UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VIII SEMESTER

MECHANICAL ENGINEERING
# SCHEME -2013

## VIII SEMESTER

### MECHANICAL ENGINEERING (M)

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Credits</th>
<th>Weekly load, hours</th>
<th>CA Marks</th>
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### 13.805 Elective IV

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<tr>
<th>Course No</th>
<th>Name of subject</th>
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<tbody>
<tr>
<td>13.805.1</td>
<td>Experimental Stress Analysis Techniques (MPU)</td>
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<tr>
<td>13.805.2</td>
<td>Aerospace Engineering (MPU)</td>
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<tr>
<td>13.805.3</td>
<td>Facilities Planning (MPU)</td>
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<tr>
<td>13.805.4</td>
<td>Design of Jigs And Fixtures (MPU)</td>
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<td>13.805.5</td>
<td>Controls In Machine Tools (MPU)</td>
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<td>13.805.6</td>
<td>Design of Pressure Vessels &amp; Piping (MPU)</td>
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<td>Tribology (MPU)</td>
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<td>Nanotechnology (MPU)</td>
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### 13.806 Elective V

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<td>Creativity &amp; Product Development (MPU)</td>
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<td>13.806.4</td>
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<td>Computational Fluid Dynamics (MPU)</td>
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<td>Management Information Systems (MPU)</td>
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<td>Production &amp; Operations Management (MPU)</td>
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<td>Propulsion Engineering (MP)</td>
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<td>Design of Heat Transfer Equipment (MP)</td>
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<td>Technology Forecasting (MP)</td>
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<td>13.806.15</td>
<td>Design of IC Engines (MP)</td>
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<td>13.806.16</td>
<td>Logistics and Supply Chain Management (MP)</td>
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<td>13.806.17</td>
<td>Surface Engineering (MP)</td>
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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 from waste, Energy plantation.

Module – II


– Energy storage plants


Module – III


Module – IV


References:


**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

Module – II

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 Benchmarking, TQM, ISO, Six Sigma and Quality circles (Brief description only).

References


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


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


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,

References:


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


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


Module – IV

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:

**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

Module – II

Module – III

Module – IV

References

**Internal Continuous Assessment** *(Maximun 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-girling and climbing –rate of climb-service and absolute ceilings-girling 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**


**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 of 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

References
1. John A. Sehbin, Plant Layout and Material Handling.

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
References


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

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
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


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

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


Module – II


Module – III


Module – IV


References


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


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


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


**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


Module – IV


References


**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

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 covalent approaches, 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


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.
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

References


**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 NONLINEAR 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

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


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

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
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

Module – II
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

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

References


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

Module – II

Module – III

Module – IV
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

2. Willie Hammer, Occupational Safety Management and Engineering, 5/e, Prentice 
   Hall, 2000.
3. Occupational Safety Manual, BHEL.
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


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


**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

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

Module – IV

References

**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 its 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

Module – IV
References


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 - brainstorming - different techniques.

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

Module – III

Module – IV
Design of prototype - testing - quality standards - marketing research - introducing new products.

References

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


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


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

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

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

References

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


Module – IV


References


**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


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


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.

References


**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


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

References


Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, 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


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

References


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

Module – III

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

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

Module – II

Module – III

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


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 overview 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

Module – II

Module – III

Module – IV
References

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 aircraft 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


Module – II


Module – III


Module – IV

References


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

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. 

Module – III

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

References

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


Module – II


Module – III


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

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.
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

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

**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

Module – II

Module – III


Module – IV

References

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.  

**Module – II**


**Module – III**


**Module – IV**

High energy modification and special processes: Electron beam hardening/glazing, Laser beam hardening / glazing ion implantation, 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


**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.