upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with simple problem, Partial automation-with numerical problem, flow lines with more than two stages, Manual Assembly lines, line balancing problem.

06 Hrs

Unit - 4

MINIMUM RATIONAL WORK ELEMENT: work station process time, Cycle time, precedence constraints. Precedence diagram, balance delay methods of line balancing largest candidate rule, Kilbridge and Westers method, Ranked positional weight method, Numerical problems covering above methods and computerized line balancing.

06 Hrs

PART – B

Unit - 5

AUTOMATED ASSEMBLY SYSTEMS: Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feed back, escapement and placement analysis of Multistation Assembly machine analysis of single station assembly.

AUTOMATED GUIDED VEHICLE SYSTEM: Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application.

08 Hrs

Unit - 6

COMPUTERIZED MANUFACTURING PLANNING SYSTEM : Introduction, Computer Aided process planning, Retrieval types of process planning , Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning.

06 Hrs

Unit - 7

CNC MACHINING CENTERS : Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning. **06 Hrs**

Unit - 8

ROBOTICS : Introduction to Robot configuration, Robot motion, programming of Robots end effectors, Robot sensors and Robot applications. [This is required for CIM automation lab 06MEL77] **06 Hrs**

TEXT BOOKS:

1. **Automation, Production system & Computer Integrated manufacturing**, M.P. Groover” Person India, 2007 2nd edition.
2. **Principles of Computer Integrated Manufacturing**, S. Kant Vajpayee, Prentice Hall India.

REFERENCE BOOKS:

1. **Computer Integrated Manufacturing**, J.A.Rehg & Henry.W. Kraebber.
2. **CAD/CAM by Zeid**, Tata McGraw Hill.

OPERATION MANAGEMENT

Sub Code: P08ME72Z
Hrs/week: 04
Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

OPERATIONS MANAGEMENT CONCEPTS: Introduction, Historical Development, Operations Management Definition, Production and Manufacturing Systems, Products V/S Services, Productivity, Factors affecting Productivity, International Dimensions of Productivity, The environment of operations. Operational excellence and world class manufacturing practices.

6 Hours

Unit - 2

OPERATIONS DECISION MAKING: Introduction, Characteristics decisions, framework for Decision Making, Decision methodology, Decision supports systems, Economic models, Statistical models.

6 Hours

Unit – 3

SYSTEM DESIGN & CAPACITY PLANNING: Design capacity, System capacity, and Determination of Equipment requirement. Facility Location and Facility Layout Location Planning for Goods and Services, foreign locations and facility layout.

6 Hours

Unit - 4

FORECASTING: Forecasting Objectives and Uses, Forecasting Variables, Opinion and Judgmental methods, Time Series methods, Exponential smoothing, Regression and Correlation methods, Application and Control of Forecasts.

8 Hours

PART - B

Unit - 5

AGGREGATE PLANNING AND MASTER SCHEDULING: Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods.

6 Hours

Unit 6:

INVENTORY CONTROL AND MATERIALS MANAGEMENT: Definition need, Components Inventory, inventory control. Scope of Materials Management, material handling, storage and retrieval, purpose of inventories, dependent and independent demand, inventory cost and order quantities, inventory classification and counting

6 Hours

Unit - 7

MATERIAL AND CAPACITY REQUIREMENTS PLANNING: Overview: MRP and CRP, MRP: Underlying Concepts, System Parameters, MRP Logic, System refinements, Capacity Management, CRP activities. Concept of continuous improvement of process.

6 Hours

Unit - 8

PURCHASING & SUPPLY MANAGEMENT: Purchase and supply chain management- Approches to purchase and supply chain management,make or buy decision, e-Procurement, Vender development, rating ,and certification.

8 Hours

TEXT BOOKS:

1. **Operations Management**, I. B. Mahadevan. Theory and practice, Pearson, 2007.

2. **Operations Management**, I. Monks, J.G., McGraw-Hill International Editions, 1987.

REFERENCE BOOKS:

1. **Modern Production/Operations Management**, Buffa, Wiley Eastern Ltd.2001
2. **Production and Operations Management**, Pannerselvam. R., PHI.2002
3. **Productions & operations management**, by Adam & Ebert. 2002
4. **Production and Operations Management**, Chary, S. N., Tata- McGraw Hill. 2002

THEORY OF PLASTICITY

Sub Code: P08ME73Z
Hrs/week: 04
Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

FUNDAMENTAL OF ELASTICITY: Concept of stress, stress transformation laws, spherical and deviator stress tensors, equilibrium equations, octahedral stresses, concept of strain, deviator and spherical strain tensors, strain transformation laws, octahedral strains, generalized hook's law., elastic strain energy, compatibility equations, theories of strength. problems.

07 Hrs

Unit - 2

PLASTIC DEFORMATION OF METALS: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or luder's cubes.

06 Hrs

Unit - 3

CUBICAL DILATION, TRUE STRESS AND STRAIN: strain tensor, principal strain, plane strain, spherical and deviator strain, octahedral strain and representative strain, problems.

07 Hrs

Unit - 4

STRESS STRAIN RELATIONS: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St. Verant's theory of plastic flow, the concept of plastic potential, the maximum work hypothesis, mechanical work for deforming a plastic substance.

06 Hrs

PART – B

Unit - 5

YIELD CRITERIA: Introduction, yield or plasticity conditions, Von Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), experimental evidence for yield criteria, energy required to change the shape with basic principle problems

07 Hrs

Unit - 6

SLIP LINE FIELD THEORY: Introduction, basic equations for incompressible two dimensional flow, continuity equations, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line nets

07 Hrs

Unit - 7

BENDING OF BEAMS: Analysis for stresses, Non linear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems.

06 Hrs

Unit - 8

TORSION OF BARS: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems

06 Hrs

TEXT BOOKS:

1. 'Theory of Plasticity' Sadhu Singh Khanna Publishers, 2003
2. 'Engineering Plasticity' W.Johnson and P.B.Mellor D Van N.O Strand Co.Ltd 2000

REFERENCE BOOKS:

1. 'Theory of Plasticity' Timoshenko & Goodyear, TMH, 1998
2. 'Theory of Plasticity' L.S.Srinath TMH,
3. 'Metal Forming Processes and Analysis' by Avitzur
4. 'Theory of Plasticity' Timoshenko & Goodyear TMH 1998

TOOL DESIGN AND ENGINEERING

Sub Code: P08ME74Z
Hrs/week: 04
Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit – 1

Introduction to tool design, tooling, requirements of a tool designer, general tool design procedure.

2 hrs

Unit – 2

- (a) Design of single point lathe tool: design of shank dimension using strength and rigidity considerations for rectangular, Square and round cross section and selection of tool geometry. Solid type tool, brazed tip tool, long indexable insert, throwaway indexable insert types and chip breakers.
- (b) Design of drill : Design of elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry.
- (c) Design of milling cutter : Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry.

8 hrs

Unit – 3

DESIGN OF JIGS & FIXTURES : Functions and difference between jigs and fixtures, advantages in

mass production, design principles, economics jigs and fixtures. Principles of location – 3-2-1 and 4-1-1 types of locations, different types of locating elements. Clamping – Principles of clamping, types of clamping including power clamping devices. Drill jigs – Types, Drill bushes, simple exercises of designing jigs for given components. Fixture Design – Turing fixtures, milling fixtures, grinding and broaching fixtures, indexing fixtures. Design of fixtures for simple components.

14 hrs

PART -B

Unit – 4

PRESS TOOL DESIGN : Working of a power press and classification of presses. Components of a simple die, press tool operation, die accessories, shearing action in punch and die, punch & die clearance, shear on punch and die, Centre of pressure and problems, scrap strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components. Bending dies – Introduction, bend allowance, spring back, edge bending die design. Drawing dies –

Single action, double action and triple action dies, factors affecting drawing, drawing die design.

12 hrs

Unit – 5

DIE CASTING DIES : terminology: Core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins, ejector plates, gate, goose – nozzle, over-flow, platen, plunger, runner, vent, water-line etc. Types of Dies : Single cavity, multicavity dies, combination dies, unit dies, advantages and disadvantages of types of dies. Die casting alloys, defects in die casting, finishing trimming and inspection of die casting components, safety, modern trends in die casting dies.

8 hrs

Unit – 6

Injection Moulding : Injection moulding machine and its elements, general configuration of a mould. 2 plate and 3 plate mould. Introduction to gate, runner, parting surface, ejection system, core and cooling system. Introduction to compression, transfer, blow moulding, extrusion, forming and calendaring.

8 hrs

TEXT BOOKS :

1. Tool design, by C. Donaldson, G.H. LeCain V. C. Goold, Tata Mcgraw Hill Pub. Edn. 1976.
2. Metal cutting theory & cutting tool design, by V. Arshinov and G. Alkseev Mir Pub. Moscow Edn. 1976.

REFERENCE BOOKS :

1. Typical example and problems in metal Cutting theory and cutting tool design, by N. Nefdov, K. Osipov, Mir Pub. Edn. 1987
2. Introduction to jigs and fixture design, M.H.A. Kempster, elbs, edn. 1974.
3. Tool engineering and design, napal Khanna Pub. Edn. 1998.
4. Fundamentals of tools design, ASTME prentice hall India. 2000.

5. Metal cutting and tool design, Dr. B. J. Ranga, Vikas Pub. Edn. 1993.
6. Manufacturing technology (foundry forming and welding) P. N. Rao, Tata Mc. Graw Hill Pub. Edn. 1996.
7. Die Casting, Doehler 2000.
8. Die casting Die Design, Burton 2000.
9. Injection Moulding Design, RGW Pye, John Wiley. 1998
10. Injection Moulding Handbook, Dominick V. Rosato & Donald V. Rosato, 1996.
11. CBS Publishers

Scheme of Examination :

Students should be asked to answer any five question out of eight questions

Chapter No :	1&2	3	4	5	6
Questions to be set :	1	3	2	1	1

EXPERIMENTAL STRESS ANALYSIS

Sub Code: P08ME75Z
Hrs/week: 04
Lecture Hrs: 52

L:T:P: 4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

INTRODUCTION – Mechanical, Optical, Pneumatic, Acoustic strain gauges. Electrical Resistance Strain Gauges – Gauge factor , types, properties of an ideal gauge material, backing material, adhesive material, protective coating; Method of bonding strain gauges, strain gauges lead wire and connections, semiconductor strain gauges problems.

08 Hrs

Unit - 2

STRAIN GAUGE CIRCUITS, WHEATSTONE’S bridge, Error due to input impedance of measuring instrument, temperature compensation, multiple gauge circuits, calibration of strain measuring system, loadcells, problems.

07 Hrs

Unit - 3

STRAIN GAUGE ROSETTES – Necessity, analysis, problems.

05 Hrs

Unit - 4

NATURE OF LIGHT – Harmonic wave, phase, amplitude, polarization. Crystal optics: Passage of light through crystalline media, absolute and relative phase difference, quarter wave plate, half wave plate, production of plane polarized light and circularly polarized light.

06 Hrs

PART- B

Unit - 5

TWO-DIMENSIONAL PHOTO ELASTICITY – Stress optic law, plane polariscope, isochromatics and isoclinics, circular polariscope, dark and bright fields arrangements, Isoclinic and Isochromatic fringe order at a point, methods of compensation separation technique.

08 Hrs

Unit - 6

PHOTO ELASTIC ANALYSIS – Calibration of photo elastic model material, properties of ideal photo elastic material, casting of photo elastic models, machining, stress relieving, scaling model prototype relation, two dimensional application, problems.

06 Hrs

Unit - 7

BIREFRINGENT COATING: Theory, photo elastic data for stress analysis, reflection polariscope. Moire techniques: Phenomenon, moiré fringe analysis, geometric approach, displacement approach, moiré techniques for inplane problems, sign and other of fringes, problems of moiré gratings, moiré fringe photograph.

06 Hrs

Unit - 8

INTRODUCTION TO HOLOGRAPHY. Introduction to brittle coating technique. Introduction to computer techniques and fringe analysis.

06 Hrs

TEXT BOOKS:

1. **Experimental stress analysis:** L.S. Srinath, M.R. Raghavan, K. Lingaiah, G. Gargesh, K. Ramachandara & B. Pant, Tata McGraw Hill publication 2000.
2. **Experimental stress analysis** by Dally & Riley, Tata McGraw Hill Publication 2001.

REFERENCE BOOKS:

1. **Analysis of stress and strain:** A.J. Duraelli, E.A. Phillips and C.H. Trao McGraw Hill, 1958.
2. **Applied stress analysis:** A.J. Durelli, prentice hall India, 1970.
3. **Moire analysis of strain:** Durelli & parks. 1996.
4. **Hand Book of experimental mechanics:** A.S.Kobayassin (Ed.,) SEM/ VCH, 2nd edn. 2000.

REFRIGERATION AND AIR CONDITIONING

Sub Code: P08ME76Z
Hrs/week: 04
Lecture Hrs: 52

L:T:P:4:0:0

CIE Marks : 50
Exam Hrs: 03
SEE Marks: 50

PART – A

Unit - 1

BRIEF REVIEW OF VARIOUS METHODS OF REFRIGERATION: Vapour compression cycle: Analysis of Vapour Compression cycle using ph and T-S diagrams- calculations, standard rating of operating conditions, Actual vapour compression cycle, Second law analysis of Vapour Compression Cycle.

8 Hours

Unit - 2

REFRIGERANTS: Types of Refrigerants, Comparative study of Ethane and Methane derivatives, selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures

6 Hours

Unit - 3

MULTI PRESSURE VAPOUR COMPRESSION SYSTEMS: Multi stage compression, Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.

6 Hours

Unit - 4

EQUIPMENTS USED IN VAPOUR COMPRESSION REFRIGERATION SYSTEM:
Compressors: Principle, types of compressors, capacity control. Condensers: Types and construction, Expansion devices: Types- Automatic expansion valve, Thermostatic expansion valves, capillary tube. Sizing Evaporator: Types & construction.

PART - B**Unit - 5**

VAPOUR ABSORPTION SYSTEM: Common refrigerant absorbent combinations, Binary mixtures, Ammonia Water Absorption system, Actual vapour absorption cycle and its representation on enthalpy. Composition diagram, calculations. Triple fluid vapour absorption refrigeration system. Water-Lithium Bromide absorption chiller.

6**Hours****Unit - 6**

PSYCHOMETRY OF AIR CONDITIONING PROCESS-REVIEW: Review of Psychometric processes, Summer Air conditioning, Apparatus Dew point, winter air conditioning. Design conditions: Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.

6 Hours**Unit - 7**

LOAD CALCULATIONS AND APPLIED PSYCHOMETRICS: Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, Bypass factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.

6 Hours**Unit - 8**

TRANSMISSION AND DISTRIBUTION OF AIR: Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design. Controls in Refrigeration and Air conditioning equipments: High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, bypass control-Damper motor. VAV controls.

8 Hours**TEXT BOOKS:**

1. '**Refrigeration and Air-Conditioning**' by C. P. Arora, Tata McGraw Hill Publication, 2nd edition, 2001.
2. '**Refrigeration and Air-Conditioning**' by W. F. Stoecker, Tata McGraw Hill Publication, 2nd edition, 1982.

REFERENCE BOOKS:

1. **'Principles of Refrigeration'** Dossat, Pearson-2006.
2. **'Heating, Ventilation and Air Conditioning'** by McQuiston, Wiley Students edition, 5th edition 2000.
3. **'Air conditioning'** by PITA, 4th edition, pearson-2005
4. **'Refrigeration and Air-Conditioning'** by Manohar prasad