Solapur University, Solapur
Structure & Syllabi of B.E. (Mechanical Engineering) Part I & II
w.e.f. Academic Year 2010-11.

B.E.(Mechanical Engineering) **Part -I**

Sr. No.	Subject	Teaching / Week					Examination Scheme			
		L	**T**	**P**	**Dr**	**Total**	**TP**	**TW**	**ORAL**	**Total**
1	I.C.Engine	3	-	2	-	5	100	25	25	150
2	Power Plant and Energy Engineering	3	-	2	-	5	100	25	-	125
3	Operations Research	3	-	2	-	5	100	25	--	125
4	Finite Element Methods	3	-	2	-	5	100	25	--	125
5	Elective - I	3	-	2	-	5	100	25	25	150
6	Project Work-I	-	-	4	-	4	-	25	-	25
7	Vacational Training	-	-	1	-	1	-	25	25	50
	Total	**15**	**-**	**15**	**-**	**30**	**500**	**175**	**75**	**750**

Notes : 1.Vacational Training (B.E. Part 1) of minimum 15days should be completed in any vacation after SE Part-II but before BE Part-I & the report should be submitted in BE Part-I.
2. Project group be of 4 students each to the extent possible.
3. Elective - I : To offer a particular subject as an Elective from the following list, minimum 15 students should opt the same.
4. For Faculty load calculations contact hours should be 2 hours / group of 4 students / week.

Elective - I :-

1. Mechanical Vibration
2. Experiment Stress Analysis
3. Process Engineering
4. Computational Fluid Dynamics
5. Nano Technology
6. Product Design
7. Robotics
8. Gas Turbines

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B.E. (Mechanical Engineering) **Part -II**

Sr. No.	Subject	Teaching / Week					Examination Scheme			
		L	**T**	**P**	**Dr**	**Total**	**TP**	**TW**	**ORAL**	**Total**
1	Refrigeration & Air Conditioning	3	-	2	-	5	100	25	25	150
2	Industrial & Quality Management	3	-	2	-	5	100	25	--	125
3	Mechatronics	3	-	2	-	5	100	25	25*	150
4	Elective - II	3	-	2	-	5	100	25	25	150
5	Project Work-II		-	8	-	8	-	75	100	175
	Total	**12**	**-**	**16**	**-**	**28**	**400**	**175**	**175**	**750**

'*' indicates Practical & Oral Examination

Notes : 1. Project group be of 4 students each to the extent possible.
2. Elective - II : To offer a particular subject as an Elective from the following list, minimum 15 students should opt the same.
3. The Practical batch be of 15 students (to the extent possible). After formation of batches, if the number of students remaining is 50% or more than batch size, a new batch be formed.
4. Practical / Tutorial load indicates the load per batch.

Elective II :-

1. Automobile Engineering
2. Production Management
3. Materials Management
4. Cost Estimation & Cost Control
5. Total Quality Management
6. Material Handling Systems
7. Reliability Engineering

B.E. (Mechanical) Part – I
I. C. ENGINE

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory: 100 Marks**
Practical: 2 Hrs/ Week	**Term work: 25 Marks**
	Oral: 25 Marks

Course Objective:
To provide an introduction to the basic principles of Internal Combustion Engines. To provide practical exercises to strengthen the student's knowledge of internal combustion engines

Section I

1 Introduction to I.C. Engines & Engine Cycles : 05
Introduction, Basic engine components and nomenclature, Classification of I. C. Engines.Engine cycles, Deviation of actual cycles from air standard cycles, Valve timing diagram for high & low speed engine, Port timing diagram.

2 Fuel systems for S.I. Engines: 05
Engine fuel requirements, Elementary and complete carburetor (Float, Idling and Acceleration system, Choke, Compensating system, economizer), Derivation for calculation of A/F ratio, Design of carburetor - Calculation of main dimensions of air and fuel supply,Effect of altitude on Air fuel ratio. Electronic Petrol injection system (MPFI) (Numerical on calculations of main dimension of carburetor)

3 Fuel Systems for C.I. Engines: 05
Requirements of injection system, Fuel metering, pressurizing and injecting system, Types of. i. system- Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles- single hole, multi hole, pintle, and pintaux, Formation of Spray, Atomization and penetration. Governing of C.I. engines. Pneumatic governors. Electronic control for diesel engine management, (Numerical oncalculations of main dimension of fuel injection system)

4 Supercharging: 03
Purpose of supercharging, Thermodynamic cycle of supercharged engine, Types of superchargers, Turbo charging, Advantages and disadvantages, Limitations of supercharging for S.I. and C.I. Engines.

5 Engine Selection: 02
Selection of an I.C. engine for Automotive, Locomotive, Aircraft,Marine, Agriculture, And Power generation based on criteria such as operating cycle, fuel used, cooling method, cylinder numbers & arrangement, speed, fuel economy and power to weight ratio.

Section II

6 Combustion in S. I. Engines: 05

Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I.Engines and its types.

7 Combustion in C.I. Engines: 05

Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion-Diesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S I and C I engines, Cetane number, Additives. Requirements of combustion chambers for C.I.engines and its types.

8 Performance And Testing Of Engines: 05

Performance parameters, Performance curves, Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Heat Balance Sheet. (Numerical on engine performance)

9 Engine Emission and Control: 03

S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods-Chemical, EGR, Standard pollution Norms – Bharat-I,II,III

10 Alternative Fuels And Engine Electronics: 02

Alternative fuels for S. I. Engines & C. I. engines, Blending, Use of CNG, Bio-gas, Non-edible oils, Ethanol, Methanol, Hydrogen,Electronic engine management system for variable valve timing, fuel supply and pollution control.

Term Work

Minimum four experiments from Study Group and Test Group Each.

Study Group:

1 Constructional details of I.C. engines
2 Study of Engine systems: Air, exhaust, Cooling, Lubrication
3 Study of ignition systems, Starting systems.
4 Study of Carburetor and Petrol injection system
5 Dismantling and assembly of engine
6 Study of fuel injection system of diesel engine

Text Group:

1 Test on slow speed Diesel Engine.(Heat Balance Sheet)
2 Test of high-speed Diesel/Petrol Engine.
3 Test on two stroke / four stroke petrol engine. (Variable Speed Test)
4 Morse Test on multi cylinder Engine
5 Visit to a engine manufacturing company / repairing unit
6 Test on computer controlled I.C. Engine
7 Measurement of engine emission.

Books Recommended

1. I. C. Engines –Mathur and Sharma.
2. I. C. Engines – Ganeshan.
3. I. C. Engines – Maleev
4. I. C. Engines – Heywood
5. Diesel & High Compression Gas Engines – P. M. Kates.
6. Internal Combustion Engines Fundamentals – E. F. Obert.

BE (Mechanical) Part-I
POWER PLANT AND ENERGY ENGINEERING

Teaching Scheme :	**Examination Scheme:**
Lectures : 3 Lectures / weeks	***Theory Exam.:*** 100 Marks
Practical : 2 Hours / week	***Term work :*** 25 Marks

Course Objective

1. Study of Power Station performance evaluation & economic analysis.
2. Study of various non-conventional energy sources & principles of energy conservation & audit.

Section – I

1. Introduction **02**

Electric Energy Growth in India, Organization of Power Sector in India, Future energy demands in India, Role of private sector in energy management.

2. Loads on Power Plant **05**

Introduction, Different load curves and load factors, Effect of variable load on power plant design & operation. (Numerical treatment to be considered)

3. Peak Load & Base Load Power Plants **03**

Introduction & classification, Requirement of peak load plant, Types, Pumped storage plants, Compressed air storage plants Load sharing between base load & peak load power stations. (Numerical treatment to be considered)

4. Major Electrical Instruments in Power Plant **05**

Introduction , Layout, Generator & exciter short circuit & its limiting methods, Switch gear, Circuit breakers, Starters, Relays & power transformer, Power factor and its measurement & improvement methods.

5. Economic Analysis of Power Plants **05**

Introduction Cost of electric energy, Fixed and operating cost, Selection & type of generation, Selection of generation equipment, Performance & operation characteristics of power plants, Tariff methods. (Numerical Treatment to be considered)

Section – II

6. Solar Energy **05**

a) Solar radiation outside the earth's atmosphere & at the earth's surface. Solar radiation measurement – pyranometer & pyrheliometer sun shine recorder. Solar radiation data, solar radiation geometry. LAT & SCT. Solar radiation on tilted surface (Numerical treatment).

b) Liquid flat plate collector – General, Performance analysis with numerical problems. Effects of various parameters.

7. Wind Energy **05**

Introduction, Power of wind, Basic components of 'WECS', Classification of WEC systems. Forces on blades & thrust of turbines, Lift & drag. Numerical problems. Performance of wind machines, typical performance characteristics for various types of rotors.

8. Other Non- Conventional energy sources **04**

Geothermal energy – Introduction, Types of geothermal resources, Methods of Harnessing.

Energy from oceans – wave energy, energy conversion devices, tidal energy- Types of tidal power plants, ocean thermal energy – Introduction, open & closed systems.

9. Energy Conservation **03**

Introduction, Principles of energy conservation, energy conservation planning, energy conservation in industries – Chemical industry, Pulp & paper industry, Cement industry, Sugar industry, Petroleum refinery, Iron & steel industry, Textile industry, Electrical energy conservation in small scale industries, Energy conservation in Electrical generation, transmission & distribution. Energy conservation in house hold & commercial sectors, Transport & Agriculture. Energy conservation Legislation

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10. Energy Audit **03**

Definition & objective of Energy audit, Energy flow diagram, Strategy of 'EA', Energy management team, Instruments for energy audit. 'EA' of illumination system, Electrical system, Heating ventilation & Air conditioning system.

Term Work

Group - I: Any two Experiment from Expt. No. 1 to 3

1. Solar radiation & its measurement
2. Test on solar water heater
3. Test on solar P-V module

Group - II: Minimum Six Assignments based on following topics -

1. Study of solar collectors
2. Study of solar thermal applications- solar water heating, space heating, power generation refrigeration, distillation, drying & cooking
3. Study of solar pond / solar photovoltaic
4. Study of Biogas plants
5. Study of instruments of a power plant water purity, PH meter, Gas analysis, Measurement of smoke & dust, Nuclear measurement
6. Study of various pollution control devices
7. Study of various Energy storage devices.

Group - III:

1. Visit & its report to renewable energy appliances
2. Visit & its report to power generation / transmission station

Books Recommended

1. Generation of electrical energy – B.R.Gupta, S.Chand & co. ltd., 5/e
2. A course in Power Plant Engineering – Arora Domkundwar Dhanpat Rai & co., 5/e
3. Solar Energy – S.P.Sukhatme, Tata mcgraw hill co.
4. Solar Energy – G.D.Rai, Khanna publishers
5. Energy Technology – S.Rao & Dr.B.B.Purulekar, Khanna publishers, 3/e
6. Power Plant Engineering – P.K.Nag, Tata mcgraw hill publishing co.
7. Power Plant Technology – M. M. El Wakil.
8. Power Plant Engineering – R. K. Rajput.

B.E. (Mechanical) Part – I
OPERATIONS RESEARCH

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks,
Practical : 2 Hrs/ Week	**Term work:** 25 Marks

Course Objectives:

1.Study of quantitative techniques in management decision-making and its applications by using mathematical models.
2. Create awareness about preparation of Project Plan.

Section I

1 Introduction: **02**
History and development of OR, Applications, modeling in operation research, O.R. models and their applications

2 Linear Programming Problems: **08**
Formulation of problem, Graphical solution, Simplex procedure for maximization and minimization, Duality concept, Sensitivity analysis under different situations. Introduction to Gomery's cutting plane method for integer programming (No Numerical Treatment on Integer Programming)

3. Assignment Model: **03**
Mathematical statement, Methods to solve balanced and unbalanced assignment problems, Maximization problems, Assignment with restrictions, Traveling salesman problem.

4. Transportation Model: **04**
Mathematical formulation, methods to obtain initial basic feasible solution (IBFS), NWCR and VAM, conditions for testing optimality, MODI method for testing optimality solution of balanced and unbalanced problems, Degeneracy and its resolution.

5. Dynamic Programming: **03**
Introduction, Bellman's Principle of optimality, shortest route (stage coach) problem, maximization problem (Cargo LOADING problem)

Section II

6. Games Theory: **05**
Introduction, Minimax and maximin principle, Solution of zero sum two persons games – Saddle point algebraic method, Dominance properties, Graphical method

7. Decision Theory: **04**
Introduction, Pay off table, Opportunity loss or regret table, Decisions under uncertainty, Laplace Criterion, Maximin or minmax principle, maximax or minimax principle, Hurwicz principle, Decisions under risk – maximum likelihood criteria, Expectation principle, Expected opportunity loss or expected regret decision trees.

8. Replacement Model: **03**

Replacement problem, Replacement model for items whose maintenance cost increases with time (money value constant) and with change in money value, Selection of best machine, Replacement of items that fail suddenly, Individual and group replacement policies.

9. Network Flow Models: **03**

Minimum spanning, 'free', Problem, minimum & maximum flow analysis

10. CPM/ PERT **05**

Fundamentals of CPM / PERT networks; CPM – construction of networks, critical path, forward and backward pass, floats & their significance.

PERT – Time Estimates, Construction of Networks, Probability of completing projects by given date.

Term Work

1. Any six assignments based on Numerical Problem Solving on above syllabus.
2. One Case Study on Industrial Visit
3. One Case Study on Project Planning

Books Recommended

1. R. Panneerselvam, "Operations Research", PHI (2002).
2. Hamdy Taha, "Operations Research – An Introduction", 7th edition PHI (2003)
3. Susy Philipose, "Operations Research", T.M.H. New Delhi.
4. S. D. Sharma, "Operation Research", Kedarnath and Rannalt Pub.
5. Hira and Gupta, "Operation Research", S. Chand and Co.
6. Ackoff R. L. and M. W. Saselni, "Fundamentals of OR", Willey, New York.
7. Swarop Kanti Gupta P.K. & Manmohan- OR Sultan Chand & Sons, New Delhi
8. Shrinath L.S.: PERT & CPM –Affiliate East West Press

B.E. (Mechanical) Part – I
FINITE ELEMENT METHOD

Teaching Scheme		Examination Scheme	
Lecturers:	**3 Hrs/ Week**	**Theory:**	**100 Marks**
Practical:	**2 Hrs/ Week**	**Term work:**	**25 Marks**

Section I

1. Introduction to the Finite Element Method: **03**
General theory, A simple one-dimensional element, Pin-jointed bar, Stress analysis of a stepped bar, Thermal rod, Heat conduction through wall.

2. Discritization of The Problem: **03**
Introduction, Geometrical approximations, Simplification through symmetry, Basic element shapes and behaviour, Choice of element type, Size and number of elements, Element shape and distortion, Location of nodes, Node and element numbering.

3. Interpolation Functions And Simplex Elements: **03**
Introduction, simplex, complex and multiplex elements, Linear interpolation polynomials for simplex elements, Natural co-ordinates, vector quantities, an axi-symmetric element

4. Formulation of The Elements Characteristic Matrices And Vectors For Elasticity Problems: **06**
Introduction, the variational formulation, one dimensional elasticity, two dimensional elasticity, axi-symmetric elasticity

5. Formulation of the Elements Characteristic Matrices And Vectors For Field Problems: **06**
Introduction, Formulation procedures, The variational formulation, The weighted residual method. Thermal problems, One dimensional heat transfer, two dimensional heat transfer, three dimensional heat transfer, axi-symmetric heat transfer. Torsional problems, Fluid flow problems.

Section II

6. Assembly And Solution of The Finite Element Equations: 05

Introduction, co- ordinate transformations, assembly of element equations, incorporation of the boundary conditions, solution of the equations, elimination method, penalty method.

7. Higher Order Element Formulations: 08

Introduction, Natural co – ordinates systems and numerical integration, higher order one dimensional elements – quadratic and cubic elements, evaluation of the element equations, an alternative formulation. Higher order two and three dimensional elements – iso-parametric triangular elements, iso-parametric quadrilateral elements, iso- Structural beam, plate and shell elements, convergence requirements of interpolation functions.

8. Modeling Procedures And Results Processing: 04

Introduction, model validity and accuracy, mesh design and refinement, element distortions, result processing , model checking.

9. Further Applications Of The Finite Element Method: 04

Introduction, nonlinear static elasticity problems – Material nonlinearity, Geometric nonlinearity. Buckling problems, Dynamic problems – Modal analysis, Transient response analysis, Harmonic response analysis, shock spectrum analysis, Transient thermal problems. parametric solid elements, stress and heat flow calculations.

Term Work

1 Minimum two examples of one dimensional bar element with and without using computer

2 Any two examples of two dimensional application of Heat Transfer, Fluid Mechanics, Solid Mechanics using standard software packages like – ANSYS, NISA, NASTRAN

3 Two assignments shall have problems for hand calculation

Books Recommended

1 "Introduction to Finite Elements in Engineering"; Chandrapatala, Belgundu, PHI.

2 "Concepts & Applications of Finite Element Analysis"; R. D. Cook, D. S. Malku; John Wiley & sons Publications 3/e 1989

3 "An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2

4 "Finite Element Analysis- Theory and Practice"; Longman Scientific & Technical

5 "Finite Element Method 1-2-3"; A. J. Baker; McGraw Hill International Editions, ISBN 0-07-909975-0

6 "The Finite Element Method – Basic Concepts and Linear Applications"; O. C, Zienkiewicz; McGraw Hill International Editions; ISBN 0-07-084175-6

B.E. (Mechanical) Part – I
MECHANICAL VIBRATION (ELECTIVE-I)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory:** 100 Marks
Practical: 2 Hrs/ Week	**Term work:** 25 Marks
	Oral: 25 Marks

Section I

1. Introduction: **03**

Importance & scope, Concepts & terms used, SHM, Complex method of representing vibration, Fourier series & harmonic analysis.

2. Single degree of freedom systems: **05**

Free vibrations, types of damping, logarithmic decrement, coulomb damping, and damping materials.

3. (a) Single degree of freedom systems: Forced Vibrations: **07**

Types of excitation, forced excitation, support excitation, excitation due to unbalance in machines, response due to above types of excitations, transmissibility, force transmissibility &motion transmissibility, vibration isolators, commercial isolation materials & shock mounts.

(b) Study of non-harmonic excitations.

4. Vibration Measuring Instruments **05**

Instruments for measurement of displacement, velocity, acceleration & frequency of vibration, spectral analyzers, FFT analyzer.

Section II

5. Two degrees of freedom systems: **03**

Free un-damped vibrations –

Principal modes and natural frequencies, co-ordinate coupling and principal co-ordinates.

6. Two degrees of freedom systems: **05**

Forced undamped vibrations:

Harmonic excitation, vibration,dampers & absorbers, introduction to dynamic vibration absorber – tuned & Untuned type.

7. Transient Vibration: **04**

Response of single DOF system to an impulsive step input, pulse input (rectangular & half sinusoidal), Laplace transfer method, phase plane method. (Theoretical treatment only)

8. Introduction to Numerical Methods in Vibration **08**

Holzer method, Releigh's method, matrix iteration method, introduction to F. E. M, Analysis techniques used in vibration (Eigen value analysis)

Term Work

Minimum Eight Experiments out of following list.

1. Experiment on equivalent spring mass system.
2. Experiment on forced vibration characteristics
3. Experiment on torsional oscillation of single rotor without damping
4. Determination of logarithmic decrement for single DOF damped system
5. Experiment on torsional vibration of two rotor without damping
6. Experiment on bi-filar and tri-filar suspension system
7. Study of different types of exciters for vibration analysis
8. Measurement of vibration parameters using vibration instruments
9. Exercise on numerical calculation of natural frequencies by either Holzer, Raleigh's or matrix iteration method.
10. Study of condition monitoring technique using vibration analysis

Books Recommended

1. Mechanical Vibration - G. K. Grover, Published by Nemchand & Brothers, Roorkee
2. Mechanical Vibration – Austin Church, Wiely Eastern.
3. Schaumm's Outline series in Mechanical Vibration - S. Graham Kelly
4. Mechanical Vibration - Dr. V. P. Singh, Published by S. Chand & Sons New Delhi.
5. Mechanical Vibrations - Sadhu & Singh
6. Mechanical Vibrations - Thomson
7. Mechanical Vibrations - Rao S.S. & Pearson

B.E. (Mechanical) Part – I
EXPERIMENTAL STRESS ANALYSIS (Elective I)

Teaching Scheme		**Examination Scheme**	
Lecturers:	3 Hrs/ Week	**Theory**:	100 Marks
Practical:	2 Hrs/ Week	**Term work**:	25 Marks
		Oral:	25 Marks

Course Objective:
Exposing the students to the experimental techniques of finding stress and strain, such as photoelasticity, strain gauges, moiré fringes, brittle coating methods.

Section I

1. Principles of Experimental approach: 03
Introduction to ESA, Advantages of ESA techniques, Necessity of various ESA methods, methodology of problem solving by ESA

2. Theory of Photo Elasticity: 12
(a) Introduction : Optics related to photo elasticity- Ordinary light, Monochromatic light, polarized light, natural and artificial birefringence.
(b) Stress optic law in two dimensions at normal incidence, material fringe value in terms of stress function.
(c) Polariscope – Plane polariscope, Circular polariscope, Different Arrangements.
(d) Effect of stressed model in plane polariscope – Isoclinics, Isochromatics
(e) Effect of stressed model in circular polariscope – Isochromatics
(f) Use of white light and determination of orders of isochromatic fringes seen in the circular polariscope.
(g) Fractional fringe measurement :
(i) Tardy's Method(with derivation) (ii) Babinet Soleil Method.

3. Photoelastic Materials: 03
(a) Criterion for selection of model materials.
(b) Properties of commonly employed photoelastic materials
(c) Casting technique and machining of model.
(d) Conclusions pertaining to material selection
(e) Calibration methods -circular disc, tensile specimen, beam model, Significance of material fringe value.

4. Analysis Techniques: **04**

a) Determination of direction of Principal stresses at given point
b) Determination of exact fringe order N and the principal stress difference ($\sigma 1 - \sigma 2$) at the given point.
c) Separation methods
i) Method based on Hooke's Law
ii) Electrical analogy method
iii) Oblique incidence method
iv) Shear difference method
d) Scaling model results to prototype

Section II

5. Elementary Treatment on the following: **03**

(a) Brittle coating method - merits, demerits and applications
(b) Moiré fringe method - merits, demerits and applications
(c) Birefringent coating-principle and working of reflection polariscope

6. Strain Measurement Methods : Electrical Resistance Strain Gauge **04**

Introduction, types, construction and material, Gauge factor, cross or transverse sensitivity, correction for transverse strain effect, semi-conductor strain gauge.

7. Selection And Mountings Of Strain Gauges: **02**

Grid, backing, adhesive, mounting methods, checking gauge installation, Moisture proofing.

8. Strain Gauge Circuitry: **03**

Measurement of force or load, Measurement of torque., Strain measurement of rotating shaft, Measurement of pressure or vacuum.

9. Computation Of Stresses: **06**

(a) Introduction – Analysis of strain gauge data by analytical and graphical methods.
(b) Analysis when principal stress directions are known.
(c) Analysis when principal stress directions are unknown.
i) Delta rosette
ii) Tee-rosette
iii) Four element rectangular rosette
iv) Rectangular rosette – Two and three element.

Term Work

Minimum Eight of the Following Experiments to be performed

1 Bonding of Strain Gauge and checking its installation
2 Calculation of Gauge Factor and Strain for Single and two arm bridges.
3 Calculation of Gauge Factor and Strain for four arms lateral and linear sensitive bridges.
4 Measurement by using commercial strain indicator and transducers.
5 Sheet casting and preparation of photo elastic model
6 Calibration of photo elastic model material.
7 Study of isoclinic, iso-chromatics and tardy method.
8 Separation of stresses using oblique incidence method.
9 Determination of stress concentration factor for circular ring or crank hook or plate with circular hole.
10 Study of moiré fringe technique.
11 Study of brittle coating method.

Books Recommended

1 Experimental stress analysis – Dally and Riley.-McGraw Hill
2 Experimental stress analysis – Dr. Sadhu Singh., Khanna Publications.
3 Experimental stress analysis – L.S.Srinath., Tata McGraw Hill
4 Experimental stress analysis – Dove and Adams
5 The strain gauge primer – Perry Listner.
6 Moiré fringes – Theocoris. Pergamon press limited.

B. E. (Mechanical Engineering) – Part I
PROCESS ENGINEERING (ELECTIVE – I)

Teaching Scheme:
Lectures: 3 hours /week
Practical : 2 hours / week / batch

Examination scheme:
Theory paper: (3hours): 100 marks
Term work: 25 marks
Oral: 25 marks

Course Objectives:

1. To understand Principles of planning the process for a given component.
2. To learn and design an optimum process for a given component.

Section – I

1. Introduction: **04**

a) Position of product and process engineering department in the organization.
b) Functions of Product and Process engineering
c) Documents released by product and process engineering dept.
d) Aspects for processing – job, batch and mass production.

2. Preliminary Print analysis: **02**

Details of different steps involved in part print analysis

3. Study of machining Accuracies **04**

a) Study of accuracies: Dimensional, Shape, Interrelation of surfaces, Surface Finish
b) Factors affecting accuracies
c) Process tolerances
d) Tolerance stack – types and effects
e) Tolerance charts

4. Feasibility study: **02**

a) Technical, economical and managerial aspects
b) Procedure to study feasibility

5. Selection of Sequence of Operations: **03**

a) Classification of operation
b) Factors deciding the sequence, combining and eliminating operations
c) Economic aspects of processing
d) Introduction to computer aided Process Planning

6. Method Selection: **02**

a) Study of Alternative Methods
b) Factors for Method Selection

Section – II

7. Selection of Equipment: **03**

a) Various sources of information.
b) Technical, economical and management consideration
c) Selection criteria for GPMs, SPM's, and CNCs for processing

8. Selection to Tooling: **04**

a) Technical specification of standard cutting tools and gauges required various machining operations.
b) Selection criteria for cutting tools and gauges
c) Study of special tools and gauges
d) Selection and machining data.

9. Preparation of Process sheet for machining of a component for: **05**

a) Job production
b) Mass production
c) Batch production
- Process benchmarking, Process proving

10. Time Estimation **03**

Calculation of standard time and production rates for various operation by considering various allowances.
Computer aided process planning and introduction to CAPP, CAM Softwares

11. Automated Processing **05**

a) Automated part orientation
b) Automated loading and unloading of parts
c) Automatic process control by in process gauging

Term Work

1 Process sheet for processing of a component on job basis
2 Process sheet for processing of a component on batch basis
3 Process sheet for processing of a component on mass basis.
(These exercises shall include the component on which processing on at least 3 machines must be included)
Process sheet shall include:
a) Sequence of operation indicating machine selected, holding method, machining data for each set up, Time estimation
b) Specification of gauges and inspection equipments.
c) I.S.O. or any commercial specifications of each tool.
4 Process sheet for processing of a component on Capstan / Turret lathe. It shall include :
a) A schematic detailed tool layout
b) A brief description of sequence of machining elements and their overlapping
c) Description of tools and tool holder
5 Process sheet for a component on CNC for batch production.
6 Industrial visit to study process designing and its report.

Books Recommended

1. Process Engineering for Manufacturing - Eary and Johnson (Prentice Hall)
2. AText Book of Production Engineering – P.C. Sharma (S. Chand & Co.) (Millenium edition 2000)
3. Manufacturing Engineering – H.W. Wage (McGraw Hill)
4. Workshop Technology Vol. III – Chapman (ELBS)
5. Manufacturing Technology: Principles for optimization – Daniel
6. Standard Manuals of ISO, QS, & TS, etc.
7. Manufacturing catalogues for cutting tools and inspection equipments.

BE (Mechanical) Part-I

COMPUTATIONAL FLUID DYNAMICS (ELECTIVE- I)

Teaching Scheme :	**Examination Scheme:**
Lectures : 3 Lectures / weeks	***Theory Exam.:*** 100 Marks
Practicals : 2 Hours / week	***Term work :*** 25 Marks
	Oral : 25 Marks

Course Objectives:

1. Study of basic concepts of computational fluid dynamics.
2. Application of CFD in heat transfer & fluid flow problems.

Section – I

1. Continuum hypothesis, Lagrangian & Eulerian formulation, Governing equations-continuity equation , Momentum equation, Energy equation**.** **05**

2. Boundary conditions-classification, initial & boundary value problems-finite difference schemes-forward, central & backward difference, basics of finite volume schemes, Implicit & explicit approaches. **04**

3. FDM for steady one-dimensional conduction & two-dimensional steady state problems, Transient one-dimensional problem. **05**

4. Two-dimensional Transient problems, Finite Volume formulation for ID heat transfer. Uniform & non-uniform Grids, Numerical Errors, Grid Independence test. **06**

Section – II

5. Governing Equations, Stream Function – Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar & Spalding, Computation of Boundary layer flow, Finite difference approach, Unstructured Grids for Viscous Flows. **06**

6. Steady One-Dimensional & Two-Dimensional Convection – Diffusion, Unsteady one dimensional Convection –Diffusion , Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – Solution of steady one dimensional heat conduction by FEM – Incompressible flow – Simulation by FEM. **07**

7. Turbulence, Effect of Turbulence and time averaged Navier Stokes Equation, Algebraic Models – One equation model, K-□ Models, K-W model. **03**

8. Algebraic stress model, Reynolds stress equation model, Standard and High & Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes. **04**

Term WORK :

(A) Study of CFD Software like Fluent / Star CD / ANSYS / CFX for

1. Steady state conduction in fluids
2. Steady state convection in fluids
3. Two-phase flows
4. Condensation and boiling heat transfer

(B) Any Six Assignments based on unit 1 to unit 2

Books Recommended

1. Muralidhar, K., and Sundararajan, T., " Computational Fluid Flow & Heat Transfer ", Narosa Publishing house, New Delhi,1995
2. Ghoshdasdidar, P.S., "Computer Simulation of flow & heat transfer "Tata McGrow-Hill Publishing Company ltd., 1998.
3. Subas, V.Patankar "Numerical Heat Transfer & Fluid Flow" 1980.
4. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation" Pineridge Press Ltd., U.K.
5. Anderson, D.A., Tannehill, J.I., & Pletcher, R.H., " Computational Fluid Mechanics & Heat Transfer", Hemisphere Publishing Corporation, Newyork, USA.
6. Bose, T.X., Numerical Fluid Dynamics, Narosa Publishing House, 1997.
7. H.K. Versteeg & W.Malalalsekara, An introduction to CFD, The Finite Volume Method, Addition Wesley Longman ltdal heat transfer fluid flow, Hemisphere publishing .

B.E. (Mechanical) Part – I
NANO TECHNOLOGY (ELECTIVE-I)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks
Practical: 2 Hrs/ Week	**Term work**: 25 Marks
	Oral: 25 Marks

Section – I

1) Introduction and Definition of Nanotechnology: **06**

Introduction, Definition, Length scales, Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing, The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Visions and Objective of Nanotechnology, Nanotechnology in Different Fields: Automobile, Electronics, Nanobiotechnology, Materials, Medicine, Dental care, Nanocomputers, Power storage, Nanotechnology products.

2) Latest Developments in Nanotechnology: **04**

Introduction, Current situation, Future Assumptions, Latest Developments, Nanocopters, Nanotubes, Biosensors, Nano structure fluid, Computers, Plastic electronics, Light emitting diodes, Solar cells,

3) Research & Development in Nanotechnology: **06**

Introduction ,Sensitive Areas Where R & D is Required, Nanotechnology and Future Perspectives, Current Perspectives, Research Work at a Glance, Nano pioneers, Convergence of Nanotechnology, Nanotechnology Globally Introduction, Potential Through R & D, Timelines for Beginning of Industrial Commercialization, Areas of Investments in Different Aspects in Nanotechnology, Efforts of Western Countries, Nanotechnology in Asia, Nanotechnology in India Introduction, Present Status, Basic Requirements in India, Research Areas in Nanotechnology, Promotion of Nanotechnology.

4) Ethical Issues in Nanotechnology: **04**

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology:
With Especial Reference to Nanomedicine, Nanomedicine Applied in Non-medical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical issues, Economic Impacts, Other Issues.

Section – I

5) Scanning Probe Microscopy: **04**

Scanning Tunneling microscopy, Atomic force microscopy: Operation, topography, phase imaging, nanolithography. Characterization and Particle size determination: X-ray diffraction, Transmission Electron Microscope

6) Basics of Nano Chemistry: **04**

Introduction, Self Assembly of Materials, Self Assembly of Molecules, Directing Self Assembly of Materials/ Molecules, Family of Self Assembling Materials, Porous Solids, Bio-Mineralization, Sam and Soft Lithography, Nanowires, Nanomachines.

7) Nano Particles: **04**

Introduction, Types of Nanoparticles, Pure Metal, Gold, Silicon, Silver, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles.

8) Nanotechnology applications: **04**

Applications in different areas Introduction, Nanotechnology in Industries, Nanotechnology in Computing, Quantum computing, Molecular computation, Nanotechnology in Electronics, Computational Nanotechnology, Computational optoelectronics, Mechanical Nanocomputers, Supercomputing systems, Nanotechnology in Health and Life Sciences, Nanotechnology in medicine, Drug delivery, Drug encapsulation, Tissue repair and implantation, Biorestorable materials, Other application of nano technology in health and medicine, Nanotechnology in Smart Materials, Sensors, Smart instruments- atom computers, Nanotechnology in Defense, Nanotechnology in Optics, Optical industry, Metrology, Electronics, optoelectronics and ICT, Nanotechnology in Environment.

TermWork

Any Six Assignments based upon Case study/Industrial Visits/ Syllabus Topics/Laboratory work.

Books Recommended

1. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
2. Nano Essentials- T. Pradeep/TMH
3. Springer Handbook of Nanotechnology - Bharat Bhusan

B.E. (Mechanical) Part – I
PRODUCT DESIGN (Elective I)

Teaching Scheme		**Examination Scheme**	
Lecturers:	3 Hrs/ Week	**Theory**:	100 Marks
Practical:	2 Hrs/ Week	**Term work**:	25 Marks
		Oral:	25 Marks

Section – I

UNIT I

Product Development history and product Development process tool.

Product development verses design, modern product development theories and methodologist in design. Product development teams. Product development planning, technical and business concerns. Understanding customer needs, Establishing product functions. Functional decomposition, modeling process, Function trees system functionality, augmentation. Aggregation, common basis, functional modeling methods.

UNIT II

Product tear down and experimentation, benchmarking and establishing engineering specification. Product portfolios and portfolio architecture.

Tear down process, tear down methods, post teardown reporting, benchmarking approach, support tools, setting specifications, portfolio architecture, types, platform, functional architecting, optimization selection. Product modularity, modular design.

UNIT III

Concepts and Modeling

Generation of concepts, information gathering and brain storming, directed search, morphological analysis, combining solutions. Decision making, estimation of technical feasibility, concept selection process, selection charts, measurement theory, numerical concept scoring, design evaluation scheme, concept embodiment, geometry and layout, system modeling, modeling of product metrics, selection of model by performance specifications, physical prototyping, informal and formal models.

Section - II

UNIT IV

Design for manufacturing and assembly.

Design for the environment, design for assembly, piece part production, cost analysis, environmental objectives, life cycle assessments, techniques to reduce environmental impact like minimum material usage, disassembly, recycle ability, remanufacturing, high impact material reduction, energy efficiency, regulation and standards.

UNIT V

Analytical and Numerical Solutions

Solution Definition, Spread sheet search, optimization, Analytical formulation, practical optimization, Numerical search, stopping criteria, sensitivity analysis Global optimality, product applications.

Patents and intectual property, Product Development economics.

UNIT VI

Physical prototypes, physical models and experimentation. Design for Robustner, prototype essentials, types of prototype, uses of prototype, Rapid prototyping, Scale, Dimensional Analysis and similitude, Design of experimentation Reduce tests and fractional experiments, statistical analysis, product application of experiments, statistical analysis, product application of physical modeling and design of experiments, Quality design theory, Noise variable matrix, Design variable matrix, Experimental matrix, selection of target designs, parametric design, Advance analysis : probability theory, sizing and variation, computer aided product design.

Term Work

Any SIX assignments based on above syllabus.

Books Recommended

1. Product Design & Development: Ulrich & Eppinger (2nd Edition, Mc Graw Hill – 2000)
2. Product Design : fundamentals and methods NFM Roozenburg, J Eekels, John Wiley and sons Ltd.
3. Product Design for manufacturing and Assembly Geoftry Boothroyd, peter dewhurst, Winstrn Knight Marcel Dekker Inc., USA.
4. Product Design : A practical guide to systematic methods of new product development, Mike Baxter, Champman and Hall.
5. Product Design and Manufacturing, AK Chitale; R.C. Gupta, Prentice – Hall India.
6. Product Design and Manufacture, John R.Lindbeck, Prentice Hall International Editime.
7. Product Design :Techniques in Revenue Engineering and New product development, Kevin Otto, Kristin wood Pearson Education Inc.

B.E. (Mechanical) Part – I
ROBOTICS (Elective- I)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	**Theory (3 Hrs)**: 100 Marks
Practical: 2 Hr. / Week/ Batch	**Term work**: 25 Marks
	Oral: 25 Marks

Course Objective:
To study fundamentals, analysis, applications and programming for Industrial Robots.

Section – I

1. Introduction: Basic Concepts, Robotics and Automation, Robot Anatomy, Classification, Structure of Robots, resolution accuracy, repeatability, point to point, continuous path robotic systems **02**

2. Robot Applications in Manufacturing: Material Transfer, Material Handling, Loading and Unloading. Processing operations, Assembly & Inspection , Applications in other areas: toxic, hazardous and inaccessible, service industry **06**

3. Robot Kinematics: Direct Kinematics of a manipulator, workspace. Inverse Kinematics- Exisitance of Inverse Kinematic solution, Number of Solutions,Geometric & Algebraic approaches to Inverse Kinematics, Inverse Kinematics of PUMA Manipulator. **08**

Section-II

4.**End Effectors, Sensors & Vision Systems** : End Effectors- Types of End Effectors, Mechanical Grippers, Vacuum/ Magnetic/Adhesive Grippers, Tools as End Effectors, Gripper Selection and Design
Sensors- Need of Sensors in a Robotic System, Robotic Sensors- Functional Classification, Status/ Environmental/ Quality Control/ Safety/ WorkCell Control Sensors, Types of Sensors: Sensors based on working principle, desirable features of sensors, various sensing devices used in robot workcells, sensor characteristics, selection of sensors, photo sensors, limit switches. Range sensors, Proximity sensors, Touch Sensors, Remote Centre Compliance (RCC) Device.
Vision System:Need of Vision in a Robotic System. **08**

5. Drives & Controls: Hydraulics and pneumatic actuators, electrical drives for robotics, control loops, basic control system concepts and models, control system analysis, robot activation & feedback components, Power Transmission Systems **04**

6. Robot Programming & Robot Operation: Introduction, low level and high level vision, sensing and digitizing, image processing and analysis, segmentation, edge detection, object description and recognition, interpretation, applications.
Programming for robots: Methods, robot programme as a path in space, motion interpolation, Robot Languages, Structures, WAIT, DELAY,SIGNAL commands, motion, end effecter and sensor commands, subroutines. **08**

Term Work

Minimum Six exercises from

1. Two Programming exercises.
2. Three case studies of applications in industry involving working out the scheme with type of robots, other accessories with sequence and logic.
3. Two Exercises on robotic simulation software.

Books Recommended

1. Industrial Robotics: Technology, Programming & Applications- Groover, Weiss, Nagel, Ordey (McGraw Hill)
2. Robotics: Control, Sensing, Vision & Intelligence. - Fu, Gonzalez, Lee(McGraw Hill)
3. Robotics Technology & Flexible Automation – S.R. Deb (TMH)
4. Handbook of Industrial Robotics – Ed. Shimon Y. Nof (John Wiley.)
5. Fundamental of Robotics, Analysis & Control – Robert J. Schilling (PHI)
6. Robotics for Engineers – Yoram Koren (McGraw Hill)
7. Introduction to Robotics: Analysis, Systems & Applications – Saeed B. Niku (Pearson Education)

B.E. (Mechanical) Part – I
GAS TURBINES (Elective-I)

Teaching Scheme
Lectures : 3 Hrs./ Week
Practical: 2 Hrs./ Week/ batch

Examination Scheme
Theory (3 Hrs.): 100 marks
Term work: 25 marks
Oral: 25 Marks

Course Objective:

1. Study of gas turbine cycles & their performance evaluations.
2. Study & Design of various elements of gas turbine plant.

Section – I

1. Introduction: **04**

Types of gas turbine, gas turbine v/s internal combustion engine (Diesel & Petrol Engine), gas turbine v/s steam engine, gas turbine plant component, applications of gas turbine.

2. Operating Cycles: **08**

Simple open cycle gas turbine or air standard Brayton cycle, Actual Brayton cycle, the cycle air flow rate, the cycle work ratio, optimum pressure ratio or max. cycle thermal efficiency, means of improving the efficiency & the specific output of simple cycle.
Open cycle gas turbine with regeneration, re-heating & intercooling, effects of operating variables on thermal efficiency air rate, work ratio.
Closed cycle gas turbine, the advantages & disadvantages of Closed cycle gas turbine over the Open cycle gas turbine, Semi closed cycle gas turbine.

3. a) Centrifugal Air / Gas Compressor: **05**

Principle of operation, velocity triangle, work done & pressure rise, slip factor power input factor, mach number at intake to impeller, surging.
b) Axial Flow Air / Gas Compressor: Working principle, velocity triangles, work done factor, degree of reaction, polytropic efficiency, overall performance, axial velocity work done factor, pressure rise in aerofoil blading

4. Gas Turbine Starting and Ignition System: **03**

General requirements, Types of staring manual & starter generator ignition systems – A.C. & simple D.C. & opposite polarity D.C. system.

Section – II

5. Gas Turbines: 08

Impulse & reaction types, axial & radial types, impulse turbine with losses, turbines mechanical efficiency & overall efficiency, theory of impulse turbine & reaction turbine, no. of stages & limitations blade clearance & blade passage area

6. Combustion Chambers & Fuels: 07

Types, comparison requirements of Combustion Chambers, combustion process, pressure loss & pressure loss factor, flame stabilization, Requirements / desirable properties of fuel used in gas turbines, types of fuel solid, liquid, gasses & there characteristics.

7. Matching of Components: 03

Performance curves, dimension less groups, linking of components. Equilibrium points & procedure.

8. Materials for Gas Turbines: 02

For wheel, blades, sheet metal parts, combustion chamber liners etc.

Term Work

Minimum 10 out of following list

01 Study of open, closed & semi open gas turbine power plant
02 Trail on simple gas turbine power plant
03 Study of construction & working of centrifugal air compressor
04 Study of construction & working of axial flow air compressor
05 Study of combustion chamber
06 Study of impulse gas turbine
07 Study of reaction gas turbine
08 Study of axial flow gas turbine
09 Study of radial flow gas turbine
10 Study of fuels supple system used in gas turbine
11 Study / Trial on open cycle / closed cycle gas turbine with regeneration / reheat / inter cooling (any one)
12 Study of gas turbine starting
13 Study of gas turbine ignition system

Books Recommended

01 'Gas Turbine & jet Propulsion' by J.K. Jain
02 'Steam Gas Turbine & Power Plants' by R. Yadav
03 'Gas Turbine' by S.R. Khajuria & S.P. Dubey
04 'Gas Turbine Theory' by H. Cohen, G.F.C. Rgers & H.H.H. Saravanamutto
05 'Gas Turbine & Jet Rocket Propulsion' by M.L. Mathur & R.p. Sharma
06 'Steam & Gas Turbine' by A. Kostxuk 7 V. Frolov
07 'Thermal Engineering' by R.K. Rajput
08 'Hydraulics & Compressible Flow Turbomachines' by A.T. Sayers
09 'Gas dynamics & Jet Propulsion' by Dr. S.L. Somasundaram
10 'Gas Turbine' by V. Ganeshan

B.E. (Mechanical) Part – I
PROJECT WORK - I

Teaching Scheme	**Examination Scheme**
Practical: 4 Hrs/ Week	**Term work**: 25 Marks

Course Objectives:

1. Application of the knowledge gained to practical situations.
2. Develop the technical problem solving ability.

Guidelines for Project content & Mark Distribution:	**Marks**
a. Project selection & Project plan	10
b. Synopsis	05
c. Work Diary	05
d. Presentation (Internal) of work carried out	05

Project Term Work:

The term work under project submitted by students shall include

1. Work Diary details:

Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for
1. Searching suitable project work
2. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the project.
3. Brief report of feasibility studies carried to implement the conclusion.
4. Rough Sketches/ Design Calculations, etc.

2. Synopsis:

The group should submit the synopsis (of 4-5 pages) in following form.
1. Title of Project
2. Names of Students
3. Name of Guide
4. Proposed work (Must indicate the scope of the work & weekly plan up to March end)
5. Approximate Expenditure

The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department.

3. Presentation:

The group has to give a power point presentation in front of the faculty of department on the synopsis.

B.E.(Mechanical) Part-I
VACATIONAL TRAINING

Teaching Scheme :
Practical : 1 Hours / week

Examination Scheme:
Term work : 25 Marks
Oral : 25 marks

Course Objectives :-

1. To make the students aware of Industrial culture & Organizational setup.
2. To create awareness about technical report writing among the student.

Procedure for Assessment of Vacational Inplant training done by student

- Every student should prepare a report of training done (minimum 15 days) in a prescribed format before end of Part I Semester.
- Format of the report will be decided by the concerned faculty.
- The report shall be comprehensive and presented in duplicate, typed on a standard A4 size sheet and bound.
- Every student should give presentation on training performed.
- Assessment of term work will be done on the basis of presentation, report & internal viva.
- The University oral examination will be based on the term work.
- Guidelines for conducting vacational training practicals :

Week No.	Task to be performed
1	Introduction of activities to be performed during the term
2,3,4	Assessment of draft reports & guidelines for improvements
5,6,7	Finalisation of report
8,9,10,11	Presentation of training performed
12,13,14	Internal viva & submission

B.E. (Mechanical) Part – II
REFRIGERATION AND AIR CONDITIONING

Teaching Scheme
Lectures : 3 Hrs./ Week
Practical: 2 Hrs./ Week

Examination Scheme
Theory Paper (3 Hrs.): 100 marks
Term work: 25 marks
Oral: 25 Marks

Course objective:
1. Study of basic refrigeration cycles and Psychrometry.
2. Refrigeration and Air Conditioning Systems Performance Evaluation

Section – I

1. a) Basic Refrigeration Cycles: 06
Refrigeration, Units of Refrigeration, Reversed Carnot cycle, Bell-Colemon cycle, Simple vapour compression cycle, Sub cooling, Super heating, liquid suction vapour heat exchanger, Calculations & performance of above cycles, Actual vapour compression cycle.
b) Air Refrigeration systems for Air Craft Refrigeration – simple system, Boot strap system, Regenerative system, Reduced ambient system (Descriptive Treatment)

2. Multipressure systems : 03
Introduction, Multistage compression, Flash gas removal, flash intercooling, complete multistage compression system, Multi evaporator systems, Cascade systems (Descriptive Treatment)

3. Refrigerants: 03
Classification , Desirable properties, Nomenclature of refrigerants, Comparison between commonly used refrigerants, Selection of refrigerant, Secondary refrigerants, Effect on ozone depletion & Global warming, Total equivalent warming impact (TEWI), Alternative refrigerants.

4. Vapour Absorption System: 04
Simple aqua-ammonia vapour absorption system, Practical aqua-ammonia vapour absorption system, Comparison between vapour absorption & vapour compression systems, Lithium Bromide absorption refrigeration systems, Electrolux refrigerator. Elementary idea of refrigerant-absorbent mixtures, Temperature-concentration diagram, enthalpy-concentration diagram. (Descriptive Treatment)

5. Refrigeration Equipments: 03
Types of Compressor, Condenser, Evaporator & Expansion devices.

Section – II

6. Psychrometry: 07

Moist air as a working substance, Psychometric properties of air, Use of psychometric tables & charts, Processes, Combinations & calculations, ADP, Coil condition line, Sensible heat factor, Bypass factor, Air washer & it's applications.(Numerical Treatment)

7. Comfort: 02

Thermal exchange between human body & environment, Factors affecting comfort, effective temperature comfort chart, Ventilation requirements.
(Theoretical Treatment)

8. Heating & Cooling Load Calculation: 07

Representation of actual air conditioning process by layouts & on Psychometric charts, Load analysis RSHF,GSHF, Enumeration & brief explanation of the factors forming the load on refrigeration & air conditioning system.
(Numerical Treatment)

9. Air Distribution System: 03

Re-circulated air, Ventilation air, Dust work, Use of friction loss & rectangular equivalent of round duct chart, Duct system, Principle of duct sizing & air distribution, it's norms, diffusers, dampers, layout, duct systems for theaters, auditorium, hospitals, assembly shop, cold storage etc.
(Theoretical Treatment)

Term Work

Group I

(Study, Demonstration & minimum five assignment on following topics)

01 Study of Refrigeration tools
02 Study of Refrigeration methods
03 Study of Refrigeration systems – domestic refrigerator, Split air conditioning, Ice plant, Deep freezer etc.
04 Study of food preservation, Methods of food freezing
05 Study of charging, leak testing of refrigeration systems
06 Study of non conventional refrigeration systems

Group II

(Minimum three experiment on following list)

01 Trial on Refrigeration primer / bench
02 Trial on Air conditioning tutor
03 Trial on mini ice plant
04 Trial on Vapour Absorption system
05 Trial on Heat Pump

Group III

Visit to refrigeration plant or Central Air conditioning plant

Books Recommended

01 'Refrigeration & Air Conditioning' by C.P. Arora
02 'Refrigeration & Air Conditioning' by Arora & Domkundwar
03 'Refrigeration and Air-conditioning' by Manohar Prasad
04 'Principle of Refrigeration' by Roy J Dossat
05 ' Air Conditioning principles & systems' by Pita
06 ' Air Conditioning Applications & design' by W.P. Jones
07 'Refrigeration & Air Conditioning'by Stocker

B.E. (Mechanical) Part – II
INDUSTRIAL & QUALITY MANAGEMENT

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks
Practical: 2 Hrs/ Week	**Term work**: 25 Marks
	Oral: 25 Marks

Course Objective :

1. To give the students an overview of the general functions of Management applicable to industrial & other organizations
2. To give insight to the philosophy & techniques of quality management applicable to manufacturing & service sectors

Section I

1. Introduction To Management: **02**

Nature & purpose of Management. System approach to Management, Function of Managers. Social responsibility & Ethics in Managing.

2. Functions of Management I : **06**

*Planning: Meaning, Types of plans, steps in planning, planning process, decision making.
*Organizing: Nature & purpose of organizing, Organization structure, Span & levels, Departmentation, Line & Staff authority & decentralization.
*Staffing: Definition, Human resource management & selection, Performance appraisal, Training & development.

3. Functions of Management II : **04**

*Leading: Human factors in managing, Motivation, Theories, 'Carrot & Stick' Hierarchy of needs, leadership, styles, communication, process.
Types- oral, written & nonverbal.
*Controlling: Process of controlling, control techniques- budget.

4. Basic Departments in Industrial Organization I : **04**

*Introduction to various enterprises functions – production operations, Marketing Finance & Human resources.
*Marketing management: nature & functions of marketing, distribution, selling & communications.

5. Basic Departments in Industrial Organization II : **04**

*Financial Management: Nature & functions of finance. Long term & short term Capital needs, sources of finance.
*Production/ operations management: Nature & function of production, Pre-production planning, Production planning & control, Materials management, Maintenance, Industrial safety.

Section II

Quality Management

6. Introduction: **06**

Definition of Quality, Elements of Quality, quality functions,
Quality Planning- Policy, quality specifications. Quality of design & of conformance factors affecting, quality control, quality cost & its control.
Total Quality Management:
Quality Gurus, Costumer satisfaction, continuous process improvement, employee involvement, supplier partnership.

7. Tools of quality control: **04**

Various tools of quality control, Check sheets, graphs, Pare to analysis, cause & effect diagram, Scatter diagram, Control charts,
simple numerical problems

8.Statistical Process Control: **04**

Statistical process control, statistical concepts, control charts for variable & attributes, Construction, interpretation & applications of $\bar{x}$,R,P & C charts, numerical problems.

9.Acceptance sampling: **04**

Types of inspection, sampling & cent percent inspections,
Sampling plans- types single & double, Operating characteristic curve,
Producer & consumer risks, Numerical problems.

10.Quality management Systems: **02**

ISO 9000 series of standards. ISO 9001 requirements,
Introduction to ISO 14000 Series of standards.

Term Work

Minimum 8 assignments based on each topic out of which 2 case studies related to industry / establishments.
Assignment should include seminar, visit report, survey, analysis & numerical problems, etc.

Books Recommended

1. Essentials of Management – Koontz Weihrich By TMH
2. Principles of Management & Administration – D. Chandra Bose. PHI
3. Principles of Management – Tripathy, Reddy by TMH
4. Total Quality Management – Besterfield & Others PHI
5. Statistical Quality Control – M. Mahajan, Dhanpatrai & co.
6. Statistical Quality Control – E.L. Grant & Leavenworth, TMH edition

B.E. (Mechanical) Part – II

MECHATRONICS

Teaching Scheme:
Lectures*:* 3 Hrs/Week
Practical: 2 Hrs/Week

Examination Scheme:
Theory: 100 Marks
Term work: 25 Marks
Practical & Oral: *25 Marks*

Section -I

1. Introduction: **04**
What is Mechatronics?, Systems, Measurement Systems, Control Systems, Microprocessor based systems, The Mechatronics Design Process,The Mechatronics approach.

2. Sensors and Transducers: **04**
Sensors for Motion and Position Measurement, Force,Torque, and Tactile Sensors, Flow Sensors, Temperature Sensors, Ultrasonic Sensors,Range Sensors, Fiber Optic Devices in Mechatronics.

3. Signal Conditioning Devices: **04**
Signal Conditioning, Operational amplifiers, Filtering, Wheatstone bridge, ADC, DAC, Multiplexers, Data Acquisition, Digital Signal Processing.

4. Actuators: **06**
Mechanical actuators-cams,gear trains,ratchet and pawl, belt and chain drives Electrical actuators- D.C.Motors, A.C.Motors, Stepper Motors, Mechanical Switches, Solenoids,Fluid Power actuators-Pneumatic and hydraulic systems, Directional Control Valves,Pressure Control Valves, Cylinders, Process Control Valves.

5. Hardware Components for Mechatronics-I **04**
Number systems, Logic Gates, Boolean algebra,Karnaugh Maps. Microprocessors-architecture of 8085,Registers,Memory,Input-Output Devices.

Section – II

6. Hardware Components for Mechatronics-II **04**
Microcontrollers-Block Diagram,Architecture of 8051,Applications-Temperature Measurement, Domestic Washing Machine.

7. Hardware Components for Mechatronics-III **04**
Programmable Logic Controllers(PLC)-Architecture of PLC,Input/Output, Input/Output processing, Ladder Diagrams,Logic functions,Latching, Sequencing,Timers, Internal relays and counters, Simple application examples.

8. Real Time Interfacing: **04**

Interfacing, Input/Output addressing,Interface requirements,Peripheral interface adapters,Serial communications interface, Examples of interfacing.

9. Communication Systems: **04**

Digital communications,Centralised,hierarchical and distributed control,Networks,Protocols,Open Systems Interconnection model,Communication interfaces.

10. Advanced Applications in Mechatronics: **04**

Sensors for condition monitoring,Mechatronic control of Automated Manufacturing, Artificial Intelligence in Mechatronics, Fuzzy Logic Applications in Mechatronics, Microsensors in Mechatronics, Roborics.

Term Work

1. One Assignment on Introduction to PLC.
2. Three Assignments on PLC Programming examples for simple applications.
3. One Assignment on Microprocessor.
4. Two assignments on Microprocessor Applications.
5. One Assignment on Microcontroller.
6. Assignments on Case studies of Mechatronic Applications

Books Recommended

1. "Mechatronics System Design", Devdas Shetty, Richard A.Kolk,Brooks/Cole(Cengage Learning),ISBN-10:81-315-0119-1.
2. **"**Mechatronics**",** Third Edition,W. Bolton,Pearson Education.
3. **"**Mechatronics**",** Mahalik N.P., TMH Publishing,ISBN-10: 0-07-048374-4.
4. **"**A Textbook of Mechatronics**",** R.K.Rajput, S.Chand, ISBN; 81-219-2859-1.
5. Introduction to 8085- Gaonkar.
6. Introduction to PLC- Gary Dumming- Delmar Publications.
7. Process Control Instrumentation Technology, Wiley,New York.
8. Mechatronics,1993,Hewit, J.R., Springer-Verlag, New York.

B.E. (Mechanical) Part – II
AUTOMOBILE ENGINEERING (Elective II)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory:** 100 Marks
Practicals: 2 Hrs/ Week	**Term work:** 25 Marks
	Oral: 25 Marks

Course Objective :
To provide an introduction to the basic principles and methods of automobile performance analysis. To provide practical exercises to strengthen the student's knowledge of automobile components. To make students aware about the entrepreneurial opportunities in automobile engineering field.

Section – I

1. Classification of Automobiles: **04**
Broad classification of Automobiles. Major Components and their functions. Types of vehicle layouts, Front engine rear wheel drive, Front engine front wheel drive, All wheel drive, Types of bodies, Body construction and materials,

2. Automobile Power Plants: **03**
Requirements of automotive power plants. Comparison and suitability considerations. Types and special features of automotive engines, Fuel cells, Electric vehicles-Layout, advantages and limitations.

3. Performance of Automobiles: **04**
Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Grade ability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for vehicle propulsion, Selection of gear ratio, Rear axle ratio. (Numerical)

4. Clutch: **03**
Automobile clutch requirements, Types & functions, Single plate, Multiplate, Centrifugal, Electromagnetic & Fluid clutches.

5. Transmission: **06**
Requirements, Types of automotive gearboxes, Working of sliding mesh, Constant mesh and synchromesh gearbox, Overdrive, Principle of operation of automatic transmission, Torque converter, Epicyclic gear trains, Propeller shaft, Universal and slip joint, Final drive and its types, Differential, Construction and types of rear axles.

Section – II

6. Steering System: **05**

Function of steering, Steering system layout, Automotive steering mechanism- Ackerman and Davis, Types of steering gear boxes, Condition for true rolling, Steering geometry-Camber, Caster, King pin inclination, Included angle, Toe-in and Toe-out, Wheel alignment, Slip angle, Under steer & over steer, Types and working of power steering,.

7. Braking System: **05**

Function of automotive brake system, Types of braking mechanism ,internal expanding & Disc brake, Mechanical, Hydraulic& Air brake system, Servo and power brakes, Anti lock and antiskid braking, Calculation of braking force required, stopping distance and dynamic weight transfer.(Numerical)

8. Suspension Systems: **04**

Suspension requirements, Sprung and Un sprung mass, Types of automotive suspension systems. Conventional and Independent, Shock absorber, Types of springs, Hotch- kiss and Torque tube drive, Reaction members-Radius rod, Stabilizer bar, Air suspension system.

9. Electrical System: **04**

Automotive batteries, Automotive lighting system. Starting system, Charging system, Voltage and current regulator, Electric horn, Dash board gauges, Wiper & side indicator circuit, Engine electronic control modules, Safety devices.

10. Two Wheelers And Three Wheelers **02**

Distinguishing features and general layout of two wheelers and three wheelers.

Term Work

Minimum seven experiments from Group A and one experiment from Group B are to be performed

Group A.

1. Study and demonstration of four wheeler chassis layout. Two-wheel & fourwheel drive layouts.
2. Study and Demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gearbox.
4. Study and demonstration of final drive and differential.
5. Study and demonstration of working Hydraulic braking system.
6. Study and demonstration of front wheel steering geometry and steering mechanism.
7. Study and demonstration of suspension system of a four-wheeler.
8. Study and demonstration of battery, electrical charging system.
9. Study and demonstration of electrical starting system
10. Study and demonstration of a] D. C. Electric horn.
    (a) Electric Fuel Gauge
    (b) Electric fuel Gauge.
    (c) Flasher unit.
    (d) Wiper circuit

Group B.

1. Experiment on wheel balancing & front wheel alignment.
2. Visit to servicing station for study of vehicle maintenance, repairs and report.

Books Recommended

1. Automobile Engineering; G. B. S. Narang
2. Automobile Mechanics; N. K. Giri
3. Automobile Electrical Equipment; P. S. Kohali
4. Motor Vehicle; Newton & Steeds
5. Automobile Engineering; Course
6. Motor Vehicle; Ketts.

B.E. (Mechanical) Part – II
PRODUCTION MANAGEMENT (Elective II)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks
Practical: 2 Hrs/ Week	**Term work**: 25 Marks
	Oral: 25 Marks

Section – I

1. Introduction: **04**

The role of production/operations, Definition, scope and objectives of Production/operations Management. Types of processes, Project jobbing, batch, continuous, Types and characteristics of manufacturing systems, service system.

2. Forecasting: **03**

Need, Definition and types of: Qualitative methods- Delphi, market research survey,Quantitave techniques- moving averages, exponential smoothening, regression analysis, accuracy of Forecasting.

3. a) Capacity Planning: **05**

Definition measurement and measures, factors influencing capacity- strategies for modifying capacity on short and long term basis. . Investment decisions and replacement analysis Make or buy flexibility

b) Aggregate planning concept strategies, evaluation of strategic alternatives,economics of scale, predicting future requirements

4.Production Planning: **04**

System concept, quantities batch size, routing- line balancing, scheduling & sequencing.

5. Production Control:- Definition and types of, **04**

Dispatching: - job orders and issue systems, dispatching rules
Progressing: - follow up, feedback, corrective actions, expediting
Coordination: - Interrelationship of PPC with other depts.

Section – II

6. Inventory Management: **06**

Inventory concepts, functions, costs, types of inventary, economic batch quantity, ABC analysis, supply chain. MRP. Material requirement planning logic. MRP system. Purchasing- EOQ, basics with & without shortage.

7. Plant Maintenance: **04**

Principles, preventive break down, TPM, Predictive.
Principles, need, policies and objectives, Types of maintenance,
Reliability and life testing, TPM.

8.Material Handling Systems: **03**

Definition, Principles of, types of, selection criteria and methods, economics of.

9. Advanced Manufacturing Systems: **03**

Japanese system, IT Kanban Toyota Prod System.
Computer aided production management systems

10. Other aspects Expediting:- **04**

Systems approach, supply chain management, rejection analysis, human factors in Prod. Management

Term Work

Minimum eight case studies or assignments based on all topics.

Books Recommended

1. Adam EE, RJ Ebert Production & operation management- Prentice Hall englewood Cliff, N.J.
2. Riggs J.L., Production System – planning, Analysis and control, - John Weily and Sons, NewYork.
3. Buffa ES Modern production & operation management, willy, NY
4. Barry Shore – Operation Management – Mc Graw hill, NY
5. Samuel Eilon – Production planning and control. Book Company, New York.
6. Terry Hill – prod/operation management.- prentice Hall
7. Sushanta tripathy – operatio management Scitech Pub.
8. James Dilworth- production & operation Management – McGraw Hill co, NY.
9. Joseph Monks Operation Management Theory and Problems, McGraw Hill

B.E. (Mechanical) Part -II
MATERIALS MANAGEMENT (Elective II)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks
Practical: 2 Hrs/ Week	**Term work**: 25 Marks
	Oral: 25 Marks

Course Objectives :

1. Study of fundamental concepts of Material Management
2. Study of applications of various techniques in Material Management

Section –I

1. Materials Management: **05**
Definition, scope, objectives, functions, Integrated materials management, organization of Materials Management- centralized and decentralised.
Duties and responsibilities of materials manager.

2. Materials Planning: **03**
Definition, Advantages, Factors influencing, bill of material, MRP.

3. Inventory Management: **05**
Basic concepts, objectives, need, types and classification. Inventory costs, EOQ- Different models (basic model without shortage, with shortage, quantity discount with single price break), ABC analysis.

4. Recent trends in Inventory Management : **03**
JIT concepts & tools**,** KANBAN

5. Make / Buy decision : **02**
Financial & manufacturing aspects

Section – II

6. Purchasing: **04**
Objectives, purchasing cycle, principles of purchasing, Vendor selection- factors and rating. Price determination –Basis & factors responsible

7. International Buying and import purchasing: **03**
Need, classification, Preliminary formalities, licensing procedure, typical problems encountered.

8. Physical distribution System: **04**
Logistics, ware house management, SCM- Supply Chain Management(introductory).

9. Stores Systems: **05**

Various functions of store, organization of store, classification and identification of items, stores location and layout, receipt and issue systems like –LIFO, FIFO, two-bin system. Storage equipments like racks, stacks, bins ,pallets, trolleys and forklifts.

10. Measuring Material Management performance : **03**

Measuring performance of materials manager, method and criteria of evaluation.

(Numerical treatment on chapter No. 3 & 6 only)

Term Work

One assignment / case study on each topic (Total 8 to 10).

Books Recommended

1. Materials Management- Dean Ammer- Taraporwala Sons & Co,Ltd.
2. Purchasing and Materials Management – P. Gopalkrishnan – TMH
3. Materials Management- Procedures, text, Cases – A.K.Datta.Prentice Hall of India
4. Materials Management- K.K.Ahuja- CBS Publishers Delhi
5. Introduction to Materials Management- Tony Arnold & Chapman.
6. Manufacturing Resource Planning (MRP II) with Introduction to ERP, SCM and CRM – Khalid Shekh
7. An integrated concept om M.M. – N.M. Shah –TMH
8. Purchasing Management -J.H.westing- John Wiely & Sons.

B.E. (Mechanical) Part – II
COST ESTIMATION & COST CONTROL (Elective II)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks
Practical: 2 Hrs/ Week	**Term work**: 25 Marks
	Oral: 25 Marks

Course Objective:
Study of various aspects of cost estimation & cost control & its applications in industry.

Section – I

1. Introduction: **04**
Concept of cost, cost unit, cost centre, elements of cost- Prime cost, factory cost, cost of production, total cost.
Cost estimating : Definition, purpose, Functions of estimation, Organization of estimating department, role of estimator , constituents of project,/product/customers order estimator, estimating procedure.

2. Estimation of Weight & Material cost : **04**
Process of breaking down product drawing into simpler parts or shapes. Finding out volumes along with the review of mensuration, Review of purchasing, receiving, issuing, recording of stock & consumption of material.

3. Estimation of time for Machining: **04**
For common machining processes carried out on lathes, drilling, milling, boring & grinding machines. CNC machines & machining centers. Consideration for parameter like length of cut, no. of cuts, cutting speed, feeds, setting / handling time & allowances for standard time calculations.

4. Machine Hour Rate Determination: **04**
Constituents, Direct cost, depreciations.

5. Estimation of costs: **04**
For other manufacturing processes such as fabrication, welding, forging & foundry.

Section – II

6.Costing & Cost Control: **04**
Definition of costing, cost price profit equation. Role & objectives of cost accounts.
Desirable conditions for a costing system.
Labour cost – Direct & indirect labour, Workmen classification, Definition of wages, Methods of remuneration.

7. Overheads: **06**

Elements of overheads, Classification based on time when computed, degree of averaging, behavioral in relation to fluctuation in volume, functional management, ease of traceability or controllability, Time of charging against revenue, methods & general considerations for : collection, analysis, allocation, apportionment, absorption of overheads.

8. Cost accounting methods: **06**

a) Job costing, factory job costing, contract cost.
b) Unit costing: Output and operating costing.
c) Process costing: Normal & abnormal losses, abnormal gains, waste, scrap, by-product.

9. Cost Control : **03**

Use of cost data for policy making & routine operation, control techniques such as budgetary control, standard cost, variance analysis, marginal cost and break even analysis.

10. Cost reduction: **03**

Areas, Procedures and systems in product, methods and lay outs, administrative and marketing, rejection analysis and value analysis & value engineering.

Note : Numerical treatment to all topics except chapter 1 & 10

Term-work

Note : Use of computer is essential for at least one exercise.
1. Estimation of weight and material cost for an assembly of three to five components.
2. Estimation for machine hour rate for representative machines – One conventional machine and
   one CNC lathe or machining center.
3. Time estimation for machining cycle for two components involving variety of processes.
4. Case study on estimation of overheads for a manufacturing unit.
5. Process costing of two components – one on conventional machine and one on CNC machine.
6. Costing of two components one each on casting & fabrication process.

Books Recommended

1. Principles & practice of Cost Accounting – N.K. Prasad – Book Syndicate Pvt. Ltd.
2. Costing Simplified: Wheldom Series – brown & Owier (ELBS)
3. Cost Accounting: B. Jawaharlal (TMH)
4. Cost Accounting: R.R. Gupta
5. Cost Accounting: 13/e – B.K. Bhar, Academic Publishers, Kolkata
6. Cost Accounting: Jain, Narang –Kalyani Publishers
7. A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G.S. Narang – Satya Prakashan.
8 .Theory & Problems of Management & Cost Accounting – M.Y. Khan, P.K. Jain –TMH.

B.E. (Mechanical) Part – II
TOTAL QUALITY MANAGEMENT (Elective II)

Teaching Scheme	**Examination Scheme**
Lecturers: 3 Hrs/ Week	**Theory**: 100 Marks
Practical: 2 Hrs/ Week	**Term work**: 25 Marks
	Oral: 25 Marks

Course Objectives:
To study the philosophy & techniques of Total Quality Management applicable to manufacturing & service sector

Section – I

1. Introduction to Total Quality Management: **04**
Definition, Basic Approach, Historical Review, Quality Gurus, Benefits of Total Quality Management, Role of Leadership, The Deming Philosophy, Quality Statements, Strategic Planning, Implementation of Total Quality Management, Quality in Service Sector.

2. a. Customer Satisfaction: **03**
Customer Perception of Quality, Feed Back, Complaints, Customer Retention.

b. Employee Involvement: **03**
Motivation, Empowerment, teams, performance appraisal, quality circle

3.Continous Process Improvement: **04**
Process, Juran Triology, PDSA Cycle, Problem Solving Method, Kaizen, Re-engineering, Six Sigma.

4. Supplier Partnership: **03**
Principles, Partnering, Sourcing, Supplier selection, Certification & Rating.

5. Performance Measures: **03**
Concepts, Strategy, Presentation, Quality Costs, Optimization of Quality Cost.
(Numerical treatment)

Section – II

6.Quality & Environment Management Systems: **04**
Introduction, ISO 9000 series of standards. Sector Specific Standards. ISO 9001 requirements. Implementation, Documentation, Internal Quality, Registration, ISO 14000 series of standards, Organization & Product evaluation standards, Concept of ISO 14001

7. Tools of Quality: **03**
Check sheets, Flowcharts, Graphs & Histograms, Pareto Diagrams, Cause & Effect Diagrams, Scatter Diagrams, Control Charts, Applications. (Numerical treatment)

8.Statistical Process Control: **03**

Control charts for Variable & Attributes, Process capability analysis, Applications, Acceptance sampling : concept, various sampling plans, OC curve, applications
(Numerical treatment)

9.Other Techniques I : **06**

Benchmarking, Concept, Process, Planning, Evaluation, Quality function Deployment,- Concept, Team, House of Quality, Process.
TPM- Total Productive Maintenance- Introduction, Process.
Management Tools-Introduction, Various Tools, Experimental Design- Introduction.

10. Other Techniques II : **04**

Failure Mode & Effect Analysis :
Introduction, Reliability, Failure Rate, Design Failure Mode & Effect Analysis, Process Failure Mode & Effect Analysis.
Taguchi's Quality Engineering :
Introduction, Loss Function, Types, Calculations, Orthogonal Arrays, Signal to Noise ratio, Parameter, Design, Tolerance Design.
(Numerical treatment)

Term-work

Minimum 8 assignments based on each topic out of which 2 case studies related to industry / establishments.

Books Recommended

1 "Total Quality Management" - Dale H. Besterfield & Others,Pearson Education
2 "Total Quality Management"Ansu Paul,.
3 Total Quality Control - Feigenban - McGraw Hill Book Company, New York
4 Statistical Quality Control - E.L. Grant & Leavenworth, TMH edition
5 " Fundamentals of Quality Control and Improvement" Amitava Mitra, Pearson Education
6 Statistical Quality Control – M. Mahajan, Dhanpatrai & co.
7 ISO9000 Quality System – Dalela

B.E.(Mechanical) Part-II

MATERIAL HANDLING SYSTEMS (ELECTIVE- II)

Teaching Scheme :
Lectures : 3 Hrs / weeks
Practical: 2 Hours / week

Examination Scheme:
Theory Exam.: 100 Marks
Term work : 25 Marks
Oral Exam.: 25 Marks

Course Objectives:

1. To study material handling equipment
2. To design material handling System

Section – I

1. Introduction – **04**

Principles of material handling, Objective & benefits of better material handling, material hansdling and plant layout, concepts of unit load, containerization and palletisation.

2. Material handling Equipments and Systems for Various Materials -

a) Storing equipments like pallets, bins, racks, decking, order picking, positioning equipments. **03**

b) Hoisting equipments like jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes & elevators. **03**

c) Conveying equipments like belt, chain, roller, wheel, trolley, tray conveyors, gravity & vibratory type conveyors, screw conveyors. **03**

d) Mobile equipments like hand trucks, fork lift trucks, powered industrial trucks and tractors, powered stackers, reach trucks, order pickers. **03**

3. Material Handling in CIMS – **03**

Need, Comparison with conventional syatems,Equipment like industrial robots and automatically guided vehicles etc.

SECTION –II

4. Material Flow – **03**

Operation sequence, material flow pattern, stages of material flow at receiving, in process and at shipping, flow planning criteria & design of flow pattern.

5. Selection of Material Handling Equipment – **10**

Factors affecting selection of material handling equipment, Material handling equation, Choices of Material Handling Equipment, General Procedure for Selection, Basic Analytical techniques, Selection of suitable types of material handling systems , Functions and Parameters, affecting service, packing and storage material, Selection of Material Handling Equipment in Green Sand Moulding Foundry, Sugar Manufacturing Industry.

6. Safety & Training – **02**

Need, Environmental and human factors in material handling, Safety Regulations

Term Work:

1. Plant layout consideration
2. Material flow analysis
3. Storing equipment
4. Hoisting equipment
5. Conveyor equipment
6. Mobile equipment
7. Selection of M.H. equipment & safety aspects
8. Industrial visits & its report.

Books Recommended

1. Material Handling - Immer J. R. (McGraw Hill)
2. Plant Layout & Material Handling - James Apple (John Wiley)
3. Material Handling System Design - James Apple ((John Wiley)
4. Material Handling Principles & Practice - Theodore H. Allegre Sr. (CBS Publishers & Distributors)
5. Material Handling- John R. Immer- McGraw Hill Co. Ltd., New York
6. Work Study - O. P. Khanna (Dhanpatrai & Sons)
7. Work Study – I. L. O.

B.E.(Mech.) Part- II
Reliability Engineering (Elective – II)

Teaching Scheme:
Lectures: 3 Hrs. per week.
Practical: 2 Hrs. per week

Examination Scheme:
Paper: 100 marks
Term Work: 25 marks
Oral: 25 marks

Course Objectives:

1. To create awareness about working and availability of product/system as and when required and the working to its fullest capacity & efficiency to the satisfaction of the end user.
2. To make students aware about the failures, maintainability and availability of the intended products/systems and services.

Section - I

1. **Probability Theory:** **03**
   Laws of probability, Total probability theorem, Probability distributions : binomial, normal, weibull, exponential, Standard deviation, Variance, Skewness coefficient, chebyshev inequality, central limit theorem.

2. **Fundamental Concepts:** **06**
   Reliability definitions, Failure, Failure density, Failure rate, Hazard rate, Mean time to failure, Mean time between failure, Maintainability, Availability, pdf, cdf, Safety and reliability, Quality, Cost and system effectiveness, Life characteristic phases, Mode of failure, Areas of reliability, Quality and reliability assurance rules, Product reliability, Importance of reliability.

3. **Reliability Prediction and Modeling:** **08**
   Series, Parallel, Mixed configuration, k out of n structure, Complex systems – enumeration method, Redundancy, Element redundancy, Unit redundancy, standby redundancy - types of standby redundancy, Simulation , Markov analysis, Monte Carlo Simulation.

4. **System Reliability Analysis:** **03**
   Reliability allocation or apportionment, reliability apportionment techniques, Reliability block diagrams and models, development of functional reliability block diagram.

Section - II

5. Reliability in Design: 08

Quality function deployment, Design analysis methods, Failure mode effects analysis(FMEA), Severity/Criticality analysis, Failure mode effects and criticality analysis (FMECA), Fault tree construction, Basic symbols, Fault tree analysis(FTA), Fault tree evaluation techniques.

6. Reliability of Mechanical Components & Systems: 06

Introduction, Strength degradation – fatigue, wear, corrosion, Materials, Components, Processes, Reliability testing.

7. Reliability in Manufacturing: 03

Introduction, Control of variation: Production, Human parameters, Acceptance sampling Failure reporting and analysis, Improving the process

8. Maintainability and Availability: 03

Objectives of maintenance, Types of maintenance, Maintainability, Factors affecting maintainability, system down time, Availability – inherent, achieved and operational availability, Reliability and maintainability trade off, Reliability centered maintenance.

Term-Work

A. Five Assignments:

1. Introduction and Probability Analysis
2. Theory of Reliability and Concepts
3. Reliability Prediction and Analysis
4. Reliability in Design
5. Reliability in Manufacturing

B. Three Case Studies:

1. Reliability Analysis of Mechanical Systems
2. System Reliability Analysis
3. Reliability Centered Maintenance of Mechanical Systems.

Books Recommended

1. L.S.Srinath, "*Reliability Engineering",* Affiliated East West Press Pvt. Ltd., 1991, ISBN 81 85336 39 3
2. E Balagurusamy, "*Reliability Engineering*", Tata McGrawHill Publishing Co., New Delhi, 1984, ISBN 0 07 451534 9
3. Patric D. T. O'Connor, "*Practical Reliability Engineering",* John Wiley & Sons, Third Edition Revised, Reprint 2001, ISBN 0 471 96025 X
4. Alain Pages and Michel Gondran, "*System Reliability Evaluation and Prediction in Engineering"* Springer-Verlag, 1986, ISBN 0 387 91276 2
5. W Grant Ireson, Clyde F Coombs, Jr, "*Handbook of Reliability Engineering and Management",* McGrawHill Book Company, 1988, ISBN 0 07 032039 X

B.E. (Mechanical) Part – II
PROJECT WORK - II

Teaching Scheme		**Examination Scheme**	
Practical:	4 Hrs/ Week	**Term work:**	75 Marks
		Oral:	100 Marks

Guidelines for Project contents & mark distribution:

a) Literature survey	05
b) Design/ Fabrication/ data collection/ Work up to completion	40
c) Out come of the Project	05
d) Work Diary	05
e) Project Report	10
f) Internal Project Presentation/ Viva	10

Project Report:

Project report should be of 25 to 50 pages (More pages can be used if needed). For standardization of the project reports the following format should be strictly followed.

1. Page size : Trimmed A4
2. Top Margin : 1.00 Inches
3. Bottom Margin : 1.32 Inches
4. Left Margin : 1.5 Inches
5. Right Margin : 1.0 Inches
6. Para Text : Times New Roman 12 point font
7. Line Spacing : 1.5 Lines
8. Page Numbers : Right aligned at footer.
   Font 12 point Times New Roman
9. Headings : New Times Roman, 14 point, Boldface
10. Certificate :

All students should attach standard format of Certificate as described by the Department. Certificate should be awarded to batch and not individual student Certificate should have signatures of Guide, Principal, and External Examiner. Entire Report has to be segmented chapter wise as per the requirement.

11. Index of Report :
    - i) Title Sheet
    - ii) Certificate from Guide/ College
    - iii) Acknowledgement
    - iv) Abstract (Brief content of the work)
    - v) List of Figures
    - vi) List of Tables
    - 1. Introduction (History, Importance of Project Area, Problem identification, Objective of the Project)
    - 2. Literature Review
    - 3. Design/ Experimentation/ Fabrication/ Production/ Actual work carried out for the same.
    - 4. Observation/ Analysis/ Findings/Results
    - 5. Discussion on Results and Conclusion

References

12. References or Bibliography: References should have the following format

For Books:
"Title of Book"; Authors; Publisher; Edition;

For Papers:
Authors, Year of Publication, "Title of Paper"; Conference Details/ General Details; Page No.

b) Presentation:
The group has to prepare a power point presentation on project report, project and present it in front of the faculty of department along with the demonstration of the project.
One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

(Sample Format for Project Work Diary)

Project Progress Sheet

Activity Week: Date from…… to……..

Description of the Work Performed by the student:

(Literature Survey /Design/ Drawings /Purchase/ Manufacturing / Testing/Data Collection/Analysis/Algorithm/Flowchart/Simulation)

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Activity to be carried out in next week:

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Remarks by the Guide/ Co-Guide:

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Date: **Sign of Guide/Co-Guide:**