# UNIVERSITY OF KERALA

## B. TECH. DEGREE COURSE

## (2013 SCHEME)

**SYLLABUS FOR**

**VIII SEMESTER**

**MECHANICAL ENGINEERING**

## SCHEME -2013

## VIII SEMESTER

## MECHANICAL ENGINEERING ( M )

| Course No | Name of subject | Credits | Weekly load, hours | | | C A Marks | Exam Duration Hrs | U E Max Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | D/ P | | | | |
| 13.801 | Energy Management(MP) | 3 | 2 | 1 | - | 50 | 3 | 100 | 150 |
| 13.802 | Industrial Engineering (MPU) | 3 | 2 | 1 | - | 50 | 3 | 100 | 150 |
| 13.803 | Automobile Engineering (M) | 4 | 3 | 1 | - | 50 | 3 | 100 | 150 |
| 13.804 | Computer Integrated Manufacturing (MU) | 4 | 3 | 1 | - | 50 | 3 | 100 | 150 |
| 13.805 | Elective IV | 4 | 3 | 1 | - | 50 | 3 | 100 | 150 |
| 13.806 | Elective V | 4 | 3 | 1 | - | 50 | 3 | 100 | 150 |
| 13.807 | Seminar (MNPSU) | 2 | - | - | 2 | 100 | - | - | 100 |
| 13.808 | Project , Viva-Voce & Industrial Visit (MNPSU) | 5 | - | - | 5 | 100 | - | 100 | 200 |
| | **Total** | **29** | **16** | **6** | **7** | **500** | | **700** | **1200** |

**13.805 Elective IV**

| | |
|---|---|
| 13.805.1 | Experimental Stress Analysis Techniques (MPU) |
| 13.805.2 | Aerospace Engineering (MPU) |
| 13.805.3 | Facilities Planning (MPU) |
| 13.805.4 | Design of Jigs And Fixtures (MPU) |
| 13.805.5 | Controls In Machine Tools (MPU) |
| 13.805.6 | Design of Pressure Vessels & Piping (MPU) |
| 13.805.7 | Tribology (MPU) |
| 13.805.8 | Cryogenic Engineering (MPU) |

**13.805 Elective IV (Contd..)**

| | |
|---|---|
| 13.805.9 | Research Methodology (MPU) |
| 13.805.10 | Nanotechnology (MPU) |
| 13.805.11 | Multiphase Flow (MP) |
| 13.805.12 | Non Linear Dynamics and Chaos (MP) |
| 13.805.13 | Value Engineering (MP) |
| 13.805.14 | Continuum Mechanics (MP) |
| 13.805.15 | Industrial Safety Engineering (MP) |
| 13.805.16 | Engineering Design (MP) |
| 13.805.17 | Advanced Decision Modeling (MP) |

**13.806 Elective V**

| | |
|---|---|
| 13.806.1 | Industrial Quality Control (MPU) |
| 13.806.2 | Creativity & Product Development (MPU) |
| 13.806.3 | Advanced Kinematics of Machines (MPU) |
| 13.806.4 | Financial Management (MPU) |
| 13.806.5 | Flexible Manufacturing Methods (MPU) |
| 13.806.6 | Computational Fluid Dynamics (MPU) |
| 13.806.7 | Management Information Systems (MPU) |
| 13.806.8 | Production & Operations Management (MPU) |
| 13.806.9 | Project Management (MPU) |
| 13.806.10 | Robotics (MPU) |
| 13.806.11 | Industrial Refrigeration (MP) |
| 13.806.12 | Propulsion Engineering (MP) |
| 13.806.13 | Design of Heat Transfer Equipment (MP) |
| 13.806.14 | Technology Forecasting (MP) |
| 13.806.15 | Design of IC Engines (MP) |
| 13.806.16 | Logistics and Supply Chain Management (MP) |
| 13.806.17 | Surface Engineering (MP) |

## 13.801 ENERGY MANAGEMENT (MP)

**Teaching Scheme:** 2(L) - 1(T) - 0(P) **Credits**: 3

**Course Objective:**

*The main objectives of this course is to provide students with a general awareness on the importance of energy and its conservation, its impact on society, various energy sources, energy conversion processes, energy management, energy audit and energy conservation measures.*

**Module – I**

Energy resources, Energy conversion processes and devices – Energy conversion plants – Conventional - Thermal, Hydro, Nuclear fission , and Non – conventional – Solar, Wind Biomass, Fuel cells, Magneto Hydrodynamics and Nuclear fusion.

Energy from waste, Energy plantation.

**Module – II**

Energy storage and Distribution – Electrical energy route – Load curves – Energy conversion plants for Base load , Intermediate load, Peak load and Energy displacement

– Energy storage plants

Energy Scenario – Global and Indian –Impact of Energy on economy, development and environment, Energy policies, Energy strategy for future.

**Module – III**

Energy Management – Definitions and significance – objectives –Characterizing of energy usage – Energy Management program – Energy strategies and energy planning Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems – Computer applications in Energy management.

**Module – IV**

Energy conservation – Principles – Energy economics – Energy conservation technologies – cogeneration – Waste heat recovery – Combined cycle power generation – Heat Recuperators – Heat regenerators – Heat pipes – Heat pumps – Pinch Technology.

Energy Conservation Opportunities – Electrical ECOs – Thermodynamic ECOs in chemical process industry – ECOs in residential and commercial buildings – Energy Conservation Measures.

**References:**

1. Amlan Chakrabarti, *Energy Engineering and Management*, Prentice Hall India, 2011.

2. Eastop and T.D. and D.R. Croft, *Energy Efficiency for Engineers & Technologists*, Longman, 1990.
3. Albert Thumann, P. E. and Wlliam J. Younger, *Handbook of Energy Audits*, Fairmont Press Ltd, 2009.
4. Wayne C. Turner, *Energy Management Hand book*, Fairmont Press Ltd., 2012.
5. Rao S. and B. B. Parulekar, *Energy Technology*, Khanna Publishers, 2012.
6. Rai G. D., *Non – Conventional Energy Sources*, Khanna Publishers, 2010.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*
*30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.*
*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course Outcome:**

*After completion of this course the students will be able*

- *To have an understanding of the impact of energy on society, the need for sustainable energy, global and Indian energy policies.*
- *To gain knowledge on various techniques of energy management and conservation.*
- *To gain the basic ideas of conducting energy audit.*

## 13.802 INDUSTRIAL ENGINEERING (MPU)

**Teaching Scheme:** 2(L) - 1(T) - 0(P) **Credits**: 3

**Course Objectives:**

The main objectives of this course are

- *To give an introduction to industrial engineering*
- *To give awareness about productivity and quality*
- *To understand the importance industrial engineering in the field of mechanical engineering so as to face challenges for the future engineers in industry.*

**Module – I**

Introduction to Industrial Engineering- Evolution of modern Concepts in Industrial Engineering , Functions of Industrial Engineering, Field of application of Industrial Engineering. Product Development and research- Design function, Objectives of design, Manufacturing vs. purchase, Economic aspects C-V-P analysis, (Problems on CVP analysis). Development of designs- prototype, production and testing – Selection of materials and processes, Human factors in design- Value Engineering, Job plan.

**Module – II**

Plant layout and Material handling- principles of material handling, Types of material handling equipments, Selection and application.

Introduction to Flexible manufacturing systems, Preventive and break- down maintenance - Replacement of equipments- Method of providing for depreciation- Determination of economic life - Simple problems.

Methods engineering: Analysis of work methods using different types of process chart and flow diagrams- Critical examination- Micro motion study and THERBLIGS - SIMO chart- Principles of motion economy – determination of allowances and standard time.

**Module – III**

Job evaluation and merit rating – Objectives and principles of job evaluation- merit incentive plan – Merit rating plans. Wages and Incentives- Primary wage systems- Time rate and piece rate system of wage payment- Incentive plans- essentials of a good wage incentive plan- Non-monitory incentives.

Industrial relations- Psychological attitudes to work and working conditions – fatigue- Methods of eliminating fatigue Effect of Communication in Industry, causes effects of industrial disputes- Collective bargaining- Trade union – Workers participation in management.

Production planning and control- Importance of planning – job, batch and mass production- Determination of economic lot size in batch production- Functions of production control – Routing , Scheduling, dispatching and follow up- Gantt charts.

**Module – IV**

Inventory Control, Inventory models -Determination of EOQ and reorder level, selective inventory control techniques. (Problems with and without stock out conditions), Supply chain management (overview only) Quality control and Inspection- Destructive and non-destructive testing methods- process capability- Statistical quality control and control charts for X and R. (Simple problems without using SQC table) Acceptance sampling and operation characteristic curves- System reliability- life testing-Bath tub curve.

Introduction to concepts of Bench marking, TQM, ISO, Six Sigma and Quality circles(Brief description only).

**References**


1. Buffa E. S., *Modern Production management*, Wiley India Pvt. Limited, 2007.
2. Ralph and Barien, *Time and motion study*, John Wiley, 1980.
3. Grant and Ievenworth, *Statistical quality control*, McGraw-Hill, 1988.
4. Kumar B., Industrial Engineering, Khanna Publishers, 2010.
5. Telsang M., *Industrial Engineering and Production Management*, S. Chand & Co., 2006.
6. Mahajan M., *Industrial Engineering and Production management*, Dhanpat Rai Publishers, 2006.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Discuss various fields of application of industrial engineering*
- *Discuss the challenges in industrial engineering.*

## 13.803 AUTOMOBILE ENGINEERING (M)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objective of this course is to provide the students a basic understanding of the construction and working of various parts and systems of an automobile.*

### Module – I

Automobiles - types, components and layout of an automobile. Classification of automotive engines, multi-cylinder reciprocating engine, construction details- main parts: cylinder head, cylinder block- cylinder liners, crank case, pistons, piston rings, connecting rod, crank shaft, cam shaft, different types of valve operating mechanisms- side cam and overhead camshaft mechanisms, valve timing. Cooling System: types, components of water cooling system- radiator, expansion reservoir, thermostat, coolant pump, fan, coolants, Lubrication: different methods of engine lubrication, parts of lubricating systems, SAE ratings for oils. Fuel system in petrol engines: fuel pumps, carburettor- different circuits, electronic petrol injection system, ECM, sensors, catalytic converter, MPFI, GDI. Diesel engine fuel system- fuel injection pump, fuel injectors, firing order, CRDI system, turbochargers, engine emission control ( brief description only), Electric and Hybrid vehicles, Introduction to fuel cells.

### Module – II

Components of Ignition systems- battery ignition system, contact breaker, distributor, automatic ignition advance methods, ignition timing, spark plugs-construction, principle of electronic ignition and ignition advance. Battery- different types, construction, battery ratings, Charging system - components, alternator- construction details, cut-out relay, regulators. Starting system circuit, starter motor- different types of starting drives, Bendix drive, over running clutch drive, solenoid starter switches. Electrical component, Direction indicators, fuel gauge, oil pressure gauge, speedometer, wind shield wiper. Automotive air-conditioning.

### Module – III

Transmission Systems- layout, components. Clutch- requirements of clutch, single plate clutch-components, diaphragm spring, wet type multiplate clutch. Types of gear boxes- constant mesh and synchromesh gear shift mechanisms, overdrive. Automatic transmission- torque converter, epicyclic gear box, planetary gear set operation, hydraulic shift control. Drive line: Propeller shaft, universal joints, slip joints, final drive, function and construction of differential, limited slip differential, types of axles, semi floating, three quarter floating and full floating drive axle.

### Module – IV

Chassis: layout, chassis frames, materials, integral body structure. Steering System: Steering geometry – castor, camber, king- pin inclination, toe-in and toe – out, wheel alignment,

types of steering gears, steering linkage, Power Steering. Suspension system: components- torsion bar, springs, shock absorbers, independent suspension, stabiliser bar, air suspension, Braking Systems: drum, disc brakes, Hydraulic brake system- layout, master cylinder, wheel cylinder, Pneumatic brakes- components, power brakes, Antilock Brake Systems, parking brake. Wheels and Tyres- types of wheels, Construction of bias ply and radial ply tyre, ply rating, tyre specifications, tubeless tyre.

**References:**


1. Crouse W. H. and D. L. Anglin, *Automotive Mechanics*, Tata McGraw Hill, 2003.
2. Kirpal Singh, *Automobile Engineering*- Vol. I & II, Standard Publishers, 2008.
3. Kohli P. L., *Automotive Electrical Equipment*, Tata McGraw Hill, New Delhi, 2004.
4. Narang G. B., *Automobile Engineering*, Khanna Publishers, New Delhi,
5. Joseph Hietner*, Automotive Mechanics*, East- West Press Pvt. Ltd, Madras, 2006.
6. Jain K. K. and R. B. Asthana, *Automobile Engineering*, Tata McGraw Hill, 1999.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course Outcome:**

*At the end of the course students will be able*

- *To understand the basic lay-out of an automobile*
- *To understand the operation of engine cooling, lubrication, ignition, electrical and air conditioning systems*
- *To understand the principles of transmission, suspension, steering and braking systems*
- *To discuss the latest developments in automobiles.*

## 13.804 COMPUTER INTEGRATED MANUFACTURING (MU)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objective:**

- *To gain knowledge on how computers are integrated at various levels of planning and manufacturing.*
- *To understand the flexible manufacturing system and to handle the product data and various software used for manufacturing.*
- *To obtain knowledge of key manufacturing technologies and their underlying principles applied in current manufacturing industry.*

### Module – I

The meaning and origin of CIM- Scope of CIM-CIM architecture- data management in CIM-CIM implementation software - Development of databases -database terminology-architecture of database systems- advantages of data base and relational database-manufacturing automation protocol.

Communication fundamentals- local area networks -topology -LAN implementations - network management and installations-CAD/CAM systems.

### Module – II

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. – cellular manufacturing.

Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems.

### Module – III

Introduction to NC, CNC, DNC machine tools, Classification of NC Systems, Constructional features of NC Machine Tools, System Drives and Feedback Devices, Adaptive Control System, Machining Centre, Turning Centre.

Part programming: Manual part programming, Preparatory and miscellaneous codes Interpolation and canned cycle, Tool compensation- APT- Computer Assisted Part Programming- Simple problems on turning, milling and drilling.

### Module – IV

FMS-components of FMS - types -FMS workstation - Robotics and material handling – Introduction, Robot anatomy, Robot Configurations-End effectors- Programming Methods-Robotic controls, Automated guided vehicles- Automated storage/ Retrieval systems.

Material requirements planning (MRP), inputs, outputs and benefits – Manufacturing resource planning (MRP II)- Just-in-time Production systems- Co-ordinate measuring machine (CMM), construction and operation-Machine Vision.

**References:**


1. Mikell P. Groover, Automation, *Production Systems and Computer Integrated Manufacturing*, Prentice Hall Inc.
2. Yoremkoren, *Computer Integrated Manufacturing System*, McGraw-Hill
3. Mikell P. Groover and Emory Zimmers Jr., *CAD/CAM*, Prentice Hall of India Pvt. Ltd.
4. Kant Vajpayee S., *Principles of Computer Integrated Manufacturing*, Prentice Hall India, 2003.
5. Radhakrishnan P., S. Subramanyan and V. Raju, *CAD/CAM/CIM*, 2nd Edition New Age International (P) Ltd., New Delhi.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course Outcome:**

*At the end of the course the students will be able*

- *To discuss automated processes in a modern manufacturing environment.*
- *To explain robotics, numerical control and the integration of computer control/usage in manufacturing.*
- *To discuss the contemporary manufacturing/production strategies such as agile manufacturing and group technology.*

## 13.805.1 EXPERIMENTAL STRESS ANALYSIS TECHNIQUES (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To understand the relation between the mechanics theory and experimental stress analysis.*
- *To establish the fundamental concepts and new experimental techniques.*

**Module – I**

Basic concepts : The generalized basic systems – Definition – Stress at a point - Stress equation of equilibrium – Principal stress – Two dimensional stress systems – Strain and stress relations – Principal strain – Strain compatibility – Plane stress – Plane stress and strain problems.

**Module – II**

Photoelastic methods : Behaviour of light – Polarised light – Plane polariser – Wave plate – Conditioning of light by a series combination of linear polariser and a wave plate – Arrangement of optical elements in polariscope . The stress optic law in two dimensions at normal incidence – Plane polariscope – Circular polariscope - Fringes – Moiré techniques – Photo elastic photography – Photo elastic model materials – Properties – Calibration methods – Analysis of photoelastic data – Isochromatics – Isoclinics – Compensation techniques - Application of photo elastic methods.

**Module – III**

Electrical strain gauges – Definition of strain and its relation to experimental determination – Strain gauge – Types – Analysis – Strain sensitivity – Gauge construction – Temperature compensation – Rosette analysis – Rectangular Delta - Delta – Stress gauge – Strain gauge circuits – Wheatstone bridge – Null Balance recording instruments – Cathode Ray Oscilloscope.

**Module – IV**

Non Destructive Tests – Need , Types – Visual Examinations , penetrate tests, Hammer tests – Brittle coating techniques – Crack patterns – Types of coatings – Elementary ideas- Holographic non Destructive testing.

**References**


1. Frocht M. M., *Photo Elasticity*, Wiley, 1948.
2. Dally J. W. and W. P. Railey, *Experimental Stress Analysis*, McGraw-Hill, 1991.

3. Durelli and Philips, *Applied Stress Analysis*, Prentice Hall, 1967.
4. Srinath L. S., M. R. Raghavan, K. Lingaiah, G. Gargesa, B. Pant, and K. Ramachandra, *Experimental Stress Analysis*, Tata McGraw Hill, 1984.
5. Pericles Theocaries, *Moire Fringes, Strain Analysis*, Prentice-Hall.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*At the end of the course the students will be able to*

- *Use the experimental techniques on the practical problems*
- *Understand underlying principles in using strain gages*
- *Understand basic principles of photo elasticity, and use it as an analysis tool.*

## 13.805.2 AEROSPACE ENGINEERING (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide fundamentals of aerospace engineering*
- *To provide an understanding of flight instruments*
- *To educate students the fundamental aerospace disciplines necessary to carry out the design of an aerospace vehicle or systems.*

**Module – I**

The atmosphere-characteristics of troposphere , stratosphere , thermosphere, and ionosphere- pressure, temperature and density variations in the atmosphere. Application of dimensional analysis – aerodynamic force – model study and similitude. 2D aero foils - Nomenclature and classification- pressure distribution in inviscid and real flows- momentum and circulation theory of aerofoil- characteristics. 3D or Finite aero foils – effect of releasing the wingtips- wing tip vortices- replacement of finite wing by horse shoe vertex system, lifting line theory-wing load distribution – aspect ratio, induced drag calculation of induced drag from momentum considerations. Skin friction and from drag- changes in finite wing plan shape.

**Module – II**

Propellers – momentum and blade element theories –propeller coefficients and charts. Aircraft performance-straight and level flight –power required and power available graphs for propeller and jet aircraft-gliding and climbing –rate of climb-service and absolute ceilings-gliding angle and speed of flattest glide takeoff and landing performance – length of runway required- aircraft ground run- circling flight – radius of tightest turn-jet and rocket assisted take –off high lift devices-range and endurance of airplanes-charts for piston and jet engine aircrafts.

**Module – III**

Flight Instruments-airspeed indicator, calculation of true air speed-altimeter, gyrohorizon - direction indicator-vertical speed indicator –turn and back indicator-air temperature indicator. (Brief description and qualitative ideas only). Ideas on stability-static and dynamic stability- longitudinal, lateral and directional stability- controls of an aero plane-aerodynamic balancing of control surfaces- mass balancing (Qualitative ideas only).

**Module – IV**

Principles of wind tunnel testing –open and closed type wind tunnels-wind tunnel balances supersonic wind tunnels. Study of subsonic, Transonic, and supersonic aircraft engines

(Description with figures Only).Elementary ideas on space travel-calculation of earth orbiting and escape velocities ignoring air resistance and assuming circular orbit.

**References**


1. Kermode A. C., (Revised by R. H. Baranad and D. R. Philpott), *Mechanics of Flight*, Pearson, 2006.
2. Houghton and Brock, *Aerodynamics for Engineering Student*, Hodder & Stoughton, 1970.
3. Anderson, *Fundamentals of Aerodynamics*, McGraw-Hill, 2012.
4. Pallett E. H. J., *Aircraft Instruments and Integrated Systems*, Longman, 1992.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*At the end of the course students will be able to*

- *Identify, formulate and solve aerospace engineering problems*
- *Perform analysis of flight dynamics of aircrafts.*

## 13.805.3 FACILITIES PLANNING (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide understanding of the overall facilities planning process*
- *To educate product, process and schedule design and their effects on the facility layout*
- *To introduce concepts of material handling and safety in industries.*

**Module – I**

Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout –Systematic layout planning – Design of Assembly lines, Line balancing methods, Computer applications in layout designs.

**Module – II**

Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air etc. – Plant safety, Elements off Industrial safety-Causes and prevention of accidents – Pollution and environmental consideration.

**Module – III**

Material handling system and equipment – Material handling in Plants-Principles of material handling-activities and functions. Stores and warehouses, Receiving and dispatching area. Choice of material handling equipment.

**Module – IV**

Material handling cost and Economical aspects-Depreciation. Equipment replacement – Repair, replacement depends on technical and economical consideration-methods of replacement studies.-simple problems-Break-even analysis.

**References**


1. John A. Sehbin, *Plant Layout and Material Handling*.
2. James A. Apple, *Plant Layout and Material Handling*, Krieger Pub Co, 1998.
3. Peymberton A. W., *Plant Layout and Material Handling*, John Wiley.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*At the end of the course students will be able to*

- *Assess the value of facility planning on the strategy of a firm*
- *Develop a systematic plant layout*
- *Discuss the environmental and economical aspects in facilities planning.*

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## 13.805.4 DESIGN OF JIGS AND FIXTURES (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide basic knowledge of work holding devices*
- *To explain the principles in designing general jigs and fixtures.*

**Module – I**

Introduction - purpose of work holding devices - principles of jig and fixture design - construction methods and materials used - process planning and typical operation layout product considerations - pre-design analysis – product analysis - operation analysis - machine analysis - operator analysis and cost analysis - examples of pre-design analysis - principles of locating and positioning - definition of location - basic principles - methods of location – pin and button locators - plane, concentric, spherical, radial and V-locators - redundant locators.

**Module – II**

Design and mechanics of clamping devices - principles of clamping – standard fixture components - types of clamps - strap, swing, hinge and two-way (multiple) clamps - wedge, pinch and magnetic clamps - latch and self locking clamps - pneumatic, hydraulic and pneumo-hydraulic clamps – design considerations in work holder design and selection - design calculations of lever type clamp - hook type clamp - wedge type clamp - screw clamps -mandrels and collets - chucks - worked examples.

**Module – III**

Fixtures - milling fixtures - slot and key-way milling fixtures - fixture for milling flanges - straddle milling fixtures - indexing fixture - face milling fixture with equalizers - profile milling fixtures - universal fixture for profile milling – boring and lather fixtures - fixture design - examples of design and drawing of milling fixtures for machining of simple components.

**Module – IV**

Fixtures for inspection testing and assembly - welding fixtures – economics Drill Jigs - definition - drill guide bushings - jig feet and legs - types of drill jigs -template -vises - leaf box and tumble jigs - indexing jigs - jaw chucks – drive chucks - magnetic chucking devices - mandrels - machine vices – indexing tables and worktables - examples of design and drawing of drill jig for machining of simple components.

**References**


1. Kempster M. H. A., *An Introduction to Jig and Tool Design*, ELBS, 1974.
2. ASTME, *Fundamentals of Tool Design*, 2010.
3. Grant H. E., *Jigs and Fixtures - Non Standard Clamping Devices*, McGraw Hill, 1971.
4. Goroshkin A.K., *Jigs and Fixtures Hand Book*, MIR Publishers, 1983.
5. Wilson and Holt, *Hand book of Fixture Design*, McGraw Hill, 1962.
6. Colving and Haas, *Jigs and Fixtures - A Reference Book*, McGraw Hill, 1938.
7. Cole B., *Tool Design*, Taraporevala, 1972.
8. Cyrill Donaldson, George H. LeCain, Joyjeet Ghose and V. C. Goold, *Tool Design*, Tata McGraw Hill, 2012.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*At the end of the course students will be able to*

- *Understand design techniques of jigs and fixtures*
- *Attain competency to design and develop jigs and fixtures for a particular part.*

## 13.805.5 CONTROLS IN MACHINE TOOLS (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To understand conventional and modern controls used with machine tools.*
- *To provide proficiency in PLCs programming.*
- *Understand the basic procedures and concepts of programming, set up and operation of a CNC Machines.*

**Module – I**

Hydraulic control- Hydraulic principles- elements of hydraulic systems- pumps filters, seals, valves, accumulators etc. Study of their functional & design characteristic.

Analysis and study of typical hydraulic circuits in machine tools. Design of systems for specific requirements- Introduction to servo systems - maintenance of hydraulic systems- Pneumatic and hydro pneumatic circuits.

**Module – II**

Numerical control: Introduction to numerical control- Application of NC machines – Types of Numerical control- Information flow in NC machine tool-Information carriers- tape reader- interpolator – Measuring devices- analogue, Digital incremental and digital absolute.

**Module – III**

Programming- manual and computer aided programming- Programming languages- APT, ADAPT, EXAPT, Economics of numerically controlled machines, adaptive control principles.

**Module – IV**

Programmable Logic Controllers - Elements of Hardware and Software, Methods of programming - Ladder Logic Programmes (LAD), Function Chart (FC), Statement List (STL) - Program scanning and its execution.

**References**


1. John Pippinger, *Industrial Hydraulics*, Gregg Division McGraw Hill, 1979.
2. Acherkan, *Machine Tools Design*, MIR Publication, 1969.
3. Mikel P. Groover, and Zimmers *CAD/CAM*, McGraw Hill, 1990.
4. Kundra C. K., P. N. Rao and N. K. Temeri, *NC Machines & CAM*, McGraw Hill, 1998.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Identify and understand the basic programming codes*
- *Describe and perform typical PLC troubleshooting*
- *Set up the CNC machining center for manufacturing simple parts*
- *Do programming to manufacture simple parts on the CNC machining center*

## 13.805.6 DESIGN OF PRESSURE VESSELS AND PIPING (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objectives of this course are*

- *To impart knowledge of design of pressure vessels and piping system*
- *To introduce use of various standards used for the pressure vessel design.*

**Module – I**

Methods for determining stresses - Terminology and Ligament Efficiency -Applications. Stresses in pressure vessels: Stresses in a circular ring, cylinder -Membrane stress Analysis of Vessel Shell components - Cylindrical shells, spherical shells, torispherical heads, conical heads - Thermal stresses -Discontinuity stresses in pressure vessels.

**Module – II**

Design of vessels: Design of tall cylindrical self supporting process columns- supports for short vertical vessels – stress concentration - at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings.

**Module – III**

Theory of reinforcement - pressure vessel design. Bucking and fracture analysis in vessels : Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick walled cylinders or tubes under external pressure - effect of supports on Elastic Buckling of cylinders - Buckling under combined External pressure and axial loading, Control and significance of Fracture Mechanics in Vessels -FEM application.

**Module – IV**

Piping, Flow diagram, Piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code. Piping components: bends, tees, bellows and valves. Types of piping supports and their behaviour; Introduction to piping Codes and Standards.

**References**


1. John F. Harvey, *Theory and Design of Pressure Vessels*, CBS Publishers and Distributors, 1987.
2. Henry H. Bedner, *Pressure Vessels, Design Hand Book*, CBS Publishers and Distributors, 1 987.
3. Stanley M. Wales, *Chemical Process Equipment, Selection and Design,* Butterworths Series Chemical Engineering, 1988.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Analyse thin plates and shells for various types of stresses.*
- *Design shells, end closures and nozzles of pressure vessels using ASME codes.*
- *Analyse piping systems.*

## 13.805.7 TRIBOLOGY (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objective of this course is to provide basic understanding of friction, wear and lubrication and to analyse various lubricating conditions.*

**Module – I**

Friction : Nature of surfaces – Mechanism of friction – Laws of friction and friction theories – Merits and demerits .Wear : Classification of wear – Theories of wear – Stages of Cohesive wear –Quantitative relationship for abrasive wear – Minor types of wear – Factors affecting wear.

**Module – II**

Lubrication : Role of lubrication in present day practice – Fundamentals of viscosity and viscous flow – Flow through capillary tubes – Parallel plates –Radial flow between parallel circular plates – Continuity equation and Reynolds equation.

**Module – III**

Viscosity and Viscometers – Starsor Viscometer – Falling sphere viscometer– Saybolt Universal Viscometer – Viscosity index. Analysis of hydrostatic oil pads – Load carrying capacity – Oil flow – Power loss – Application to thrust bearing, use of restrict hydro static squeeze films.

**Module – IV**

Analysis and application of Hydrodynamic Lubrication – Load carrying capacity, power loss and friction in ideal journal bearings – Use of linkage factors – Significance of Sommerfeld number – Eccentricity ratio – Unit load.

**References**


1. Basu, Sen Gupta and Ahuja, *Fundamentals of Tribology*, PHI, 2005.
2. Sushil Kumar and Srivatsava, *Tribology in Industry*, S. Chand Co., 2014.
3. Majumdar B., *Tribology*, S. Chand Co., 2010.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

After completion of this course the students will be able to

- *Analyse and solve tribological problems*
- *Apply scientific information and knowledge about tribological problems and solutions to industry.*

## 13.805.8 CRYOGENIC ENGINEERING (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide the knowledge of evolution of low temperature science*
- *To provide knowledge on the properties of materials at low temperature*
- *To familiarize with various gas liquefaction systems and to provide design aspects of cryogenic storage and transfer lines.*

**Module – I**

Introduction to Cryogenic Systems, Historical development, Low Temperature properties of Engineering Materials, Mechanical properties- Thermal properties- Electric and magnetic properties –Cryogenic fluids and their properties. Applications of Cryogenics: Applications in space, Food Processing, super Conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry. Low temperature properties of engineering materials.

**Module – II**

Liquefaction systems ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.

**Module – III**

Gas liquefaction systems: Introduction-Production of low temperatures-General Liquefaction systems- Liquefaction systems for Neon. Hydrogen and Helium –Critical components of Liquefaction systems. Cryogenic Refrigeration systems: Ideal Refrigeration systems- Refrigeration using liquids and gases as refrigerant- Refrigerators using solids as working media.

**Module – IV**

Cryogenic fluid storage and transfer systems: Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems, Pressure flow-level and temperature measurements.– Types of heat exchangers used in cryogenic systems. Cryo pumping Applications.

**References**

1. Klaus D. Timmerhaus and Thomas M. Flynn, *Cryogenic Process Engineering*, Plenum Press, New York, 1989.

2. Randal F. Barron, *Cryogenic Systems*, McGraw Hill, 1986.
3. Scott R. B., *Cryogenic Engineering*, Van Nostrand Co, 1959.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Discuss properties of material at cryogenic temperatures.*
- *Discuss various liquefaction systems*
- *Explain cryogenic heat exchangers*

## 13.805.9 RESEARCH METHODOLOGY (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To formulate a viable research question*
- *To analyze the benefits and drawbacks of different methodologies*
- *To understand how to prepare and execute a feasible research project.*

**Module – I**

Introduction – meaning of research- objectives of research-motivation in research- types of research-research approaches – significance of research- research methods Vs methodology – criteria for good research**,** Defining research problem- what is a research problem-selecting the problem- necessity of defining the problem.

**Module – II**

Literature review – importance of literature review in defining a problem- critical literature review –identifying gap areas from literature review Research design–meaning of research design-need–features of good design- important concepts relating to research design-different types –developing a research plan.

**Module – III**

Method of data collection–collection of data- observation method interview method-questionnaire method – processing and analyzing of data- processing options- types of analysis- interpretation of results.

**Module – IV**

Report writing – types of report – research report , research proposal, technical paper significance- different steps in the preparation – lay out, structure and language of typical reports- simple exercises - oral presentation– planning, preparation, practice- making presentation – answering questions - use of visual aids-quality and proper usage-Importance of effective communication with illustrations.

**References**


1. Coley S. M. and C. A. Scheinberg, *Proposal writing*, Newbury-Sage Publications, 1990.
2. Leedy P. D. and J. E. Ormrod, *Practical Research Planning and Design*, 4/e, Macmillan, 2001.

3. Day Ra, *How to Write and Publish A Scientific Paper*, Cambridge University Press, 1989.
4. Earl Babbie, *The practice and Social Research*, Wordsworth Publishing Co., 1994.
5. Ansari J. H. and Mahavir, *ITPI Reading Material on Planning Techniques*, ITPI, 2000.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Identify and formulate the research problem,*
- *Effectively Collect relevant data pertaining to the problem,*
- *Carry out the research and write research papers/thesis/dissertation.*

## 13.805.10 NANOTECHNOLOGY (MPU) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To introduce nanotechnology and nanostructures*
- *To introduce fabrication and characterization techniques used in nanotechnology.*

**Module – I**

Introduction and scope-Classification of nanostructures: Quantum dots, quantum wires, quantum wells, nanoclusters, nanotubes, super lattices, nanocrystalline materials-Effects of nanometer length scale – Changes to the system total energy, changes to the system structures- Effect of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.

**Module – II**

Fabrication methods: Top down and bottom up approaches-Top down processes: Milling, Lithographics, machining process, pulsed laser methods- Bottom up processes: Vapour phase deposition methods, PVD, CVD, electro-deposition, plasma assisted deposition process, MBE, chemical methods, colloidal and solgel methods.

**Module – III**

Characterisation methods: General classification of characterization methods, Microscopy techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Diffraction Techniques-Spectroscopy Techniques – Raman Spectroscopy, Surface analysis and depth profiling- Mechanical Properties-Magnetic and Thermal properties.

**Module – IV**

Applications of Nanotechnology (nano materials and devices)-Applications of nanocomposites, nanocrystalline materials, nano layered structures, nanomagnetic materials-magneto resistance- Carbon nanotubes: SW, MW, nanostructured coatings- nano sensors: order from chaos, characterization, perception, nano sensor based on quantum size effect, Electrochemical sensors, Sensors based on physical properties, Nanobiosensors, smart dust- nanomachines: covalent and non covalentapproaches, Molecular motors and machines, molecular devices, single molecular devices, practical problems with molecular device- nanofluids: nanoparticles, preparation of nanofluids, thermophysical properties of nanofluids in comparison with base fluid- nanoswitches - nano computers- nanofilters.

**References**


1. Muralidharan V. S. and A Subramnya, *Nano science and Technology*, Ane books Pvt Ltd.
2. Pradeep T.*, Nano: The essentials*, McGraw – Hill education, 2007.
3. John Mongillo, *Nano Technology*, Greenwood Press, 2007.
4. Bandyopdhyay A. K., *Nanomaterials,* New age international publishers, 2008.
5. Jeremy Ramsden, *Nanotechnology*, Elsevier, 2011.
6. Kelsall Robert W., Ian Hamley and Mark Geoghegan, *Nanoscale Science and Technology,* Wiley Eastern, 2005.
7. Gregory Timp, Nanotechnology, Springer-Verlag, 1999.
8. Charles P Poole, Frank J Owens, Introduction to Nanotechnology, John Wiley and Sons, 2003.
9. Bharat Bhushan, *Handbook of Nanotechnology*, Springer, 2010.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Discuss properties of materials at nanoscale*
- *Discuss the fabrication and characterization methods used in nanotechnology*
- *Discuss the various applications of nanotechnology.*

## 13.805.11 MULTI PHASE FLOW (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide in-depth knowledge in two phase flow and heat transfer*
- *To cover major ideas, models, analytic methods and frontier topics in multiphase flow.*

**Module – I**

Basic equations and empirical correlations for multi-phase flow - flow patterns-identification and classification - flow pattern maps and transition -momentum and energy balance - homogeneous and separated flow models -correlations for use with homogeneous and separated flow models – two phase flow through inclined pipes and singularities - void fraction and slip ratio correlations - influence of pressure gradient - empirical treatment of two phase flow - drift flux model - correlations for bubble, slug and annular flows, Pressure losses through enlargements, contractions, orifices, bends and values.

**Module – II**

Boiling and multiphase heat transfer - vapour-liquid equilibrium mechanisms -pool boiling convective boiling - heat transfer in partial and fully developed sub-cooled boiling - void fraction and pressure drop in sub-cooled boiling -saturated boiling heat transfer - two phase forced convection laminar and turbulent flow solutions for film heat transfer - empirical equations for film boiling and transition boiling - burnout mechanism and correlations – critical coefficient in nucleate and convective boiling.

**Module – III**

Condensation - basic processes of condensation - mechanism of evaporation and condensation - film condensation on a planar surface –drop wise condensation - pressure gradient in condensing systems - methods of improving heat transfer coefficient in condensation.

**Module – IV**

Critical multiphase flows - mathematical models - critical flow criterion -compatibility conditions and their physical interpretation – experimental observations - propagation of small disturbances - pressure drop limitation effect - graphical representation of critical flow conditions.

**References**

1. Collier J. G. and Thorne, *Convective Boiling and Condensation*, Oxford, 1996.

2. Hsu Y. Y. and R. W. Graham, *Transport Processes in Boiling and Two Phase Systems*, Hemisphere, 1976.
3. Ginoux J. J., *Two Phase Flows and Heat Transfer*, Hemisphere, McGraw Hill, 1978.
4. Tong L. S., *Boiling Heat Transfer and Two Phase Flow*, Wiley, 1965.
5. Hewitt G., Delhaye J. M. and Zuber, *Multiphase Science and Technology*, Vol. I., McGraw Hill, 1967.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand the characteristics of multiphase flow and master motion equations*
- *Analyze the multiphase flow problem with multiphase flow dynamics.*

## 13.805.12 NONLENEAR DYNAMICS AND CHAOS (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To acquire basic knowledge of nonlinear differential equations*
- *To provide knowledge of modern research methods for nonlinear dynamical systems.*

**Module – I**

Introduction to dynamical systems: discrete time systems - continuous time systems - autonomous and non autonomous systems - phase space and flows - attracting sets - concepts of stability

Equilibrium solutions: fixed points and stability of continuous - time systems- classification and stability of equilibrium solutions - fixed points of maps and their stability - local and global bifurcation of continuous systems - static and dynamic bifurcations - bifurcation of maps.

**Module – II**

Periodic solutions - periodic solutions of continuous - time dynamical systems - autonomous and non autonomous systems - limit cycle –floquet theory - Poincare' maps - bifurcation - symmetry breaking - cyclic fold – period doubling - transcritical and Hopf bifurcations

Quasiperiodic solutions: Poincare' maps - circle map - construction of quasiperiodic solutions.

**Module – III**

Chaotic solutions of maps: dynamics of logistic equation – bifurcation diagram of one-dimensional maps - feigenbaum number - Henon map

Chaotic solutions of continuous systems: Duffing's equation –Rossler equations - period doubling and intermittency mechanisms

Experimental methods in chaotic vibrations: experimental system to measure the Poincare' map of a chaotic physical system.

**Module – IV**

Fractals and dynamical systems: Koch curve - cantor set –fractal dimension - measures of fractal dimension - capacity dimension – correlation dimension and Information dimension - fractal dimension of strange attractors

Tools to identify and analyze motions: time history - state-space and pseudo state space - embedding dimension and time delay - Fourier spectra, Poincare' sections and maps - lyapunov exponents.

**References**


1. Nayfeh A. H. and B. Balachandran, *Applied Nonlinear Dynamics*, John Wiley, 2008.
2. Thomson J. M. T. and H. B. Stewart, *Nonlinear Dynamics and Chaos*, John Wiley, 2002.
3. Moon F. C., *Chaotic and Fractal Dynamics*, John Wiley, 1992.
4. Wiggins S., *Introduction to Applied Nonlinear Dynamical Systems and Chaos*, Springer, 2003.
5. Baker G. L. and J. P. Gollub, *Chaotic Dynamics*, Cambridge University Press, 1990.
6. Peitgens, Jurgens and Saupe, *Chaos and Fractals*, Springer Verlag, 2004.
7. Scheinerman E. R*., Invitation to Dynamical Systems*, Prentice Hall, 2012.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Describe the fundamental differences between linear and nonlinear dynamics*
- *Ability to carry out analysis of nonlinear dynamical systems.*

## 13.805.13 VALUE ENGINEERING (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide understanding and to apply value engineering for building design projects.*
- *To gain an understanding of the total decision-making methodology of value engineering.*

**Module – I**

Introduction: History, Basic concepts of value engineering, development and scope of value management, value analysis, functions and value-Basic functions, Secondary functions values-Use value, Esteem value, Cost value and Exchange value Costing Vs Value engineering, principles of costing & cost estimation, benefits.

**Module – II**

Steps in value engineering process-preparation problem selection, information, evaluation. Creation, selection and presentation, implementation and follow up. Selection of project, team members, general phase, information phase, Creation phase, evaluation phase, investigation and implementation phase, audit.

**Module – III**

Project work: work sheets, objectives, techniques, guidelines, Checklist, cost worth model, role of creativity, Approaches-job plan, DARSIRI, FAST Diagram as a tool, examples on usage of these tools.

**Module – IV**

Value Engineering cases: Value Engineering raises production and productivity, Value Engineering is intensive cost search, Value Engineering prevents unnecessary uses of resources. Methodology, Industrial cases - Product manufacturing, Chemical processing, Automated Production, Semi –Automated production.

**References**


1. Iyer S. S., *Value Engineering*, New Age International (P) Ltd, New Delhi, 2000.
2. Datta A. K., *Materials Management, Inventory Control and Logistics*, Jaico Publishing House, Mumbai, 2001.
3. Miles L. D, *Techniques of Value Analysis and Value Engineering*, McGraw Hill, 2000.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand the basics of Value Engineering(VE) to ensure that a standardized method is used for VE applications to projects*
- *Create alternative solutions for the future with optimal selection*

## 13.805.14 CONTINUUM MECHANICS (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objective of this course is to give exposure to the necessary mathematical background and the underlying physical and geometric concepts associated with the deformation of continuous medium subjected to three-dimensional force fields.*

**Module – I**

Continuum Theory- The Continuum Concept, Continuum Mechanics, Essential Mathematics - Scalars, Vectors, and Cartesian Tensors, Tensor Algebra in Symbolic Notation, Summation Convention, Indicial Notation, Matrices and Determinants, Transformations of Cartesian Tensors, Principal Values and Principal Directions of Symmetric, Second-Order Tensors, Tensor Fields, Tensor Calculus, Integral Theorems of Gauss and Stokes.

**Module – II**

Stress Principles - Body and Surface Forces, Mass Density, Cauchy Stress Principle, The Stress Tensor, Force and Moment Equilibrium, Stress, Tensor Symmetry, Stress Transformation Laws, Principal Stresses, Principal Stress Directions, Maximum and Minimum Stress Values, Mohr's Circles for Stress, Plane Stress, Deviator and Spherical Stress States, Octahedral Shear Stress.

Kinematics of Deformation and Motion - Particles, Configurations, Deformation, and Motion, Material and Spatial Coordinates, Lagrangian and Eulerian Descriptions, The Displacement Field The Material Derivative, Deformation Gradients, Finite Strain Tensors, Infinitesimal Deformation Theory, Stretch Ratios, Rotation Tensor, Stretch Tensors, Velocity Gradient, Rate of Deformation, Vorticity, Material Derivative of Line Elements, Areas, Volumes.

**Module – III**

Fundamental Laws and Equations - Balance Laws, Field Equations, Constitutive Equations, Material Derivatives of Line, Surface, and Volume Integrals, Conservation of Mass, Continuity Equation, Linear Momentum Principle, Equations of Motion, The Piola-Kirchhoff Stress Tensors, Lagrangian Equations of Motion, Moment of Momentum (Angular Momentum) Principle.

**Module – IV**

Law of Conservation of Energy, The Energy Equation, Entropy and the Clausius-Duhem Equation, Restrictions on Elastic Materials by the Second Law of Thermodynamics, Invariance, Restrictions on Constitutive Equations from Invariance, Constitutive Equations.

Linear Elasticity -Elasticity, Hooke's Law, Strain Energy, Hooke's Law for Isotropic Media, Elastic Constants, Elastic Symmetry; Hooke's Law for Anisotropic Media, Isotropic

Elastostatics and Elastodynamics, Superposition Principle, Plane Elasticity, Linear Thermoelasticity, Airy Stress Function, Torsion, Three-Dimensional Elasticity.

**References**


1. Mase G. T. and G. E. Mase, *Continuum Mechanics for Engineers*, CRC, 1999.
2. Reddy J. N., *An Introduction to Continuum Mechanics*, Cambridge University Press, 2013.
3. Shaums Outline, *Continuum Mechanics*, McGraw Hill, 1970.
4. Sudhakar Nair, *An Introduction to Continuum Mechanics*, Cambridge University Press, 2009.
5. Heinbockel J. H., *Introduction to Tensor Calculus and Continuum Mechanics*, Trafford Publishing, 2001.
6. Fung Y. C., *First Course in Continuum Mechanics*, Pearson, 1993.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Gain an understanding of matrix, vectors, and Cartesian Tensors*
- *Learn the concepts of material and spatial descriptions, deformation gradient, polar decomposition and strain measures*
- *Learn material rate of change, dual vectors and tensors, rate of deformation and spin tensor*
- *Learn bulk material rate of change, conservation of mass, momentum and energy, deformation of an area element, and Piola-Kirchhoff stresses.*

## 13.805.15 INDUSTRIAL SAFETY ENGINEERING (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To integrate ethical, social, current, and global issues and responsibilities in practices*
- *To understand and educate the impact of safe operations in an industry and the benefits of it.*

**Module – I**

Introduction to the development of industrial safety and management – History and development of Industrial safety – implementation of factories Act –formation of various council – safety and productivity – safety organizations safety committees – safety committees structure – roll of management and roll of Govt. in industrial safety - safety analysis.

**Module – II**

Operational safety (Hot Metal Operation): Hot metal operation – safety in Cutting – safety in welding – safety in Boilers- Pressure vessels – Furnace (all types) - Heat treatment processes shops – electroplating – grinding – forming processes- rolling – forging - surface hardening – casting – Moulding – coiling. Operational safety (cold metal operation): Safety in handling of portable power tools – hand grinder - machining shop – drilling – polishing machine – safety in assembly shop – material handling – dock safety – safety in generation and distribution of power – distribution and handling of industrial gases – safety in inspection.

**Module – III**

Safety in chemical laboratories – ammonia printing – safety in power press – safety in sewage – disposal and cleaning. Safety in Industrial pollution and control – working at height. Accident prevention and protective equipments: Personal protective equipment – survey the plant for locations and hazards – part of body to be protected. Education and training in safety – prevention causes and cost of accident. Housekeeping – first aid – fire fighting equipment – Accident reporting – investigations. Industrial psychology in accident prevention –safety trials.

**Module – IV**

The Acts which deal the safety and industrial hygiene: Features of Factory Act – explosive Act – boiler Act – ESI Act – workman's compensation Act – industrial hygiene – occupational safety – diseases prevention – ergonomics. Occupational diseases, stress, fatigue. Health,

safety and the physical environment. Engineering methods of controlling chemical hazards, safety and the physical environment: Control of industrial noise and protection against it-Code and regulations for worker safety and health.

**References**


1. Ray Asfahl C., *Industrial Safety and Health Management*, 5/e, Prentice Hall, 2003.
2. Willie Hammer, *Occupational Safety Management and Engineering*, 5/e, Prentice Hall, 2000.
3. *Occupational Safety Manual*, BHEL.
4. Krishnan N. V., *Safety in Industry*, Jaico Publishers House, 1996.
5. John Ridley, *Industrial Safety and the Law*, P.M.C. Nair Publishers, 1998.
6. John Channing, *Safety Law for Occupational Health and Safety*, Butterworth-Heinemann; 1999.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Recognize the need of safety in industries*
- *Proved solutions to safety issues in industries.*

## 13.805.16 ENGINEERING DESIGN (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objectives of this course are*

- *To develop skills in the engineering design process*
- *To have basic awareness of engineering design and analysis softwares.*
- *To provide sound knowledge in failure analysis of critical components.*

**Module – I**

Engineering activities, The Engineering Profession, Ethics in Engineering, Product Life Cycle, The design Process- Steps, Morphology of Design, Design Drawings, simple design examples, review of CAD,FDM,FEM ,Creative problem solving and decision making, Modeling and simulation, mathematical modeling and computer simulation, optimization, search methods, linear programming, Methods of optimum design.

**Module – II**

Material selection, Performance characteristics of materials, Material selection process, Evaluation methods for materials, value analysis, weighted property index, cost versus performance relations, design examples, Role of processing in design, Design for Casting, Design for Machining, Design for welding, residual stresses in design.

**Module – III**

Design for assembly, Design for brittle fracture and fatigue fracture, design for corrosion resistance, designing with plastics. Economic decision making, cost comparison, depreciation, profitability, inflation, sensitivity and break even analysis, Cost evaluation, categories of cost, method of developing cost estimates, how to price a product, life cycle costing, cost models.

**Module – IV**

Failure analysis, Causes of failures, Failure modes, Techniques for failure analysis, Nondestructive testing methods, Probabilistic approach to design, Reliability theory, Design for reliability, Communicating the design, recording of results and writing technical reports, visual aids and graphics.

**References**


1. George E. Dieter, *Engineering Design- A Materials and Processing Approach*, McGraw Hill, 2000.
2. Harry Cather, Richard Morris, Mathew Philip, Chris Rose, *Design Engineering* Elsevier, 2001.

3. John R. Dixon, *Design Engineering*, McGraw-Hill, 1966.
4. Shigley, *Mechanical Engineering Design*, McGraw-Hill, 2014.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Apply a systematic approach to engineering design*
- *Find, organize and evaluate information on a range of topics related to problems in engineering design*
- *Use computer-aided design (CAD) software to develop and present design solutions.*

## 13.805.17 ADVANCED DECISION MODELLING (MP) (Elective IV)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To introduce the students to advanced topics in decision modelling.*
- *To enhance problem solving skills to more advanced levels.*
- *To experiment with real life problems and promote decision making skills.*

### Module – I

Development of operations research as a branch of knowledge since World War II– Fields of application of operations. Queuing theory – Birth and death processes – Basic queuing process – Single server and multiple server models – Poison input and exponential service – Limited source, limited queue etc. Priority disciplines – Practical applications.

### Module – II

Linear programming – Graphical solutions – Simplex method – Transportation problem – Assignment problem solution to transportation, Assignment and trans-shipment problems – Post optimality analysis – Complications and their resolution – Practical applications and examples.

### Module – III

Network theory – Maximal flow problems – Travelling salesman problems -network with PERT /CPM. Introduction to dynamic Programming, Stochastic programming and integer Programming

Inventory theory – deterministic inventory models. Decision making – Statistical decision theory. Decision trees. Replacement –replacement in anticipation of failure – Group replacement.

### Module – IV

Scheduling on machines 2 job – 2-machine problem – Johnson's algorithm –graphical solution. Game theory – Practical application of game theory – 2 person zero – Sum games – Solving simple games – Mixed strategy – Graphical solution.

**References**


1. Hillier and H. Lieberman, *Introductions to Operations Research*, Holden-Day, 1980.
1. Wagner, Philips and Ravindran, *Introductions to Operations Research*, Tata McGraw Hill, 2005.

2. Ackeff and Sasionic, *Fundamentals of Operations Research*, Wiley.
3. Churchman, Ackeff and Arneff, *Operations Research*, Wiley.
4. Taha, *Operations Research*, McGraw Hill, 1999.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Discuss the optimization techniques used in decision making*
- *Discuss scheduling problems.*

## 13.806.1 INDUSTRIAL QUALITY CONTROL (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide an introduction to fundamental concepts of statistical Process control*
- *To understand the complexities of statistical analysis and control chart interpretation*
- *To understand the concept of reliability and it's improving techniques*

**Module – I**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and s chart. Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

**Module – II**

The concept of Acceptance sampling, Economics of inspections, Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – The Operating characteristic curve– producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans. Minimum inspection per lot, Formulation of Inspection lots and selection of samples.

**Module – III**

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

**Module – IV**

Experimental design and Taguchi method, Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

**References**


1. Grant E. L., *Statistical Quality Control*, McGraw Hill, 1988.
2. Srinath L. S., *Reliability Engineering*, Affiliated East West Press, 2011.
3. Monohar Mahajan, *Statistical Quality Control*, Dhanpat Rai & Sons, 2001.
4. Gupta R. C., *Statistical Quality Control*, Khanna Publishers, 2003.
5. Besterfield D. H., *Quality Control*, Prentice Hall, 2004.
6. Sharma S. C., *Inspection Quality Control and Reliability*, Khanna Publishers, 2002.
7. Danny Samson, *Manufacturing & Operations Strategy*, Prentice Hall, 1991.
8. Connor, P. D. T. O., *Practical Reliability Engineering*, John Wiley, 2012.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand the philosophy and basic concepts of quality improvement*
- *Demonstrate the ability to use the methods of statistical process control*
- *Apply failure analysis of critical components in practical situations.*

## 13.806.2 CREATIVITY AND PRODUCT DEVELOPMENT (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To make students aware of various factors to achieve successful technological achievements.*
- *To provide basic concepts of prototype design and testing.*

**Module – I**

The process of technological innovation- factors contributing to successful technological innovation - the need for creativity and innovation – creativity and problem solving - brain storming - different techniques.

**Module – II**

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques).

**Module – III**

Research and new product development - Patents - Patent search – Patent laws - International code for patents - Intellectual property rights (IPR).

**Module – IV**

Design of proto type - testing - quality standards - marketing research -introducing new products.
Exercise/laboratory sessions: Creative design - Model Preparation - Testing - cost evaluation – Patent application.

**References**


1. Harry Nystrom, *Creativity and Innovation*, John Wiley & Sons, 1979.
2. Brain Twiss, *Managing Technological Innovation*, Pitman Publishing Ltd., 1992.
3. Harry B. Watton, *New Product Planning*, Prentice Hall Inc., 1992.
4. Khandwalla P. N., *Fourth Eye (Excellence through Creativity)*, Wheeler Publishing, 1992.
5. *I.P.R. Bulletins*, TIFAC, New Delhi, 1997.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Provide with the knowledge to use systematic inventive thinking and creative problem-solving methodology*
- *Consider various aspects that affect the development of a new product using innovative approaches*
- *Solve product development problems using a systematic approach*
- *Design and test prototypes.*

## 13.806.3 ADVANCED KINEMATICS OF MACHINES (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objective of this course is to build a platform for design of mechanisms and machines.*

### Module – I

Kinematics Pairs : Classifications of kinematics pairs – Number of points of support in a plane – Subdivision of higher pairs – Kinematics chains –Classification of Kinematics chains

Coupler curves : Definition and Equation– Roberts law – Cognate linkages – Cognate of the slider crank – Double points of a coupler curve – Coupler curve atlas .Analytical Design of 4 bar Mechanism for co-ordinated motion of the crank: Fneuden–Steins equations – Sample design – Three co-ordinate crank position – Co-ordinates of the crank velocities and derivatives – Design of a four bar mechanism for constant angular velocity ratio of the cranks – Choice of knecesion points.

### Module – II

The Euler-Savarg equation and its graphical representation – Determination of the Centre of Curvature of the path of a point – Euler-Savarg equation for points between the instantaneous centre and the inflexion point – General form of the Euler-Savarg equation – Relation between the position of a point in the movable plane and the centre of the curvature of its path – The inflection circle – Envelops and generation curves – Transformation of Euler-Savarg equation.

### Module – III

Graphical construction – Construction of the inflexion centre if the centre of the curvature of both centrodes are known, Kinematics chains of n-links: Number of lines of centres – Kinematics chains with constrained motion – Minimum number of hinges in one link in a closed chain with constrained motion.

### Module – IV

General analysis of Kinematics chains –Transformation of kinematics chain by the use of higher hinges –Replacement of turning pairs by sliding pairs – Criterion of constrained motion for Kinematic chain with higher pairs .An Introduction to the Synthesis of mechanism : Two position of link – Three position of a link – The pole triangle and practical application.

**References**


1. Rosenouver and Willis, *Kinematics of Mechanism*, Associated General Publications.
2. Hall Jr., *Linkage Design*, Waveland Press.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand the fundamentals of machine design for desired kinematic performance*
- *Apply principles of kinematic synthesis, analysis and dynamics to machines and mechanisms*
- *Use graphical and analytic methods to study mechanisms*
- *Apply vector mechanics as a tool for solving kinematic problems.*

## 13.806.4 FINANCIAL MANAGEMENT (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To create basic knowledge of budgeting*
- *To provide fundamentals of financial resources.*

**Module – I**

Introduction - finance and related disciplines scope of financial management -functions - objectives of financial management - an overview on Indian financial system, Financial analysis - financial statement analysis - ratio analysis.

**Module – II**

Statement of change in financial position - working capital basis only Capital budgeting: nature - evaluation techniques - traditional technique -discounted cash flow techniques (NPV & IRR).

**Module – III**

Working capital: nature - determinants - computation of working capital sources of corporate finance - capital market - stock exchanges - equity -debt.

**Module – IV**

Other financial instruments - foreign investments and financing sources- Euro currency market, Euro issues, GDR, ADR etc.

**References**


1. Khan and Jain, *Financial Management*, TMH, 2007.
2. Prasanna Chandra, *Financial Management*, TMH, 2008.
3. Shapiro A. C., *Modern Corporate Finance*, Max well Macmillan, 1989.
4. Brealey and Onyers, *Principles of Corporate Finance*, McGraw Hill, 2013.
5. Pandey I. M., *Financial Management*, Vikas Publishers, 2015.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand both the theoretical and practical role of financial management in business corporations.*
- *Access financial information from a wide variety of sources and use this information to research and assess corporations*
- *Identify tools used by finance professionals in making financial decisions.*

## 13.806.5 FLEXIBLE MANUFACTURING METHODS (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To give elementary ideas of automation in industries*
- *To develop NC programming skills*
- *To provide an overview of features of robotics.*

**Module – I**

Introduction Computer technology - hardware - types of memory -input/output devices – software - mini/micro computers and programmable controllers - computer aided design - fundamentals of CAD - the design process - application of computers for design - manufacturing data base. Numerical control of machine tools- basic components of NC systems – NC coordinate systems - motion control system - application of numerical control.

**Module – II**

NC part programming - punched tape - tape coding and format - manual part programming - computer assisted part programming - APT language – NC programming with interactive graphics Manufacturing systems - development of manufacturing system.

**Module – III**

Components of FMS - FMS work station - Job coding and classification - group technology- benefits of FMS - tools and tooling - machining centres - head indexers -pallets - fixtures Work handling equipments - system storage – automated guided vehicles - industrial robots - programming of robots - assembly &inspection.

**Module – IV**

Flexible manufacturing system management - FMS control software -manning of FMS - tool management - controlling precision - simulation and analysis of FMS - approaches to modelling for FMS - network simulation -simulation procedure - FMS design - economics of FMS - artificial intelligence.

**References**


1. Groover M. P., *Automation, Production Systems and Computer Integrated Manufacturing*, Prentice Hall of India, 1984.
2. Groover, Emory and Zimmers, *CAD/CAM Computer Aided Design and Manufacturing*, Prentice Hall of India, 1983.

3. Joseph Talavage and Hannam, *Flexible Manufacturing Systems in Practice*, Marcel Dekker Inc., 1987.
4. Kant Vajpayee, *Principles of Computer Integrated Manufacturing*, Prentice Hall of India, 1994.
5. Yoram and Koren, *Computer Control of Manufacturing Systems*, McGraw Hill, 1983.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Employ automation in a manufacturing environment*
- *Describe the fundamentals of NC technology*
- *Design an automated system to meet defined operational specifications*
- *Acquire knowledge of industrial robotics and Flexible Manufacturing Systems*
- *Identify and distinguish the different components and interfaces in a Flexible manufacturing System.*

## 13.806.6 COMPUTATIONAL FLUID DYNAMICS (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To introduce Governing Equations of viscous fluid flows*
- *To introduce numerical modelling and its role in the field of fluid flow and heat transfer*
- *To enable the students to understand the various discretization methods, solution procedures and turbulence modelling.*
- *To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.*

**Module – I**

Introduction to CFD, Historical background, applications, advantages. Basic steps of CFD. Meshes, Structured and unstructured mesh, Classification of structured grids. Governing equations: continuity and momentum equations. Equation of transport of a scalar. Potential, Euler and Navier-Stokes equations.

**Module – II**

Steady and unsteady flows. Typical boundary conditions such as Dirichlets and Neumann conditions. TDMA method., Numerical problem up to four unknowns using TDMA.
Cell centered finite volume discretization of terms of governing equations such as time derivative, convective and diffusion. Analytical solution of a one dimensional convection diffusion equation. Upwind, central and blended difference approximations for convection term, QUICK scheme. Implicit, explicit and Crank-Nicolson schemes.

**Module – III**

Statistical representation of turbulent flows: Homogeneous turbulence and isotropic turbulence, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling, Different types of turbulence model: Eddy viscosity models, Mixing length model, Turbulent kinetic energy and dissipation, The κ-ε model, Advantages and disadvantages of κ -ε model, More two-equation models: RNG κ-ε model and κ-ω model, Reynolds stress model (RSM),Large eddy Simulation (LES),Direct Numerical Simulation (DNS).

**Module – IV**

Pressure-velocity decoupling for incompressible flows - SIMPLE and PISO algorithms. Density based solutions for compressible flow, TVD and Van-leer schemes for compressible flow.

Typical results of CFD analysis. Stream lines, method for generating stream line, velocity contours and pressure contours, Method of drawing a velocity vector. Solution of Lagrangian coordinates of a fluid particle. Commercial CFD packages.

**References**


1. Patankar Suhas V., *Numerical Heat Transfer and Fluid Flow*, Taylor &Francis, 1980.
2. Versteeg H. K. and Malalasekera W., *An introduction to Computational Fluid Dynamics*, Longman, 2008
3. Fletcher C. A. J., *Computational Techniques for Fluid Dynamics I*, Springer Verlag, 1984.
4. Anderson Dale A., C. Tannehill John and H. Pletcher Richard, *Computational Fluid Mechanics and Heat Transfer*, Taylor & Francis, 2016.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Discuss numerical modelling and its role in the field of fluid flow and heat transfer*
- *Apply the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems*
- *Discuss established engineering methods to solve complex engineering problem.*

## 13.806.7 MANAGEMENT INFORMATION SYSTEMS (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide the importance of information system*
- *To provide awareness regarding strategic role of information in organizational management.*
- *To equip students with the use of documentation tools in structured analysis.*

**Module – I**

Introduction to Information Systems - Challenges of Information Systems -Contemporary approach to Information systems - Computer based Information Systems - Types and examples of Information systems. OAS, TPS, MIS, DSS and ESS. Information technology Infrastructure- Hardware, Software, Database, People and Procedures -Data Communication network-Modems, Types of Communication Channels, Channel configurations, Channel sharing devices, Types of networks.

**Module – II**

System concept: Organisation as a system- The strategic role of information in Organisational Management; Technical foundations of information systems System Development – system development life cycle – structured methodologies – Prototyping – CASE methodology**.** System analysis, Need for System analysis, Role of System Analyst in Data processing and User departments. Project selection, Feasibility study. Cost benefit analysis- System Investigation, Fact finding, Identifying areas for system study, inspection of Documents, Interviewing staff, Tools for determining System requirement, Activities in requirement determination, Identify Data and Information Produced, Development of System Profiles, tools for Documenting procedures and Decisions.

**Module – III**

Structured analysis, Documentation tools, Flow charts, Data flow diagram, Data dictionary, Data structure diagram, structure chart, System analysis completion report. System Design, Structured system design, Input design and control, Output system design, File and data base design, System Development, System control, Documentation

.

**Module – IV**

Coding techniques- Detection of errors – verification and validating- System Implementation and control - testing –Software quality assurance-software metrics- Security. Application of

Information Systems: Accounting Information systems and Financial Information System, Marketing Information System, Banking Information Systems.

**References**


1. Kenneth C. Laudon and Jane P. Laudon, *Management Information Systems – Managing the Digital Firm*, Pearson Education, 2002.
2. Gordon B. Davis, *Management Information Systems : Conceptual Foundations, Structure and Development*, McGraw Hill, 1994
3. Robert A. S., *Computers and Information Systems,* Prentice-Hall.
4. Burch John G. Jr and Others, *Information Systems theory and Practice*, John Wiley & Sons, 1974.
5. James A. O'Briean, Management Information Systems, Tata McGraw Hill, 2006
6. Steven Alter, *Information Systems – A Management Perspective,* Addison Wesley, 1999.
7. Murdick and Ross, Information Systems for Modern management, 1971.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Identify and analyze requirements for information systems*
- *Effectively evaluate technology alternatives to solve problems in an MIS context*
- *Demonstrate effective communication with individuals, teams, and large groups*
- *Explain the role and significance of effective management information systems and to optimizing organizational performance.*
- *Apply error detection and coding techniques.*

## 13.806.8 PRODUCTION AND OPERATIONS MANAGEMENT (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

*The main objectives of this course are*

- *To give the basic understanding of the core features of the operations and production management.*
- *To provide students for the framework for strategic thinking and decision making*
- *To provide elementary ideas of planning and control production.*

**Module – I**

Demand forecasting:- basic models, Long and Short-term demand forecasting methods, Regression analysis and smoothing methods, Estimation of trend, cycle, and seasonality components, Analysis of forecast error and computer control of forecasting systems, multi item forecasting, slow-moving item forecasting. Basic inventory models:- assumptions, performance measures, multi-item joint replacement model. Inventory systems under risk:- service levels, safety stock, joint determination of Q and R, time-varying demands.

**Module – II**

Aggregate inventory management:- Exchange curves, stock out situations, safety stock policies, distribution inventory systems. Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning – Design of Assembly lines, Line balancing methods, Computer applications in layout designs. Routing problems:-algorithms, Dispatching.

**Module – III**

Aggregate planning:- definition, value of decision rules, aggregate planning strategies, methods. Master production schedule:- bill of material, structuring BOM, disaggregation techniques, managing and maintenance of MPS. Material Requirements Planning:- MRP and MRP II, MRP concepts and advantages, implementation.

**Module – IV**

Capacity planning and control, controlling continuous production, batch processing technique, Just-in-time, KANBAN system. Job Shop production activity planning:- scheduling, shop loading, sequencing, priority rules for dispatching jobs, mathematical programming and heuristics. Introduction to Business Process Re-engineering, Enterprise Resource Planning, and software packages.

**References**


1. Narasimhan *et al., Production Planning and Inventory Control*, PHI, 1995.
2. White R. L. and J. A. White, *Facilities Location and Layout –an Analytical Approach*, PHI, 1992.
3. Buffa, *Production and Operations Management*, John Wiley & Sons.
4. Krajewski L. J., *Operations Management: Strategy and Analysis*, Pearson Education, 1998.
5. James L. Riggs, *Production Systems*, John Wiley & Sons, 1970.
6. Silver, Pyke and Peterson, *Inventory Management and Production Planning and Scheduling*, John Willey & Sons, 1998.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

At the end of the course students will be able to

- *Apply fundamental concepts of operations management*
- *Apply knowledge of approaches to operational performance improvement*
- *Use specialized knowledge in Operations Management to solve business processes*
- *Develop the ability to identify operational methodologies to assess and improve an organizations performance.*

## 13.806.9 PROJECT MANAGEMENT (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To understand project activities and implementation of projects*
- *To provide both basic and some advanced exposure to project management.*

**Module – I**

Concept of a project-classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost time) project priority matrix-work break down structure. Capital budgeting process- Planning- Analysis-Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis.

**Module – II**

Financial estimates and projections: Cost of projects-means of financing estimates of sales and production-cost of production-working capital requirement and its financing-profitability- projected cash flow statement and balance sheet. Break even analysis.

**Module – III**

Basic techniques in capital budgeting-non discounting and discounting methods- payback period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects.

**Module – IV**

Project administration- progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off. Concepts and uses of PERT, cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management softwares.

**References**


1. Prasannachandra, *Project Planning, Analysis, Selection, Implementation and Review*, Tata McGraw Hill, 2012.
2. Clifford F. Gray and Erik W. Larson, *Project Management – the Managerial Process*, McGraw Hill, 2014.

3. David I Cleland, Project Management, McGraw Hill International Edition, 1999.
4. Gopalakrishnan, *Project Management*, Macmillan India Ltd., 2005.
5. Harvey and Maylor, *Project Management*, Pearson Publication, 2010.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand the concepts of project definition, life cycle, and importance of projects.*
- *Handle the complex tasks of time estimation and project scheduling, including PERT and CPM.*
- *Develop competencies in project costing, budgeting, and financial appraisal.*
- *Appreciate the elements of risk and quality in projects.*
- *Appreciate and understand the use of computers in project management, by demonstrating any software.*

## 13.806.10 ROBOTICS (MPU) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide the concepts of vision system and image processing*
- *To equip students to write programs for automatic functioning of a robot*
- *To make them familiar with various robot sensors and their perception principles that enable a robot.*

**Module – I**

Definition – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Basic robot motions - Point to point control, Continuous path control. Robot Parts and Their Functions – Need for Robots – Different Applications. Robot drive systems and end effectors: Pneumatic Drives – Hydraulic Drives –Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives.

**Module – II**

End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations Sensors and machine vision: Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Laser Range Meters).

**Module – III**

Proximity Sensors (Inductive, Capacitive, and Ultrasonic), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques.
Robot kinematics and robot programming: Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional) – Deviations and Problems.

**Module – IV**

Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs. Industrial Applications: Application of robots in machining, welding, assembly, and material handling.

**References**


1. Fu K.S., R. C. Gonalez and C. S. G. Lee, *Robotics Control Sensing, Vision and Intelligence*, McGraw Hill International Edition, 1987.
2. Groover M. P., *Industrial Robotics – Technology, Programming and Applications*, McGraw Hill, 2001.
3. YoramKoren, *Robotics for Engineers*, McGraw Hill Book Co., 1992.
4. Janakiraman P. A., *Robotics and Image Processing*, Tata McGraw Hill, 1995.
5. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, *Robotic Engineering- An Integrated Approach*, Prentice Hall Inc, 1989.
6. Yu Kozyrev, *Industrial Robots*, Mir Publishers, 1985.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Become familiar with the history, concept, development and key components of robotics technologies*
- *Classify and characterize the robots based on the configuration and work volume*
- *Solve the problems related to robot design and control*

## 13.806.11 INDUSTRIAL REFRIGERATION (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide an over view of industrial applications of refrigeration systems*
- *To give the concepts of different freezing and distribution methods of perishable food materials*
- *To provide design concepts of different controls with refrigeration systems.*

**Module – I**

Brief Review of the methods of refrigeration – Air vapour compression and vapour absorption refrigeration systems. Review of the components of a vapour compression system. Methods of Food Preservation :Microbiology of foods. Theories and methods of chilling and freezing. Temperature – Time graph of Freezing process. Relation between air velocity and freezing time. Calculation of freezing time. Heat velocity of foods. Relation between moisture content and time. Drying during constant and falling the above periods.

**Module – II**

Refrigeration load in freezers. Processing, storage and distribution of chilled and frozen foods. Such as Meat, Poultry, Fish, Eggs, Dairy products, Beverage Products, Fruits, Vegetables, Fruit Juice Concentrates and Bakery products. Food storage requirement. Cold storage, frozen storages. Design of cold storage and frozen stores.

**Module – III**

Refrigerated warehouse , Refrigerated trucks, trailers and containers. Railway refrigerated cars, marine refrigeration. Refrigeration in Air transport. Refrigeration in chemical Industry Industrial Air conditioning – for different type of Buildings – Hospitals, Computer Centre, Laboratories. Theatres, printing plants, Textile processing etc. Automobile air conditioning Air conditioning for Aircrafts, ships and in spacecrafts. Heating and cooling loads. System Design – Ventilation requirements.

**Module – IV**

Plant air flow design. duct work design – variation of air pressure along a duct, Duct sizing. Introduction to Automatic control systems – components of control systems. Control systems diagram. Heating and ventilating control. Single duct variable air temperature and volume controls. Elementary ideas of the controls used in chilled water plants.

**References**


1. Dossat, *Principles of Refrigeration*, John Wiley, 1961.
2. ASHRAE Data Book- (3 Volumes)


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand theories and applications of food preservation*
- *Familiarise with the storage and distribution of food products*
- *Apply the knowledge of refrigeration in different industries*
- *Design conditioned air conveying systems and controls.*

## 13.806.12 PROPULSION ENGINEERING (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide the students with an overview of various air craft engines*
- *To provide students with an overview of various rocket technologies and applications.*
- *To provide students with knowledge of the tools to analyze various rocket propulsion systems such as liquid propellant rocket engines, solid propellant rocket motors, multi-stage launch vehicles, arcjets, solid core nuclear thermal rocket motors, and ion thrusters.*
- *To provide the students with an overview of the testing of rocket engines.*

**Module – I**

Fundamentals of Propulsion- Classification types of propulsive devices-Airscrew, Turbojet, Turboprop, turbofan, Turboshaft, Ramjet, Scramjet, Pulsejet and Rocket engines. Comparative study of performance characteristics applications. Theory of propulsion – Thrust, thrust power and efficiencies of turbojet engine.

**Module – II**

Thermodynamics analysis of turbojet engine cycle. Turbojet engine components- air intakes, Compressors, Combustion chambers, turbines, nozzles turbine and compression matching – Thrust augmentation.

**Module – III**

Rocket propulsion- general operating principles of chemical, electrical nuclear and solar rockets. Chemical Rockets- Classification. Performance parameters for chemical rockets and their relationship, Energy and efficiencies, simple problems, Solid propellants- Types- burning rate- grain Configurations, Igniters liquid propellants- Classification- Typical fuels and oxidizers, properties and specifications, Selection. Liquid propellant feed systems injectors.

**Module – IV**

Starting and ignition – Precautions in propellant handling. Hybrid Rockets combustion processes in SPR and LPR combustion instability- Control of instabilities –Cooling of Rocket motors Flight Performance- Velocity and attitude in simplified vertical Refractory staging of rockets. Rocket Testing- Test facilities and safeguards. Measurement System Terminology, Flight Testing.

**References**


1. Sutton G. P. and Oscar Biblarz, *Rocket Propulsion Elements*, John Wiley & Sons, 2013.
2. Philip Hill and Carl Peterson, *Mechanics and Thermodynamics of Propulsion*, Pearson, 2014.
3. Balachandran P., *Fundamentals of Compressible Fluid Dynamics*, PHI Learning, 2006.
4. Yahya S. M., *Fundamentals of Compressible Flow*, New Age International, 2008.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Apply the knowledge in the fields of aircraft and rocket propulsion*
- *Perform thermodynamic analysis of aircraft engines*
- *Carry out performance analysis of aircraft systems and components*
- *Formulate and solve rocket engine problems.*

## 13.806.13 DESIGN OF HEAT TRANSFER EQUIPMENT (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To give basic ideas of heat transfer devices*
- *To make students aware of thermal stresses and types of failures in heat transfer equipments.*
- *To provide concepts to design different types of heat exchangers.*

**Module – I**

Classification and General features of heat Exchangers, Shell and Tube Heat Exchangers, Regenerators and Recuperators- Industrial Applications. Temperature distribution and its implications, Overall heat transfer co-efficient, Counter flow and parallel flow, Logarithmic mean temperature difference(LMTD), Effectiveness. NTU – Effectiveness– Calculation of heat transfer area by different methods – Caloric or average fluid temperature – The pipe wall temperature.

**Module – II**

Effect of Turbulence, Friction factor, Pressure loss, Channel divergence. Computation of total pressure drop of shell side and tube side for both baffled and un-baffled types – Pressure drop in pipes and pipe annulus-Thermal Stress in tubes, Types of failures.
Design of double pipe Exchanges – Shell and tube pipe exchangers – The tubular element – Tube pitch – Shells – Tube sheet – Baffles – Tube sheet layout and tube counts (tube matrix) – V-band Exchangers – Shell side film coefficients – Shell side mean velocity – Shell side Equivalent diameter – The true temperature difference in 1-2 Exchanger – Shell side and tube side pressure drops – Fouling factors.

**Module – III**

Design of a shell and type – Type 1 Exchangers – Extended surface exchangers – Design of a Finned type double pipe exchanger – Longitudinal Fins and Transverse fin. Design of Evaporators: Design of Shell and Tube, Plate type evaporators. Cooling Towers : Packing, Spray design, Selection of pumps, Fans and Pipes.

**Module – IV**

Testing and Maintenance, Experimental Methods. Condensers –Condensation of a single vapour –Drop wise and film wise condensation –Process applications – Condensation on a surface – Development of equation for calculation – Comparison between horizontal and vertical condensers –The allowable pressure drop for a condensing vapour – Influence of

impurities on condensation – Condensation of steam – Design of a surface condenser – Different types of boiling.

**References**


1. Kern D. Q., *Process Heat Transfer*, Tata McGraw Hill, Edition, 1997.
2. Arthur P. Frass, *Heat Exchanger Design*, Second Edition, John Wiley &Sons, 1996.
3. Taborek T., G. F. Hewitt and N. Afgan, *Heat Exchangers, Theory and Practice*, McGraw Hill, 1980.
4. Walker, *Industrial Heat Exchangers-A Basic Guide*, McGraw Hill Book, 1980.
5. Nicholas Cheremisioff, *Cooling Tower*, Ann Arber Science pub., 1981.
6. Holger Martin, *Heat Exchangers*, Hemisphere Publishing Corporation, London, 1992.
7. Sukatme S. P., *A Text book on Heat Transfer –TEMA standards,* Universities press, 2005.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Understand the basics of heat transfer processes in heat exchangers.*
- *Have basic knowledge about the roles of numerical techniques in the design of heat transfer equipment.*
- *Obtain the knowledge about the selection criteria for device used in heat transfer equipment.*

## 13.806.14 TECHNOLOGY FORECASTING (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide an overview of technology forecasting techniques*
- *To provide basics of strategic planning tools.*

**Module – I**

Introduction and Historical Background – Examples of notable successes and failures. Epistemology of forecasting : Nature of technological change – ontological and teleological views – Types of forecasts – Exploratory projections –Target projections – Validity criteria .Dimensions of technological change : Intellectual , Philosophical and cultural factors – Political and international factors – Military and strategic posture.

**Module – II**

Macro economics – Micro economics – Communications and social feedback– Technological diffusion and innovation. Forecasting techniques Morphological analysis: Analysis of functional capabilities - Morphological analysis of future words – Network methods .Trend extrapolation : Curve fitting – Envelops , constraints and scales –intensive and extensive micro variables – The inertia of trend curves.

**Module – III**

Heuristic forecasts : Extrapolation of dependant variables and constrained variables – analogies ,metaphors and structural models – Phenomenological models – Operational models and simulations .Intuitive methods – Forecasting by experts – Structured interactions – Man –machine interactions. Policy and strategic planning : Planning as tool for forecasting – Policy – Planning methods – Strategic planning methods – Cast effectiveness – PPOS– Demand oriented planning – Operations analysis and systems analysis.

**Module – IV**

Introduction to technology assessment. TA and its relevance – History of TA in Government and Industry – Steps in TA – The MITRE Methodology – Brief review of techniques which can be used in TA including cross impact analysis, systems analysis , cost benefit analysis and formal models – Case studies –(Suggested projects : To be a TA project relevant to the Kerala context).

**References**


1. Rober U. Ayres, *Technology Forecasting*, McGraw Hill, 1969.
2. *Selected readings on Technology Assessment* – IIT Bombay and Dept. of Science and Technology, New Delhi.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Evaluate the probability and significance of various possible future developments*
- *Plot trends in technical economic performance*
- *Apply the knowledge of micro and macro economics*
- *Effectively integrate data into strategic decisions.*

## 13.806.15 DESIGN OF IC ENGINES (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To give general ideas of heat engine cycles*
- *To equip the students with actual cycle analysis*
- *To provide basic ideas of design of IC engines and components.*

### Module – I

Introduction-Basic engine components and nomenclature- First law analysis of engine cycles-engine performance parameters –simple problems. Review of Air standard cycle (brief description regarding the concepts)-Fuel air cycle and their analysis-dissociation, effects of operating variables like compression ratio, fuel-air ratio on thermal efficiency and power.

### Module – II

Actual cycle and their analysis-time loss factor, heat loss factor, exhaust blow down. Comparison of fuel air cycle and actual cycle. Two stroke engines-introduction-advantages and disadvantages-Scavenging various methods of scavenging and charge induction. -Terminologies like reference mass, delivery ratio, scavenge ratio, trapping efficiency, scavenging efficiency, and charging efficiency, relative cylinder charge. Scavenging models-perfect displacement and complete mixing model-scavenging efficiency-simple problems.

### Module – III

Supercharging, Design of Intake and Exhaust port calculations (with the help of charts)Study of transducers for IC engine application (only brief description about various types) Measurement aspects related to IC engines-speed measurement, torque measurement (only dynamometers), airflow measurement, exhaust gas measurement and treatment, Materials and manufacturing process of main components of engines.

### Module – IV

Design of IC engines-Basic decisions, Preliminary analysis, Cylinder number, size and arrangement - Detailed design procedure for piston, connecting rod, crank shaft, poppet valves, cylinder and cylinder head.

**References**

1. Taylor C. F., *IC Engine Theory and Practise* –Vol.1 and 2, MIT Press, 1985.

2. Lickty, *IC Engines*, McGraw-Hill, 1951.
3. Heywood, *IC Engines*, McGraw-Hill.
4. Richard James, *IC Engine Design*, Macmillan.
5. Schweitzer, *Scavenging of 2 Stroke Engines*, Addison-Wesley.
6. Ganesan V., *Fundamentals of IC Engines*, Tata McGraw-Hill, 2012.
7. Shyam K. Agarwal, *IC Engines*, New Age International, 2006.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Perform thermodynamic analysis of IC engines*
- *Carry out performance tests of engines and components*
- *Describe turbo-supercharging systems from a performance perspective*
- *The combustion and emission formation in the engines*
- *Nurture thoughts and reasoning in current engine development.*

## 13.806.16 LOGISTICS AND SUPPLY CHAIN MANAGEMENT (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide the concept of evolution of supply chain models*
- *To make them aware of current trends and role of supply chain in E-business.*

**Module – I**

Introduction: Logistics – Concepts, definition, approaches - factors affecting logistics. Supply chain: Basic tasks – new corporate model. Supply chain management (SCM): The new paradigm- the modular company – network relation – supply process –procurement process – Distribution management.

**Module – II**

Evolution of supply chain models: Strategy and structure – Factors of supply chain – Manufacturing strategy stages - supply chain progress – model for competing through supply chain management – PLC grid – supply chain redesign – Linking SC with customer.

**Module – III**

Supply chain activity systems: Structuring the SC – SC and new products –functional roles in SC – SC design framework – collaborative product commerce.

SCM – Organization and information system: Management task –logistics organization – logistics information systems – topology of SC application – MRP, ERP – warehouse management system – product data management – cases.

**Module – IV**

Current trends, E-Business – Framework and Role of Supply Chain in e- business and b2b practices. Supply Chain IT Frame work. E-Supply Chains, E – Logistics- eSRM, eLRM, eSCM, Agile Supply Chains. Reverse Logistics, Global Logistic.

**References**


1. Schraj P. B. and T.S. Lasen, *Managing Global Supply Chain*, Viva Books, New Delhi, 2000.
2. Ayers J. B., *Hand Book of Supply Chain Management*, St. Lencie Press, 2000.
3. Nicolas J. N., *Competitive Manufacturing Management*, McGraw-Hill, NY, 1998.

**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Apply concepts and activities of the supply chain to actual organizations*
- *Apply sales and operations planning, MRP and lean manufacturing concepts*
- *Apply logistics and purchasing concepts to improve supply chain operations*
- *Analyze the global business environment*
- *Assess the effectiveness of logistics and materials management throughout the global supply chain.*

## 13.806.17 SURFACE ENGINEERING (MP) (Elective V)

**Teaching Scheme:** 3(L) - 1(T) - 0(P) **Credits**: 4

**Course Objectives:**

The main objectives of this course are

- *To provide fundamentals of tribology*
- *To give an overview of hard facing operations*
- *Elementary ideas of high energy and special processes like electron beam and laser beam surface modification processes.*

### Module – I

Tribology: Introduction to tribology, Wear: Types of wear - adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication and wear testing. Plating Processes: Fundamentals of electrode position, plating of nickel, chromium, tin and copper, pulsed plating, hydrogen embrittlement, plating adhesion, electroless plating, electrochemical conversion coating, selective plating for repair, plating properties, hard anodizing.

### Module – II

Hard facing processes: SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal -spray, flame spray processes -HVOF, Detonation gun and jet kote processes, hard facing consumables. Special diffusion processes: Principle of diffusion processes – Boriding, Aluminising, Siliconising, Chromising, Sursulf - Selection of diffusion Processes.

### Module – III

Characteristics of diffused layer – micro structure and micro-hardness evaluation – properties and applications. Thin film coatings: Physical vapour deposition processes – Thermal evaporation - sputter coating - Ion plating – Chemical vapour deposition –reactive sputtering - TiC, TiN, Alumina, CBN, Diamond and DLC coatings. Structure, properties and applications.

### Module – IV

High energy modification and special processes: Electron beam hardening/glazing, Laser beam hardening / glazing ion inplantation, Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electrospark deposition, fused carbide cloth, thermal / chemical, Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates.

**References**


1. Kenneth G. Budinski, *Surface Engineering for Wear Resistance*, Prentice Hall, Englewood Cliff, 1990.
2. *ASM Metals Handbook, Vol.5, Surface Engineering*, Metals Park, Ohio, 1994.
3. Ernest Rabinowicz, *Friction and Wear of Materials*, 2nd edition, John Wiley & Sons, NY, 1995.
4. Sudarshan T. S., *Surface Modification Technologies – An Engineer's Guide*, Marcel Dekker, New York, 1989.


**Internal Continuous Assessment** *(Maximum Marks-50)*

*50% - Tests (minimum 2)*

*30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.*

*20% - Regularity in the class*

**University Examination Pattern:**

*Examination duration: 3 hours* *Maximum Total Marks: 100*

*The question paper shall consist of 2 parts.*

*Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.*

*Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.*

**Course outcome:**

*After completion of this course the students will be able to*

- *Acquire basic understanding of friction, lubrication, and wear processes*
- *Describe standard methods to modify surfaces*
- *Equip with various surface coating technologies and their application in industry.*

## 13.807 SEMINAR (MNPSU)

**Teaching Scheme:** 0(L) - 0(T) - 2(P) **Credits**: 2

**Course Objective:**

*The main objective of this course is to provide experience in presentations and to improve their communication skills.*

The student shall present a seminar on a topic which is of high relevance to Mechanical Engineering. A seminar report must be submitted at the end of the semester. The topic of the seminar shall be different from the topic of his/her project work which is being done during seventh and eighth semesters.

**Internal Continuous Assessment** *(Maximum Marks-100)*

*40% - Assessment by the Guide*
*40% - Assessment by the Committee.*
*20% - Regularity in the class*

**Course Outcome:**

*After completion of this course the students will be able to*

- *Acquire the basic skills to perform literature survey and present papers*
- *Acquire communication skills*

## 13.808 PROJECT, VIVA-VOCE AND INDUSTRIAL VISIT (MNPSU)

**Teaching Scheme:** 0(L) - 0(T) - 5(P) **Credits**: 5

**Course Objective:**

- *To do a detailed study on a selected topic based on current journals or published papers.*
- *To impart the ability to perform as an individual as well as a team member in completing a project work.*

The project work (project phase 1) started in the seventh semester, shall be continued (project phase 2) in the eight semester. The student/s must submit the final project report at the end of the eight semester. At least two evaluations should be conducted by a panel consisting of project coordinator/senior faculty, project guide, and a faculty specialized in the area. The students may be assessed individually and in groups.

**Internal Continuous Assessment** *(Maximum Marks-100)*

The distribution of marks is as follows:

| | |
|---|---|
| *Work Assessed by Guide:* | *50%* |
| *Assessed by a three member committee:* | *50%* |

**University Examination Pattern:**

*Viva-Voce* *Maximum Total Marks: 100*

*Marks shall be awarded based on the overall performance, Project report, Seminar report, Subject knowledge and general awareness in the field of Mechanical Engineering*

**Course Outcome:**

*After completion of this course the students will be able to*

- *Acquire the basic skills to perform literature survey and present papers*
- *Acquire communication skills and improve their leadership quality as well as the ability to work in groups.*