University of Calicut

Scheme and Curriculum

B. Tech. - Mechanical Engineering

2009
## Combined First and Second Semesters (Common for all branches)

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Marks</th>
<th>Sem-end duration-hours</th>
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<tbody>
<tr>
<td>EN08 101</td>
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## Third Semester - Mechanical Engineering

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## Fourth Semester - Mechanical Engineering

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## Fifth Semester - Mechanical Engineering

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<td>ME09 505</td>
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### Sixth Semester - Mechanical Engineering

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<td>ME09 604</td>
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<td>ME09 Lxx</td>
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<td>ME09 607(P)</td>
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**Electives (Sixth Semester):**

- ME09 L01 Composite Materials
- ME09 L02 Computational Methods in Engineering
- ME09 L03 Industrial Maintenance
- ME09 L04 Mechatronics
- ME09 L05 Tool Engineering and Design

### Seventh Semester - Mechanical Engineering

<table>
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<th>Code</th>
<th>Subject</th>
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<td>ME09 702</td>
<td>Operations Management</td>
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<td>ME09 703</td>
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<td>Project</td>
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## Eighth Semester - Mechanical Engineering

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<td>ME09 801</td>
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### Electives (Seventh and Eighth Semester):

- ME09 L06 Aerospace Engineering
- ME09 L07 Automobile Engineering
- ME09 L08 Combustion Engineering
- ME09 L09 Computational Fluid Dynamics
- ME09 L10 Computerised Materials Management
- ME09 L11 Control System Engineering
- ME09 L12 Cryogenic Engineering
- ME09 L13 Design of Heat Transfer Equipments
- ME09 L14 Design of Jigs and Fixtures
- ME09 L15 Design of Pressure Vessels and Piping
- ME09 L16 Financial Management
- ME09 L17 Fracture Mechanics
- ME09 L18 Heating, Ventilation and Air-conditioning Design
- ME09 L19 Industrial Automation
- ME09 L20 Industrial Tribology
- ME09 L21 Logistics and Supply Chain Management
- ME09 L22 Quality Engineering and Management
- ME09 L23 Industrial Safety Engineering
- ME09 L24 Marketing Management

Scheme and Curriculum – B.Tech. Mechanical Engineering
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**GLOBAL ELECTIVES:**

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<td>PE09 L25</td>
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<td>EC09 L25</td>
<td>Bio-medical Instrumentation</td>
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University of Calicut

Syllabus: 3rd – 8th semesters

B. Tech. - Mechanical Engineering

2009
EN09 301: Engineering Mathematics III
(Common for all branches)

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective

This course provides a quick overview of the concepts and results in complex analysis that may be useful in engineering. Also it gives an introduction to linear algebra and Fourier transform which are wealths of ideas and results with wide area of application.

Module I: Functions of a Complex Variable (13 hours)
Functions of a Complex Variable – Limit – Continuity – Derivative of a Complex function – Analytic functions – Cauchy-Riemann Equations – Laplace equation – Harmonic Functions – Conformal Mapping – Examples: \( Z^2, \sin z, \cos z, \sinh z, \cosh z, (z+i/z) \) – Mobius Transformation.

Module II: Functions of a Complex Variable (14 hours)

Module III: Linear Algebra (13 hours) - Proofs not required

Module IV: Fourier Transforms (14 hours)

Reference books

7. Anthony Croft, Robert Davison, Martin Hargreaves, Engineering Mathematics, 3e, Pearson Education.
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
EN09 302: Humanities and Communication Skills
(Common to all branches)

Teaching scheme
2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives

- To identify the most critical issues that confronted particular periods and locations in history;
- To identify stages in the development of science and technology;
- To understand the purpose and process of communication;
- To produce documents reflecting different types of communication such as technical descriptions, proposals, and reports;
- To develop a positive attitude and self-confidence in the workplace; and
- To develop appropriate social and business ethics.

Module I (8 hours)

Humanities, Science and Technology: Importance of humanities to technology, education and society- Impact of science and technology on the development of modern civilization.
Contributions of ancient civilization: Chinese, Indian, Egyptian and Greek.
Cultural, Industrial, Transportation and Communication revolutions.
Advances in modern India: Achievements in information, communication and space technologies.

Module II (9 hours)

Concept of communication: The speaker/writer and the listener/reader, medium of communication, barriers to communication, accuracy, brevity, clarity and appropriateness
Reading comprehension: Reading at various speeds, different kinds of text for different purposes, reading between lines.
Listening comprehension: Comprehending material delivered at fast speed and spoken material, intelligent listening in interviews
Speaking: Achieving desired clarity and fluency, manipulating paralinguistic features of speaking, task oriented, interpersonal, informal and semi formal speaking, making a short classroom presentation.
Group discussion: Use of persuasive strategies, being polite and firm, handling questions and taking in criticisms on self, turn-taking strategies and effective intervention, use of body language.

Module III (10 hours)

Written Communication: Note making and taking, summarizing, notes and memos, developing notes into text, organization of ideas, cohesion and coherence, paragraph writing, ordering information in space and time, description and argument, comparison and contrast, narrating events chronologically. Writing a rough draft, editing, proof reading, final draft and styling text.
Project report: Reference work, General objective, specific objective, introduction, body, illustrations using graphs, tables, charts, diagrams and flow charts. Conclusion and references
Preparation of leaflets, brochure and C.V.

Module IV (9 hours)

Human relations and Professional ethics: Art of dealing with people, empathy and sympathy, hearing and listening. Tension and stress, Methods to handle stress
Responsibilities and rights of engineers- collegiality and loyalty – Respect for authority – Confidentiality – conflicts of interest – Professional rights, Rights of information, Social responsibility

Scheme and Curriculum – B.Tech. Mechanical Engineering
Senses of ethics – variety of moral issues – Moral dilemma – Moral autonomy – Attributes of an ethical personality – right action – self interest

Reference Books
2. Jayashree Suresh and B S Raghavan, Professional Ethics, S Chand and Company Ltd, 2005
3. Subrayappa, History of Science in India, National Academy of Science, India
6. Jovan van Emden and Lucinda Becker, Effective Communication for Arts and Humanities Students, Palgrave macmillam, 2009
9. Larson E, History of Inventions, Thompson Press India Ltd.

Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 303: Fluid Mechanics

Teaching scheme
4 hours lecture and 1 hour tutorial per week

Credits: 5

Objective
- To study the physical behavior of fluids and fluid systems, and laws governing this behavior
- To study the action of forces on fluids and of the resulting flow pattern

Module I (18 hours)
Fluid Statics: Pressure – Pascal’s law-Hydrostatic law-variation of pressure in static fluids—absolute and gauge pressures – measurement of high and low pressures – manometers – forces on bodies and surfaces submerged in fluids – Buoyancy and flotation- stability of bodies submerged and floating in fluids – metacentric height.

Module II (16 hours)
System and control volume approach - basic equations – Reynold’s transport equations – differential and integral form of continuity, momentum and energy equations – application of the above equations for one dimensional flow – velocity and momentum corrections - one dimensional flow along streamline and stream tubes - Euler’s equation - Bernoulli’s equation – applications - Venturimeter, Orificemeter, Pitot tube, Orifice, Mouthpiece, Notches and weirs.

Module III (20 hours)

Module IV (18 hours)
Introduction to turbulence, classification, scales of turbulence - Reynold’s stresses- turbulence models- Prandtl mixing length concept.

Text Books
1. Douglas, Fluid Mechanics, Pearson Education
2. D. S. Kumar, Fluid Mechanics, S K Kataria & Sons
Reference Books

Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 304: Computer Assisted Machine Drawing

Teaching scheme

3 hours practical and 1 hour theory per week

Objectives: To impart the fundamental concepts of machine drawing.

- To develop primary knowledge of working drawings.
- To produce orthographic drawing of different machine parts.
- To develop skill to produce assembly drawings.
- To develop skill to produce detailed drawings of machines parts from assembly drawing.
- To develop skill to produce drawings by using any standard CAD software.

Module I (12 hours - 1 Printout, 2 Drawing sheets)


b) Couplings and pulleys: Types of shaft keys and their proportions: Solid and split muff couplings - Protected and flexible type - Claw coupling - Universal coupling, Pulleys: Flat pulleys - V-pulleys - Stepped cone pulleys.

Module II (26 Hrs. - 2 Printouts, 4 Drawing sheets)

a) Tolerances and Fits: Limits and tolerances of machine parts - Hole system and shaft system of tolerances - Designation of fundamental deviation - Types of fits and their selection - Indication of dimensional tolerances and fits on simple machine parts - Geometrical tolerances - Recommended symbols - Indication of geometrical tolerances on simple machine parts - Surface roughness - Indication of surface finish on drawings - Preparation of shop floor drawings of simple machine parts.

b) Bearings: Solid journal bearings - Bushed bearings - Plummer block and footstep bearings - Types of rolling contact bearings - Conventional representation of ball and roller bearings - Assembly of radial and thrust type rolling contact bearings in housing. (Scaled drawings of machine parts or their assembly showing dimensional tolerance are to be prepared.)

Module III (34 Hrs. - 3 Printouts, 4 Drawing sheets)


b) Assembly Drawings: Steam stop valve - Spring loaded safety valve – Blow-off-cock - Gate valve- Glove valve- Ball valve- Non return valve (Scaled drawings of assembled views are to be practiced).
Note:

- Drawing practical classes have to be conducted by using any standard CAD software and using drawing instruments in alternative weeks (3 Hours) preferably for each half of the students. Semester End examination (3 Hours) shall be conducted by using drawing instruments only.
- All drawing exercises mentioned above are for class work. Additional exercises wherever necessary may be given as home assignments.

References:


**Internal Assessment**

Printouts (Best 5) 05x02 = 10
Drawing sheets (Best 8) 08x01 = 08
Tests (Best 2) 02x05 = 10
Attendance and Regularity = 02
Total = 30

**University examination pattern**

Question I: Two questions of 15 marks each from (a) and (b) sections of module I.

Question II: Two questions of 20 marks each from (a) and (b) sections of module II.

Question III: Two questions of 35 marks each from (a) and (b) sections of module III.

Total = 70 marks
University of Calicut

ME09 305: Electrical Technology

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To study the performance of different dc and ac machines
- To familiarise various electrical measuring instruments
- To give an overview of electric drives and power electronic control scheme

Module I (12 hours)

Module II (12 hours)
Principle of indicating instruments – moving coil, moving iron and dynamometer type instruments – extension of range of ammeter and voltmeter using current transformer and voltage transformer – principle and working of induction type energy meter

Module III (15 hours)

Module IV (15 hours)
Electrical Drives - Parts of electrical drives - Choice of electric drives - Status of DC and AC drives - Dynamics of Electric drives - Fundamental torque equations – Speed torque conventions and multiquadrant operation - Components of load torque - Nature and classification of load torque - Steady-state stability – load equalisation. (7 Hrs.)
Power semiconductor devices - Symbol and control characteristics of SCR – comparison of SCR, TRIAC, MOSFET and IGBT – Basic concepts of Rectifier (AC-DC), Inverter (DC-AC) and Choppers (DC-DC) (no derivations) - Chopper control of separately excited dc motor - Three phase Induction motor drives - Stator voltage control - Frequency control - Voltage and frequency control (8 Hrs.)
Text Books
3. Dubey G.K., Fundamentals a/Electrical Drives, Narosa

Reference Books

Internal Continuous Assessment *(Maximum Marks-30)*
- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 306: Metallurgy and Material Science

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective:
- To impart knowledge on engineering materials, deformation of the crystals, equilibrium diagrams of selected alloy systems, heat treatment of steels, properties of steels, cast iron and other alloys, and its application

Module I (10 hours)

Module II (15 hours)

Module III (15 hours)

Module IV (14 hours)

Text Books
1. William D Callister, Material science and engineering,
2. Raghavan V, Material science and engineering,

Reference Books
1. Shackelford, Materials science for Engineers,
2. Van Vlack, Materials science and Engineering,

Internal Continuous Assessment (Maximum Marks-30)
University of Calicut

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 307(P): Electrical Technology Lab

Teaching Scheme

3 hours per week

Credits: 2

Objectives

- To familiarize various electrical measurement equipments and measurement methods
- To obtain the performance characteristics of dc and ac machines

1. Calibration of single phase energy meter (Induction and Static type) by direct loading
2. Load test on DC shunt generator
   a. Plot external characteristics
   b. Deduce internal characteristics
3. Load test on 3-phase squirrel cage induction motor.
4. Load test on DC series motor
   a. Plot the performance characteristics
6. Determination of V-I characteristics of linear resistance and incandescent lamp
7. No-load and blocked rotor tests on slip ring induction motor
   a. Determine equivalent circuit parameters
   b. Predetermine the torque, line current and efficiency from equivalent circuit corresponding to a specified slip.
8. Measurement of L,M & K of i) transformer windings and ii) air core coil.
9. OC & SC tests on 3-phase alternator
   a. Predetermine the voltage regulation at various loads and different power factors by EMF method.
10. Load test on single phase transformer
     a. Determine efficiency and regulation at various loads and unity power factor.
11. OC & SC tests on single phase transformer
     a. Determine equivalent circuit parameters
     b. Predetermine efficiency and regulation at various loads and different power factors.
12. Open circuit characteristics of dc shunt generator
    a. Plot OCC of rated speed
    b. Predetermine OCC for other speeds
    c. Determine critical field resistance for a specified speed
    d. Determine critical speed for a specified shunt field resistance

Internal Continuous Assessment (Maximum Marks-50)

60%-Laboratory practical and Record (30 marks)
30%- Test/s (15 marks)
10%- Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)

70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
20% - Viva voce (10 marks)
10% - Fair record (5 marks)
Objectives

- To acquaint with the basics of centre lathe and CNC lathe.
- To impart training on centre lathe and CNC lathe.

2. Study of centre lathe – general features, parts and functions – different machining operations on centre lathe – turning, taper turning, thread cutting, drilling, boring, reaming, tapping, profile turning, knurling.
4. Study of tolerances and surface finish – measuring tools and gauges.
5. Exercises: on centre lathe requiring simple turning, taper turning, knurling, boring and thread cutting.
6. Exercises on centre lathe including multi-start thread, square thread, and internal thread.
7. Study of CNC lathe.
8. Exercises on CNC lathe: Turning, step turning

Reference Books
2. R. Quesada, T. Jeyapoovan, Computer Numerical Control, Pearson Education
5. E. D. Lawrence, Manufacturing Processes & Materials for Engineers, Prentice Hall

Internal Continuous Assessment (Maximum Marks-50)
60% - Workshop practicals and Record (30 marks)
30% - Test/s (15 marks)
10% - Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)
70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
20% - Viva voce (10 marks)
10% - Fair record (5 marks)
EN09 401A: Engineering Mathematics IV
(Common for ME, CE, PE, CH, BT, PT, AM, and AN)

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective
The use of probability models and statistical methods for analyzing data has become common practice in virtually all scientific disciplines. Two modules of this course attempt to provide a comprehensive introduction to those models and methods most likely to be encountered and used by students in their careers in engineering. A broad introduction to some important partial differential equations is also included to make the student get acquainted with the basics of PDE.

Module I: Probability Distributions (13 hours)

Module II: Theory of Inference (14 hours)

Module III: Series Solutions of Differential Equations (14 hours)

Module IV: Partial Differential Equations (13 hours)
Introduction – Formation of PDE – Complete Solution – Equations solvable by direct integration – Linear PDE of First order, Lagrange’s Equation: Pp + Qq = R – Non-Linear PDE of First Order, F(p,q) =0 , Clairaut’s Form: z = px + qx + F(p,q) , F(z,p,q) =0 , F_{1}(x,q) = F_{2}(y,q) – Classification of Linear PDE’s – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables – D’Alembert’s solution of one dimensional wave equation.
Text Books

Module I:
Richard A Johnson, CB Gupta, *Miller and Freund’s Probability and statistics for Engineers, 7e*, Pearson Education- Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7

Module II:

Module III:
Erwin Kreysig, *Advanced Engineering Mathematics, 8e*, John Wiley and Sons, Inc.- Sections: 4.1, 4.3, 4.4, 4.5

Module IV:
Sections: 11.2, 11.3, 11.4, 9.8 Ex.3, 11.5

Reference books

Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
### University Examination Pattern

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**Maximum Total Marks: 70**
EN09 402: Environmental Science
(Common for all branches)

Teaching scheme
2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives
- To understand the problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues and create awareness among the students to address these issues and conserve the environment in a better way.

Module I (8 hours)
The Multidisciplinary nature of environmental science. Definition-scope and importance-need for public awareness. Natural resources. Renewable and non-renewable resources: Natural resources and associated problems-forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects on forests and tribal people- water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.- Food resources: World food problems, changes caused by agriculture over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.-Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources, Land resources: Land as a resource, land degradation, man induced land slides, soil erosion and desertification.

Module II (8 hours)
Ecosystems-Concept of an ecosystem-structure and function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession- Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest ecosystem- Grassland ecosystem- Desert ecosystem-Aquatic ecosystem(ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its consideration
Introduction- Definition: genetic, species and ecosystem diversity-Biogeographical; classification of India- value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values Biodiversity at Global, national, and local level-India at mega-diversity nation- Hot spot of biodiversity-Threats to biodiversity: habitat loss, poaching of wild life, man, wild life conflicts – Endangered and endemic species of India-Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module III (10 hours)
Environmental pollution
Definition-Causes, effects and control measures of Air pollution- Water pollution-soil pollution-Marine pollution-Noise pollution-Thermal pollution-Nuclear hazards-Solid waste management: Causes, effects and control measures of urban and industrial wastes-Role of an individual in prevention of pollution-pollution case studies-Disaster management: floods, earth quake, cyclone and landslides-Environmental impact assessment
Module IV (10 hours)
Environment and sustainable development-Sustainable use of natural resources-Conversion of renewable energy resources into other forms-case studies-Problems related to energy and Energy auditing-Water conservation, rain water harvesting, water shed management-case studies-Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust-Waste land reclamation-Consumerism and waste products-Reduce, reuse and recycling of products-Value education.

Text Books

Reference Books
2. Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net
4. Down to Earth, Centre for Science and Environment
5. Hawkins, R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
9. Survey of the Environment, The Hindu (M)
*M Magazine

Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as Report of field work, literature survey, seminar etc.
10% - Regularity in the class
Note: Field work can be a visit to a local area to document environmental assets-river/forest/grass land/mountain or Visit to local polluted site-urban/rural/industrial/agricultural etc. or Study of common plants, insects, birds etc. or Study of simple ecosystems-pond, river, hill slopes etc. or mini project work on renewable energy and other natural resources, management of wastes etc.
### University Examination Pattern

**PART A:**  *Short answer questions (one/two sentences)*  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:**  *Analytical/Problem solving questions*  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:**  *Descriptive/Analytical/Problem solving questions*  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 403: Mechanics of Solids

Objectives
- To acquaint with the basic concepts of stress and deformation in solids.
- To practise the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

Module I (18 hours)

Module II (18 hours)

Module III (18 hours)

Module IV (18 hours)
Text Books

Reference Books

Internal Continuous Assessment *(Maximum Marks-30)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)*
5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions*
4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions*
4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 404: Casting and Joining

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objectives:

- To provide knowledge on theory of solidification of metals
- To acquire knowledge on different casting processes
- To impart conception on various welding processes
- To understand fundamentals of soldering, brazing, adhesive bonding and ceramic joining.

Module I (10 Hours)
Introduction- solidification of metals and alloys-homogeneous and heterogeneous nucleation-cast structures-casting alloys- foundries-furnaces and melting practices- pattern- pattern allowances- casting design- gating system design- risering -flow of molten metal in moulds.

Module II (16 Hours)
Casting processes- comparison-sand casting-shell moulding-CO2 process-expended polystyrene process – plaster mould casting- ceramic mould casting-investment casting-permanent mould casting-slush casting-pressure casting-die casting-centrifugal casting-squeeze casting-semisolid casting- rapid solidification- casting of single crystal components- defects- inspection and testing of castings.

Module III (14 Hours)

Module IV (14 Hours)
Brazing, Soldering and Adhesive bonding –Physical aspects – Surface energy and contact angle – Capillary action - Theory of soldering and Brazing - Fluxes-Heat sources and heat transfer- Filler materials- Different types of brazing- Braze welding- Adhesives bonding- Contact adhesives- Polyester, polyamide and polyurethane melt adhesives- Toughened acrylic and epoxy adhesives- Silicone adhesives Joint design -Joining of Ceramics - Metal/ceramic joining and ceramic/ceramic joining-Diffusion bonding

Reference Books:
5. P Khanna, *Welding Metallurgy*
7. Serope Kalpakjian, *Manufacturing Engineering and Technology*, Addison Wesley

**Internal Continuous Assessment (Maximum Marks-30)**

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

**Maximum Total Marks: 70**
University of Calicut

ME09 405: Fluid Machinery

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objectives:

- To impart the basic principles on the relationship between forces and its resulting motion of bodies due to impact of fluid jets.
- To understand the working and design principles of hydraulic turbines and pumps.

Module I (14 Hours)

Module II (14 Hours)

Module III (14 Hours)

Module IV (12 Hours)

Text Books
1. Bensal, Hydraulic machines,
2. Jagadish Lal, Hydraulic machines,

Reference Books
University of Calicut

**Internal Continuous Assessment (Maximum Marks-30)**

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks=20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks=40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 406: Thermodynamics

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objectives:
- To impart the basic concepts of thermodynamics

Module I (14 Hours)
Basic concepts and definitions – Macroscopic and microscopic approach, Continuum concept, system and control volume, properties, processes and cycles, Method of checking of properties, Quasi-static process, homogeneous and heterogeneous systems, thermodynamic equilibrium, Zeroth law of thermodynamics – measurement of temperature, Temperature scales, Concept of absolute temperature scale.
Different forms of energy, Stored energy and transition energy, work and heat, different types of work transfer, pdV work, indicator diagram, Free expansion, First law of thermodynamics, Joule’s experiment, First law applied for a cycle and change of state – internal energy and enthalpy, Joule’s law, PMM1, first law applied for open system, Steady flow energy equation and applications.

Module II (14 Hours)
Second law of thermodynamics – thermal reservoir, cyclic heat engine, Kelvin – Plank and Clausius’ statement, PMM2, refrigerator and heat pump, reversibility and irreversibility, Causes of irreversibility, types of irreversibility, Carnot cycle, Carnot’s theorem.
Entropy, Clausius’ theorem, Clausius’ inequality, Entropy principle and its applications, Available energy, Law of degradation of energy, useful work, dead state, Availability, Gibb’s and Helmholtz function, Second law efficiency, Third law of thermodynamics.

Module III (14 Hours)
Properties of pure substances, p-v, p-T, T-s diagram for a pure substances, critical point and triple point, saturation states, liquid vapour mixtures, dry, wet and superheated steam. Use of steam table and Mollier diagram.

Module IV (12 Hours)
Thermodynamic relations – Maxwell’s Equations, Tds equations, Joule Kelvin effect, Clausius – Clapeyron equation
Psychrometrics - Properties of atmospheric air, Psychrometric properties – dry bulb temperature, wet bulb temperature and dew point temperature, specific humidity, relative humidity, degree of saturation, use of psychrometric chart, simple problems.

Text Books
University of Calicut

Reference Books

Internal Continuous Assessment *(Maximum Marks-30)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*

5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

4 x 5 marks=20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

4 x 10 marks=40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 407(P): Material Testing Lab

Teaching scheme

3 hours practical per week

Objectives

- To provide knowledge on the mechanical behaviour of materials.
- To acquaint with the experimental methods to determine the mechanical properties of materials.

1. Standard tension test on mild steel using Universal Testing Machines and suitable extensometers
2. Stress-strain characteristics of brittle materials – cast iron
3. Spring test – open and closed coiled springs – determination of spring stiffness and modulus of rigidity
4. Determination of modulus of rigidity of wires
5. Hardness tests – Brinell hardness, Rockwell hardness (B S C scales), Rockwell superficial hardness (N & T scales), and Vickers hardness
6. Impact test – Izod and Charpy
7. Bending test on wooden beams
8. Fatigue testing – study of testing machine
9. Photoelastic method of stress measurements (two dimensional problems)
10. Torsion test on mild steel rod
11. Shear test on mild steel rod

Reference Books


Internal Continuous Assessment (Maximum Marks-50)

- 60% - Practicals and Record (30 marks)
- 30% - Test/s (15 marks)
- 10% - Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)

- 70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
- 20% - Viva voce (10 marks)
- 10% - Fair record (5 marks)
ME09 408(P): Production Engineering Lab-II

Teaching scheme

Credits: 2

3 hours practical per week

Objectives

• To acquaint with basic machine tools.
• To impart training on shaper, slotting, milling and grinding machines.

Introduction:

a) Limits, fits and tolerances.
c) Spindle drives – milling cutter – indexing head.
d) Simple, compound, differential and angular indexing.

Study of machines:

a) Shaper
b) Planer
c) Slotting machine
d) Drilling machine
e) Milling machine
f) Grinding machine
g) Power saws

Exercises:

1) Exercises on shaper and slotting machines – cube with V-groove, slot and guide ways.
2) Exercise on milling machine – spur gear and helical gear milling by simple and differential indexing, surface milling, slot and key way milling.
3) Exercise on grinding and tool grinding

Reference Books

1. HMT, Production Technology, Tata McGraw Hill.
2. ASTME, Tool Engineers Hand Book.
5. R. V. Rao, Metal Cutting and Machine Tools, S K Kataria & Sons

Internal Continuous Assessment (Maximum Marks-50)

60% - Workshop Practicals and Record (30 marks)
30% - Test/s (15 marks)
10% - Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)

70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
20% - Viva voce (10 marks)
10% - Fair record (5 marks)
ME09 501: Heat and Mass Transfer

Objectives

- To impart the concept of various modes of heat and mass transfer.
- To develop understanding about the method of determination of heat transfer rates in conduction, convection and radiation.

Module II (18 hours)

Module II (18 hours)

Module III (18 hours)

Module IV (18 hours)

Text Books

Reference Books
4. D. S. Kumar, Heat and Mass Transfer,
Internal Continuous Assessment *(Maximum Marks-30)*

- *60% -* Tests (minimum 2)
- *30% -* Assignments (minimum 2) such as homework, problem solving, etc. At least one assignment should be programming / problem solving using computers.
- *10% -* Regularity in the class

University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 502: Advanced Mechanics of Solids

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objectives

- To impart concepts of stress and strain analysis in a solid.
- To study the methodologies in theory of elasticity at a basic level.
- To acquaint with energy methods to solve structural problems.

Module I (14 hours)

Module II (14 hours)

Module III (13 hours)
Special problems in bending: Unsymmetrical bending – shear center – curved beams with circular and rectangular cross-section.
Energy methods in elasticity: Strain energy of deformation – special cases of a body subjected to concentrated loads, due to axial force, shear force, bending moment and torque – reciprocal relation – Maxwell reciprocal theorem – Castigliano’s first and second theorems – virtual work principle – minimum potential energy theorem - complementary energy.

Module IV (13 hours)
Torsion of non-circular bars: Saint Venant’s theory - Prandtl’s method - solutions for circular and elliptical cross-sections - membrane analogy - torsion of thin walled open and closed sections – shear flow.

Text Books

Reference Books
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
Section 1: Engineering Economics

Objective
Impart fundamental economic principles that can assist engineers to make more efficient and economical decisions.

Module 1 (14 Hrs)
Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Private and Social cost, Opportunity cost.
Functions of Money and commercial Banking. Inflation and deflation: concepts and regulatory measures.

Module II (13 Hrs)

Text Books

Internal Continuous Assessment (Maximum Marks-15)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
University of Calicut

Section 2: Principles of Management

Objective

• To provide knowledge on principles of management, decision making techniques, accounting principles and basic management streams

Module I (13 hours)
Principles of management – Evolution of management theory and functions of management
Organizational structure – Principle and types. Decision making – Strategic, tactical & operational decisions, decision making under certainty, risk & uncertainty and multistage decisions & decision tree
Human resource management – Basic concepts of job analysis, job evaluation, merit rating, wages, incentives, recruitment, training and industrial relations

Module II (14 hours)

University Examination Pattern – for Section 1
Note: Section 1 and Section 2 are to be answered in separate answer books

PART A: Short answer questions (one/two sentences) 2 x 2 marks = 4 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 2 x 5 marks = 10 marks
Candidates have to answer two questions out of three. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 2 x 10 marks = 20 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 35
marketing mix, advertising and sales promotion. Project management – Phases, organisation, planning, estimating, planning using PERT & CPM
Reference Books
2. Lucy C Morse and Daniel L Babcock, *Managing engineering and technology*, Pearson Prentice Hall
8. Weist and Levy, *A Management guide to PERT and CPM*, Prantice Hall of India

Internal Continuous Assessment *(Maximum Marks-15)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern – for Section 2
*Note: Section 1 and Section 2 are to be answered in separate answer books*

**PART A:** Short answer questions (one/two sentences)  
2 x 2 marks=4 marks  
1 x 1 mark = 1 mark  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
2 x 5 marks=10 marks  
Candidates have to answer two questions out of three. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
2 x 10 marks=20 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 35*
ME09 504: IC Engines and Gas Turbines

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objectives

- To provide knowledge on actual engine cycles, thermodynamics of combustion, components of SI and CI engines, performance testing of IC engines, theory of combustion in IC engines and gas turbine theory

Module I (16 hours)

Internal combustion engines – Engine classification - four stroke and two stroke - spark ignition and compression ignition - valve timing diagram - air standard cycles - Otto, diesel and duel combustion cycles - actual engine cycles - effect of dissociation - variable specific heats and heat losses - scavenging - objectives - effects and methods

Thermodynamics of combustion – combustion reaction of common fuels – air fuel ratio – exhaust gas composition – flue gas analysis – air fuel ratio from exhaust gas composition – enthalpy of formation – application of first law of thermodynamics to chemically reacting systems-

Module II (13 hours)


Module III (12 hours)


Combustion in CI engines - phase of normal combustion - diesel knock - effect of engine variables on diesel knock - cetane number - additives in diesel - combustion chambers of CI engines-IC Engine exhaust emission control-standards.

Module IV (13 hours)

Text Books

Reference Books

Internal Continuous Assessment *(Maximum Marks-30)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
Objectives

- To provide knowledge on kinematics of selected mechanisms, design of cams, Theory and Analysis of gears, Gear Trains and Synthesis of Mechanisms. These are the topics based on which the student will develop the design and practical problem solving skills in the area of Mechanisms in the future courses.

Module I (14 hours)
Introduction to kinematics and mechanisms - Various mechanisms, kinematic diagrams, degree of freedom- Grashof’s criterion, inversions, Coupler curves - straight line mechanisms exact, approximate – Ackerman Steering Mechanism - Hooke’s joint - Geneva Mechanism - Mechanical advantage, Transmission angle - Displacement Velocity and Acceleration analysis - Relative motion - Relative velocity - Instant centre -Kennedy’s theorem - Relative acceleration - Coriolis acceleration - Graphical and analytical methods – Complex number methods - Computer oriented methods.

Module II (13 hours)
Cams - Classification of Cam and followers - Displacement diagrams, Velocity and Acceleration analysis of SHM, Uniform Velocity, Uniform acceleration, Cycloidal – Graphical Cam profile synthesis –Pressure angle- Analysis of Tangent cam with roller follower and Circular cam with flat follower. Introduction to Polynomial cams.

Module III (14 hours)

Module IV (13 hours)
Kinematic synthesis ( Planar Mechanisms) - Tasks of kinematic synthesis – Type, Number and dimensional synthesis – Precision points - Graphical synthesis for motion - Path and prescribed timing - Function generator – 2 position and 3 position synthesis – Overlay Method - Analytical synthesis techniques Freudenstein's equation – Complex number methods - One case study in synthesis of mechanism.
Text Books

Reference Books
2. C. E. Wilson, P. Sadler, *Kinematics and Dynamics of Machinery*, 3rd edition, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-30)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: Computer oriented assignments using spread sheet or any suitable software packages are to be included

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
University of Calicut

ME 09 506: Metal Cutting and Forming

Teaching scheme
2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives:
- To impart fundamental knowledge on theory of machine tools, metal cutting principles, advanced machining processes and press working operations.

Module I (7 Hours)
Metal cutting: cutting variables - mechanics of chip formation - types of chips produced - orthogonal and oblique cutting - velocity relationships - cutting forces - cutting power temperature in cutting - single point and multipoint tools - tool geometry - tool designation - tool wear and tool life - machinability - cutting tool materials - cutting fluids - economics of machining.

Module II (9 Hours)

Module III (10 Hours)

Module IV (10 Hours)

Text books

Reference Books
1. HMT, Production Technology, Tata McGraw Hill Pvt. Ltd.
2. ASTME, Fundamentals of Tool Design, Prentice Hall of India
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions  
4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 507(P): Fluids Lab

Teaching scheme

3 hours practical per week

Credits: 2

Objectives

- To strengthen the knowledge on fluid mechanics principles, and hydraulic machinery through lab experiments.
- To equip the students to carry out independent experiments, and to train them to analyse, report and infer the results.

1. Study of plumbing tools and pipe fittings
2. Measurement of metacentric height and radius of gyration of floating bodies
3. Measurement of viscosity of fluids
4. Study of discharge measuring instruments
5. Measurement of pressure and velocity
6. Calibration of venturimeter, orifice meter, notches and weirs, nozzle meters, and rotameters
7. Pipe friction – minor losses in pipes - verification of Bernoulli’s theorem
8. Demonstration of laminar and turbulent flow in pipes – critical velocity
9. Experiment on flow through open channels – venturiflume
10. Demonstration of forces on curved and plane surfaces
11. Evaluation of torque & performance of turbines – operating characteristics – Muschel’s curves

Reference Books

2. J. P. Holman, Experimental methods for Engineers, McGraw Hill
3. D. G. Shepherd, Principles of Turbo Machinery, Mc Millan

Internal Continuous Assessment (Maximum Marks-50)

60% - Practicals and Record (30 marks)
30% - Test /s (15 marks)
10% - Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)

70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
20% - Viva voce (10 marks)
10% - Fair record (5 marks)
ME09 508(P): Thermal Lab-I

Teaching scheme
3 hours practical per week

Credits: 2

Objectives
- To strengthen the knowledge on heat engine, and heat transfer principles through lab experiments.
- To equip the students to carry out independent experiments, and to train them to analyse, report and infer the results.

1. Study of systems of petrol and diesel engines
2. Study of automotive parts
3. Study of heat transfer equipments
4. Test on IC engines:
   - Constant speed performance characteristics of petrol and diesel engines.
   - Valve timing diagram
5. Determination of viscosity, flash and fire point and calorific value of the fuel
6. Heat transfer experiments:
   - Emissivity measurement of a radiating surface
   - Measurement of solar radiation
   - Thermal conductivity of a metal rod
   - Measurement of unsteady state conduction heat transfer
   - Experimental study on forced convection heat transfer

Reference Books
3. Obert, Internal Combustion Engines, McGraw Hill

Internal Continuous Assessment (Maximum Marks-50)
- 60% - Practicals and Record (30 marks)
- 30% - Test/s (15 marks)
- 10% - Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)
- 70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
- 20% - Viva voce (10 marks)
- 10% - Fair record (5 marks)
ME09 601: Dynamics of Machinery

Teaching scheme

4 hours lecture and 1 hour tutorial per week

Objectives

- To impart knowledge on Force analysis of machinery, balancing of rotating and reciprocating masses, Gyroscopes, Energy fluctuation in Machines. This forms the second part of the basics needed in the area of Mechanisms for Design courses in future.

- To introduce the fundamentals in Vibration, Vibration analysis of Single degree and multi degree freedom systems. To impart knowledge required to understand the physical significance and design vibration systems with desired conditions

Module I (16 hours)

Module II (18 hours)

Module III (20 hours)

Module IV (18 hours)
Text Books

Reference Books
2. C. E. Wilson, P. Sadler, *Kinematics and Dynamics of Machinery*, 3rd edition, Pearson Education.

Internal Continuous Assessment (*Maximum Marks-30*)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: Computer oriented assignments using spread sheet or any suitable software packages are to be included

University Examination Pattern

**PART A:** Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 602: Finite Element Method

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objectives
- To acquaint with basic concepts of finite element formulation methods.
- To practise finite element methodologies through simple structural and heat transfer problems.

Module 0 (2 hours)

Module I (13 hours)
Beam element: Beam relationships – 1-D beam element FE formulation - element stiffness matrix – load considerations – boundary conditions – member end forces.

Module II (13 hours)
Interpolation – shape function – Lagrange interpolation - 1D linear and quadratic, 2D linear triangle and bilinear rectangular elements.

Module III (13 hours)

Module IV (13 hours)
Advanced topics: Introduction to non-linear and dynamic finite element procedures, error estimation, coupled problems (only brief details are needed).

**Text Books**
1. T. R. Chandrupatla, *Finite Element Analysis for Engineering and Technology*, University Press
4. S. S. Bhavakatti, *Finite Element Analysis*, New Age International

**Reference Books**
3. K. J. Bathe, *Finite Element Procedures in Engineering Analysis*, Prentice Hall of India

**Internal Continuous Assessment (Maximum Marks-30)**
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, etc. At least one assignment should be programming / problem solving using computers.
10% - Regularity in the class

**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  
\[5 \times 2 \text{ marks}=10 \text{ marks}\]  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
\[4 \times 5 \text{ marks}=20 \text{ marks}\]  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
\[4 \times 10 \text{ marks}=40 \text{ marks}\]  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
University of Calicut

ME09 603: Machine Design-I

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objectives
- To provide basic knowledge on the design considerations and methodology of various machine elements.

Module I (15 Hrs)

Module II (13 Hrs)

Module III (14 Hrs)
Design of welded joints- Representation of welds - stresses in fillet and butt welds- design for static loads - bending and torsion in welded joints- eccentrically loaded welds - design of welds for variable loads. Springs- stresses and deflection of helical springs with axial loading – curvature effect – resilience - design of spring for static and fatigue loading- surging- critical frequency- stress analysis and design of leaf springs- nipping.

Module IV (12 Hrs)
Shafts and axles design- stresses- causes of failure in shafts - design based on strength, rigidity and critical speed- design for static and fatigue loads- repeated loading- reversed bending-design of couplings- rigid and flexible couplings-design of keys and pins.

Note: The following data books are permitted for reference in the final examination:
- PSG Design Data, DPV Printers, Coimbatore.
- Prof. Narayana Iyengar B.R & Dr Lingaiah K, Machine desing Data Handbook, Vol I & II

Text Books

Reference Books
**Internal Continuous Assessment (Maximum Marks-30)**

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, etc. Atleast one assignment should be programming / problem solving using computers.
- **10%** - Regularity in the class

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**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 604: Operations Research

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart knowledge on linear programming, transportation problem, assignment problem, game theory and queuing theory.

Module I (13 hours)
Review of the properties of matrices and matrix operations - Lines and hyper planes – linear inequalities – convex sets – extreme points – fundamental theorem of linear programming - Development of OR – Phases of OR – Scope of OR – Advantages and limitations of OR. Formulation and application of linear programming to production, marketing, finance and other areas – Concepts of Solution space, convex region, basic feasible solution, optimal solution – Solving LPP by graphical method

Module II (14 hours)

Module III (13 hours)

Module IV (14 hours)
### Reference Books

3. Hadley G., *Linear Programming*, Addison Wesley

### Internal Continuous Assessment (Maximum Marks-30)

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 605: Computer Integrated Manufacturing

**Teaching scheme**

2 hours lecture and 1 hour tutorial per week

**Credits:** 3

**Objectives**

- To impart fundamental knowledge of Numerical Control, NC part programming, Controls in CIM, material handling systems.
- To acquire comprehensive idea on FMS and Robotics.

**Module I (7 hours)**
Introduction- fundamentals of numerical control- advantages of NC system - classification of NC system - NC and CNC - open loop and closed loop systems - features of NC machine tools - fundamentals of machining- design considerations of NC machine tools- methods of improving machine accuracy and productivity- special tool holders.

**Module II (10 hours)**
NC part programming - manual programming - part programming examples- point to point programming and contour programming- computer aided programming concepts- post processor- program languages- APT- programming - part programming examples.

**Module III (10 hours)**
Controls in CIM- material handling in CIM- AGV- Vehicle guidance- vehicle management and safety- automated storage systems- ASRS components and operations- features of ASRS- automatic data capture- barcode technology- magnetic strips- optical character recognition- group technology- part family- part classification and coding - features OPITZ classification and multi class coding system.

**Module IV (9 hours)**
Flexible manufacturing system- types of FMS- components of FMS- FMS workstations- material handling and storage systems- FMS layout- configurations- computer control systems in FMS- applications and benefits of FMS- industrial robotics- robot anatomy- configurations- joints- drive systems- robot control systems- end effectors- sensors in robots- industrial robot applications- robot programming- on line and off line programming

**Text Books**

Reference Books


Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
Objectives

- To practise the steps involved for the selection, execution, and reporting of the project.
- To train the students for group activities to accomplish an engineering task.

A team of students having a maximum of five members shall constitute a batch for the mini-project. The head of the department will decide the framing of the project batches. The subject content of the mini project shall be from emerging /thrust areas, topics of current relevance having research aspects or shall be based on industrial visits undergone in 4th, 5th semesters. At the end of the semester, each group of students should submit a report duly authenticated by the respective guide, to the head of the department.

Mini Project will have internal marks 50 and Semester-end examination marks 50. Internal marks will be awarded by respective guides as per the stipulations given below.

- Attendance, regularity and individual contribution of each student (20 marks)
- Individual evaluation through viva voce / test (30 marks)
Total (50 marks)

Semester End examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.

- Report = 25 marks
- Concept/knowledge in the topic = 15 marks
- Presentation = 10 marks
Total marks = 50 marks
Objectives

- To strengthen the knowledge on heat engines, and heat transfer principles through advanced experiments.
- To equip the students to carry out independent experiments, and to train them to analyse, report and infer the results.

1. Test on IC engines:
   - Variable speed performance test on petrol and diesel engines
   - Determination of friction power – retardation test and morse test
   - Study of the effect of cooling water on engine performance
   - Heat balance test
   - Analysis of the exhaust gas of IC engines

2. Heat transfer experiments:
   - Performance studies on a shell and tube heat exchanger
   - Performance studies on parallel and counter flow arrangements in a concentric pipe heat exchanger

3. Performance tests on air compressor and blower

4. Performance test on refrigeration plant

Reference Books

3. Obert, Internal Combustion Engines, McGraw Hill

Internal Continuous Assessment (Maximum Marks-50)

- 60% - Practicals and Record (30 marks)
- 30% - Test/s (15 marks)
- 10% - Regularity in the class (5 marks)

Semester End Examination (Maximum Marks-50)

- 70% - Procedure, conducting experiment, results, tabulation, and inference (35 marks)
- 20% - Viva voce (10 marks)
- 10% - Fair record (5 marks)
ME09 L01: Composite Materials

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide knowledge on characteristics of composites, manufacturing and testing methods, mechanical behaviour, recent trends and its application.

Pre-requisites: Basic knowledge of material science and mechanics of solids

Module I (13 hours)
Introduction to composites: Characteristics and classifications of composites – study of fibers, flake and particulate composites.

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
### Internal Continuous Assessment *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*

- All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

- **5 x 2 marks=10 marks**

**PART B:** *Analytical/Problem solving questions*

- Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

- **4 x 5 marks=20 marks**

**PART C:** *Descriptive/Analytical/Problem solving questions*

- Two questions from each module with choice to answer one question.

- **4 x 10 marks=40 marks**

*Maximum Total Marks: 70*
ME09 L02: Computational Methods in Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

- To impart the concept of various numerical methods in engineering.
- To develop understanding about the method of applying numerical techniques with the help of computers for solving complex problems.

Pre-requisites: Basic knowledge of engineering mathematics

Module I (13 hours)

Module II (13 hours)

Module III (14 hours)

Module IV (14 hours)
Text Books

Reference Books

Internal Continuous Assessment *(Maximum Marks-30)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, etc. Atleast one assignment should be programming / problem solving using computers.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  \(5 \times 2 \text{ marks} = 10 \text{ marks}\)
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  \(4 \times 5 \text{ marks} = 20 \text{ marks}\)
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  \(4 \times 10 \text{ marks} = 40 \text{ marks}\)
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L03: Industrial Maintenance

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide knowledge on basic concepts of maintenance, vibration monitoring, non-destructive testing and concepts of reliability

Module I (12 hours)
Basic concepts purpose and functions of maintenance- types of maintenance- condition monitoring– principles and method –Transducers for vibration measurement.

Module II (14 hours)

Module III (14 hours)
Ferrography – spectral oil analysis procedure – non destructive testing – liquid penetrant testing – radiographic inspection – ultra sonic testing acoustic emission corrosion monitoring – resistance techniques – technique providing information on plant regarding corrosion monitoring

Module IV (14 hours)

Text Books
1. L. S. Sreenath, Vibration spectrum analysis A practical approach; Steve Goldman Industrial Press Inc.

Reference Books
**Internal Continuous Assessment** *(Maximum Marks-30)*

- **60% -** Tests (minimum 2)
- **30% -** Assignments (minimum 2) such as home work, problem solving, etc. Atleast one assignment should be programming / problem solving using computers.
- **10% -** Regularity in the class

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**University Examination Pattern**

**PART A:** *Short answer questions (one/two sentences)* 
5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions* 
4 x 5 marks=20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions* 
4 x 10 marks=40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L04: Mechatronics

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide basic knowledge on elements, principles and design of electronic controls for mechanical systems.

Pre-requisites: Basic knowledge of electronics and mechanical engineering.

Module I (13 hours)

Module II (13 hours)
Condition monitoring – principles - sensors for force, vibration, temperature, and noise-acoustic emission – principles and applications.

Module III (14 hours)
Closed loop controllers - proportional, derivative and integral controls - PID controller - digital controllers - controller tuning - adaptive control of machine tools.
Mechatronics in Robotics - robot position and proximity sensing - tactile sensing. Man-machine interface.

Module IV (14 hours)
Stages in designing mechatronic systems - traditional and mechatronic design -possible design solutions - case studies of mechatronic systems - pick and place robot - automatic car park system - engine management system.
### Text Books

### Reference Books
1. R. C. Dorf, R. H. Bishop, *Modern Control Systems*, Addison Wesley
2. Krishna Kant, *Computer Based Industrial Control*, Prentice Hall of Indian Private Limited

### Internal Continuous Assessment (Maximum Marks-30)
- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, etc. Atleast one assignment should be programming / problem solving using computers.
- 10% - Regularity in the class

### University Examination Pattern

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*Maximum Total Marks: 70*
ME09 L05: Tool Engineering and Design

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To impart knowledge on basic concepts of tool design.

Module I (13 hours)
Design of chips forming tool, chip removal process, principle, classification of tools, tool geometry – tool materials – multi point tools – milling cutter, drills, reamer, taps, broaches, Machining time estimation for milling, drilling, cutting power estimation in milling, drilling operations, boring bar, vibration damping of bar boring.

Module II (13 hours)
Power presses, types, die cutting operation, press tonnage calculations – scrap-strip layout, compound & progressive dyes, design of dies for simple components, drawing dies, blank development, press tonnage and blank holding pressure, draw dies for simple components.

Module III (13 hours)

Module IV (13 hours)
Design of work holders: Purpose of work holders, function, principle of location and clamping, locators, toll forces, design of work holder for tapping, fixture components, work holders for round work pieces – mandrels, collets.

Reference Books
1. A. Bhattacharya, Metal cutting theory and practice, Central Book Publishers.
2. ASTME, Fundamentals of tool design, Prentice Hall.
5. HMT, Production Technology, Tata McGraw Hill
### Internal Continuous Assessment *(Maximum Marks-30)*

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### University Examination Pattern

**PART A:** Short answer questions *(one/two sentences)*  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
Objectives

- To provide basic design skill with regard to clutches, brakes, belt drives, bearings and gears.

Module I (20 Hrs)

Module II (17 Hrs)

Module III (19 Hrs)

Module IV (16 Hrs)
Design recommendations for Forgings- castings and welded products- rolled sections- turned parts- screw machined products- Parts produced on milling machines. Design for manufacturing - preparation of working drawings - working drawings for manufacture of parts with complete specifications including manufacturing details.

Note: The following data books are permitted for reference in the final examination:

- PSG, Design Data, DPV Printers, Coimbatore.
- Prof. Narayana Iyengar B.R & Dr Lingaiah K, Machine design Data Handbook, Vol I & II.

Text Books

Reference Books
**Internal Continuous Assessment** *(Maximum Marks-30)*

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<td><strong>Maximum Total Marks:</strong> 70</td>
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ME09 702: Operations Management

Objectives
- To impart knowledge on production, planning and control functions, method study, materials management, inventory models, maintenance management and project management

Pre-requisites: nil

Module I (14 hours)
Forecasting technique – Causal, Time series and Qualitative methods – Regression, Moving average- Trend and seasonality- Exponential smoothing and Delphi technique
Product design and development – principles of good product design- quality and cost consideration – standardization – simplification

Module II (13 hours)
Process design and planning – Types – Fixed, Product, process, hybrid and FMS
Facility location and layout – Influencing factors and evaluation methods – Layout design process – Computerised layout planning - Assembly line balancing – Material handling systems
Work system design – Method study – Recording techniques- micro motion study – work measurement
Aggregate production planning – Master production scheduling – Material requirement planning – Manufacturing resource planning

Module III (14 hours)
Materials Management: Purchase Management- Stores Management
Inventory: Functions – Costs – classifications – Deterministic and Probabilistic Inventory models- Quantity discount – Safety stock
Dispatching, progress reporting and expediting functions

Module IV (13 hours)
Maintenance and replacement – Preventive and breakdown maintenance – Economic aspects – Replacement of equipment – methods
Reference Books

5. Monks, Joseph G. Operations Management, Mc Grawhil
7. Weist and Levy, A Managemnt Guide to Pert and CPM, Prentice Hall of India
8. Samuel Eilon, Production Planning and Control, Universal Book Corporation
9. Francis and White, Facility Layout and Location, Prentice Hall Inc
11. Biegel, Production Control, Prentice Hall of India

Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
Objectives

- To provide the fundamental concepts and principles of metrology and instrumentation
- To impart the various methods of measurement of physical and mechanical quantities

Module I (9 hours)


Module II (9 hours)


Module III (9 hours)


Module IV (9 hours)

coordinate measuring machine construction – operation and programming – machine vision – image acquisition and digitization - image processing and analysis.

**Text Books**

**Reference Books**
4. Instrumentation, measurement & analysis by B.C. Nakra & K.K. Choudhary, TMH
5. ASME, *Hand Book of Industrial Metrology*.

**Internal Continuous Assessment (Maximum Marks-30)**
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
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**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  
5 x 2 =10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 =20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 =40 marks
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 704: Power Plant Engineering

Teaching scheme  
2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives
- To impart the concept of power plant technology.
- To develop understanding about power plant cycles, power generation devices, and power plant economics.

Module I (9 hours)
Analysis of vapor power cycle- Rankine cycle-re heat and re- generative cycles-open and closed feed water heaters –cogeneration- combined gas power cycle-binary vapour cycle.

Module II (9 hours)
Steam turbines- classification-velocity diagrams-efficiencies-turbine performance and governing, condensers and cooling towers –classification –selection and performance
Thermal power plant systems- fuel handling and ash handling systems-combustion equipments-super heaters, economizers and air-pre heaters. Pollution from thermal power plant-pollution control.

Module III (9 hours)
Modern high pressure boilers-sub critical and super critical steam generation-rating of boilers-boiler efficiency-equivalent evaporation-boiler draught-guidelines for selection of boilers for steam power plants-.boiler testing and trials-inspection and safety regulations.

Module IV (9 hours)
Nuclear and MHD power generation-nuclear fission-chain reaction- pressurized water reactors-boiling water reactors-gas cooled reactors-fast breeder reactors-MHD power cycle principles.
Economics of power plant-actual load curve- fixed cost- operating cost-variable load operation.

Text Books

Reference Books
2. P. C. Sharma, Power Plant Engineering, S.K Kataria and Sons
3. Domkundwar, Power Plant Engineering, S. Chand.
**Internal Continuous Assessment (Maximum Marks-30)**

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*Maximum Total Marks: 70*
University of Calicut

ME09 707(P): CAD Lab

Teaching scheme
3 hour practical per week

Credits: 2

Objectives
- To train the students in solid modelling
- To practise static and dynamic analyses using FEM
- To practise computer controlled manufacturing methods

1. Exercises on solid modeling (12 hours)
   Introduction to computer graphics - viewing transformations, curves and surfaces generation, curve fitting and curve fairing techniques - 2D, wire frame, 3D shading - familiarity with Boolean operations - sweep, revolve, loft, extrude, filleting, chamfer, splines etc. - windowing, view point, clipping, scaling and rotation transformations using commercial solid modeling packages

2. Exercises on finite element analysis (12 hours)
   Introduction to FEM - 1D, 2D and 3D elements - shape functions - preprocessing - boundary conditions, structured and free mesh generation - analysis - linear and non linear analysis - static and dynamic analysis - post processing - display, animation, extraction of nodal data - exercises on heat conduction and elasticity may be given using commercial FEM packages

3. Assembly and mechanism design (6 hours)
   Assembling of various parts and tolerance analysis - synthesis and design of mechanisms - animations - exercises on various mechanisms like four bar linkages and its variations - cam and follower - two and four stroke engines

4. Computer aided manufacturing (9 hours)
   Part programming fundamentals - manual part programming and computer aided part programming - hands on training in computer controlled turning and milling operations - familiarity with windows based software packages - tool path generation and simulation - exercises on CNC lathe and machining center/milling machines

5. Programming of industrial robots (6 hours)
   Introduction to robotics - structure, workspace analysis and various components - actuators - sensors - encoders - end effectors - applications - hands on training on industrial robots - manual and programmed path planning

6. Computer aided inspection and quality control (3 hours)
   Introduction to CMM - classification - structure - components - familiarity with measurement software packages and its modules - demonstration of the capability of coordinate measuring machine using a sample component e.g. - engine block - concepts of reverse engineering and rapid prototyping technology
Reference Books

Internal Continuous Assessment *(Maximum Marks-50)*
- 60% - Practicals and Record (30 marks)
- 30% - Test /s (15 marks)
- 10% - Regularity in the class (5 marks)

Semester End Examination *(Maximum Marks-50)*
- 70% - Procedure, modelling steps, analysis, results, and inference (35 marks)
- 20% - Viva voce (10 marks)
- 10% - Fair record (5 marks)
Objectives

- To provide knowledge of uncertainties involved in any measurement.
- To train the students in the calibration and use of different measuring instruments.

I. (a) Determination of uncertainties in computed quantities such as the following
   (i) Volume of a rectangular block or cylinder computed from measurements of length, width, height and diameter
   (ii) Water power computed from measurements of density, local acceleration due to gravity, volumetric flow rate and head
   (iii) Shaft power computed from measurements of speed and torque
   (iv) Electrical power computed from measurements of “number of rotations of energymeter disk”, time taken and “energymeter constant”

(b) Selection of instruments for computing quantities with desired uncertainties

II. Determination of bias and random error of the following instruments by calibrating them using proper standards
   (i) Load cells such as strain-gauge-load cells, strain-gauge-beam transducer etc.
   (ii) Rotameter
   (iii) Bourdon-tube pressure gauge
   (iv) LVDT
   (v) Thermocouples
   (vi) Tachometers
   (vii) Constant area flow meters

III. (a) Preparation of a psychrometric chart for the laboratory and determination of psychrometric properties of atmospheric air - use of Sling psychrometer
   (b) Analysis of exhaust gases and flue gases with the help of orsats apparatus, gas chromatograph, paramagnetic oxygen analyser, smokemeter etc.
   (c) Acoustic measurements: sound level meter-octave band filter- preparation of noise contours
   (d) Plotting of velocity profiles using pitot tubes and hot wire anemometers

IV. Study of, and making measurements with: Water meter, velometers, pH meter, slip gauges, comparators, planimeter, pyrometers, RTDs, thermistors, CRO, multimeters, linear capacitance meters & LDR (light depended resistance)

V. Determination of static and dynamic characteristics of zero, first and second order instruments

Reference Books

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

- 60% - Practicals and Record (30 marks)
- 30% - Test /s (15 marks)
- 10% - Regularity in the class (5 marks)

### Semester End Examination (Maximum Marks-50)

- 70% - Procedure, modelling steps, analysis, results, and inference (35 marks)
- 20% - Viva voce (10 marks)
- 10% - Fair record (5 marks)
**ME09 709(P): Project**

**Teaching scheme**
1 hour practical per week

**Credits:** 1

**Objectives**
- To practise the steps involved for the selection, execution, and reporting of the project.
- To train the students for group activities to accomplish an engineering task.

The project work shall be a theoretical/ experimental/ design/ software project on any of the topics of mechanical engineering interest. The head of the department will decide the framing of the project batches. Each of the batches shall consist a minimum of five students. The topic of the project should be different from his/her mini project. A faculty member will always be supervising each group as an internal guide. In case an industrial project is selected by a batch, in addition to the internal guide, there should be an external guide from the industry.

During this semester, each group is required to select a topic for the project and study the feasibility. A project evaluation committee will be constituted by head of the department at the beginning of the semester. A brief report of the chosen project should be submitted before the committee within two weeks from the beginning of the VIIth semester. The committee will give permission for the project after examining the feasibility. In the event of rejection of the topic by the committee, the students should resubmit a new project topic within one week, and get it approved by the committee. After getting the permission, they have to conduct a detailed literature survey, and collect sufficient information and necessary data. Further, they have to prepare an action plan to carry out the project in the next semester. At the end of the semester, each group should prepare a preliminary report of the project, and appear before the committee for evaluation.

The assessment of the projects should be done at the end of the seventh semester by the committee. The committee will award the group average marks based on the group-wise performance. Based on the group average awarded by the committee, the respective guide will award the individual internal marks (max. 100 marks). For awarding individual marks following points shall be noted.
- Attendance, regularity and individual contribution of each student
- Individual evaluation through viva voce / test
ME09 801: Refrigeration and Air Conditioning

Teaching scheme
4 hours lecture and 1 hour tutorial per week

Credits: 5

Objectives
• To impart the concept of the basic principles, working, scientific analysis and system components of different types of refrigeration and air conditioning systems.
• To impart the knowledge of various types of refrigerants, their properties, selection criteria and environmental aspects

Pre-requisites: Fundamentals of thermodynamics and heat and mass transfer

Module I (18 hours)

Module II (18 hours)

Module III (20 hours)

Module IV (16 hours)
filters, grille – grille accessories – dampers, diffusers, registers, fans and blowers, AHUs. AC system controls – thermostat and humidistat.

Text Books
4. ASHRAE *Handbook*.

Reference Books

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

5 x 2 marks = 10 marks

PART B: *Analytical/Problem solving questions*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

4 x 5 marks = 20 marks

PART C: *Descriptive/Analytical/Problem solving questions*

Two questions from each module with choice to answer one question.

4 x 10 marks = 40 marks

Maximum Total Marks: 70
ME09 802: Compressible Fluid Flow

Teaching scheme
2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives
- To impart the concept of compressible fluid flow.
- To develop understanding about flow through duct and nozzles under various conditions.

Module I (9 hours)

Module II (9 hours)

Module III (9 hours)
Adiabatic flow through constant area duct with friction – fanno line – variation of flow properties – coking due to friction – use of gas tables.
Flow through constant area duct with heat transfer – Rayleigh line – Rayleigh flow equations – conditions for maximum heat transfer – use of gas tables.

Module IV (9 hours)

Text Books

Reference Books
## Internal Continuous Assessment *(Maximum Marks-30)*

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## University Examination Pattern

### PART A: Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

### PART B: Analytical/Problem solving questions  
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

### PART C: Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
Objectives

• To practise various activities involved in a seminar talk – gathering information, preparation of slides, discussion, reporting.
• To develop the communicative and writing skills in technical reporting.

Individual students are required to choose a topic from emerging /thrust areas, topics of current relevance having research aspects in the field of mechanical engineering, or shall be based on industrial visits undergone in the previous semesters, preferably from outside the B.Tech syllabus and give a seminar on that topic for about thirty minutes. A group consisting of at least three faculty members should assess the presentation and will award the marks to the students. Evaluation shall be based on the following pattern.

• Report = 50 marks
• Concept/knowledge in the topic = 20 marks
• Presentation = 30 marks
  Total marks = 100 marks
Objectives
- To practise the steps involved for the selection, execution, and reporting of the project.
- To train the students for group activities to accomplish an engineering task.

During VIIIth semester, each group is required to complete the project as per the plan made in the preliminary report submitted during the VIIth semester. At the middle of the VIIIth semester an Interim Evaluation will be carried out by the evaluation committee constituted in the previous semester. At the end of the semester, each group should also appear for Final Evaluation. Maximum marks for the Interim Evaluation and Final Evaluation will be 30 and 70, respectively.

Interim Evaluation of the project should be done at the middle of the eighth semester by the committee. Each group should submit a copy of the Interim Report of the Project before the committee. Also, copies of the Approval of Project and Preliminary Report shall be submitted to the evaluation committee. The committee will award the group average marks based on the group-wise performance. Based on the group average awarded by the committee, the respective guide will award the individual internal marks (max. 30 marks). For awarding individual marks following points shall be noted.
- Attendance, regularity and individual contribution of each student
- Individual evaluation through viva voce / test

Final Evaluation will be conducted by the committee at the end of the semester. The students are required to bring the Final Project Report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.
- Report = 40 marks
- Concept/knowledge in the topic = 20 marks
- Presentation = 10 marks
  Total marks = 70 marks
**ME09 807(P): Viva Voce**

**Credits:** 3

**Objectives**
- To assess the knowledge and experience gathered during the course.

There will be an Semester-end Examination for the conduct of viva voce. The examination will be covering the theory subjects, mini project, main project, seminar, industrial visit, paper presented at national level or above that has been undergone by the student. A panel of examiners consisting of three members, two external examiners and one internal examiner will conduct the viva voce and award the marks. Mark distribution shall be as follows.

- Subjects : 40
- Seminar : 20
- Project & Mini project : 30
- Industrial visit/ paper presented at national level or above : 10
- Total marks : 100
ME09 L06: Aerospace Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

- To impart the concepts of aerospace engineering.
- To develop understanding about aerofoil theory and airplane performance.

Pre-requisites: Basic knowledge of fluid mechanics and gas dynamics

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
1. Dommasch, Airplane Aerodynamics,
2. A. C. Kermode, Mechanics of Flight,
3. Houghton, Brock, Aerodynamics for Engineering Students,
Internal Continuous Assessment (Maximum Marks-30)

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions  
4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L07: Automobile Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart the concepts of automobile engineering.
- To develop understanding about various automobile components

Pre-requisites: Basic knowledge of mechanical engineering

Module I (13 hours)
Introduction: General classification of automobiles, layout of chassis, types of drives of automobile.

Module II (13 hours)
Cooling system: Methods of cooling – coolant types.

Module III (13 hours)
Brakes: Mechanical, hydraulic, vacuum and air brakes – antilock braking systems.

Module IV (13 hours)
Types of wheel: Integrated rim – flat base rim alloy wheel – wheel balancing.
Tyres: Tubeless tyres – ply ratings – radial tyres.

Text Books
1. J. Heitner, Automotive Vehicles,

Reference Books
1. K. Singh; Automobile Engineering- vol I and II
2. Narag, Automobile Engineering, Khanna publishers
3. K. M. Gupta, Automobil Engineering- vol I and II
**Internal Continuous Assessment (Maximum Marks-30)**

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

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**University Examination Pattern**

**PART A:** *Short answer questions (one/two sentences)*

5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
University of Calicut

ME09 L08: Combustion Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart the concept of principles of combustion.
- To develop understanding about principles of thermodynamics of combustion.

Pre-requisites: Basic knowledge of thermodynamics and heat transfer.

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Miscellaneous topics: Droplet combustion – fluidised bed combustion – air pollution.

Text Books

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks

Candidates have to answer four questions out of six. There should be at least one question from
**Internal Continuous Assessment** *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

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**University Examination Pattern**

**PART A:** *Short answer questions (one/two sentences)*

5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L09: Computational Fluid Dynamics

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives:
- To impart the concept of computational methods in fluid flow and heat transfer
- To develop understanding about principles of fluid flow modelling.

Pre-requisites: Basic knowledge of fluid mechanics and heat transfer

Module I (13 hours)
Classification of partial differential equations - system of first and second-order partial differential equations - initial and boundary conditions - finite difference formulations - finite difference equations – simple applications in steady state conduction and convection.

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)
Introduction to finite volume method – regular finite volume – approximations in the discretization technique – discretization procedure – semi-explicit method – implementation of boundary conditions (only elementary theory and no direct problems).

Text Books
1. T. Sundararajan, *Computational fluid flow and heat transfer*, Narosa publishing House

Reference Books
1. A. Hoffmann Klaus, *Computational Fluid Dynamics for Engineers - Volume I*, Engineering Education System, Wichita
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L10: Computerised Materials Management

Objectives

- To provide knowledge on basics of advances in materials management

Pre-requisites: Basic knowledge of management principles

Module I (14 hours)

Module II (13 hours)
Inventory control – Basic methods in Inventory – Assumptions used in deriving models. Inventory costs and EOQ model. Price breaks and quantities – Effects of variations in lead-time and demand. Effects of shortage cost on EOQ. Systems of Inventory control, Design of Inventory control systems. Development of Computer Programme for forecasting.

Module III (14 hours)

Module IV (13 hours)

Reference Books
1. Bnchan, Kbenigsberg, Scientific Inventory Management
2. Starr, Miller, Inventory Management
4. P.Gopalakrishnan, Integrated Material management
5. Tershine, Principles of Inventory management
Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks=10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks=20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks=40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L11: Control System Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide knowledge on basics of control system

Pre-requisites: Basic mathematics

Module I (14 hours)

Module II (13 hours)
Classification of control systems-Trancient response analysis-first and second order representations- Derivation of Transfer functions.

Module III (14 hours)

Module IV (13 hours)
Math lab fundamentals- linear and non linear systems –matrix, tensor representations of control systems –solutions by math lab (simple examples).

Reference Books
1. R. K. Jain, Mechanical and Industrial Measurements
2. D. M. Considine, Process Instrument and Control Hand Book
3. E. O. Doeblin, Measurements System, Application and Design
4. K. Ogatta, Modern control systems,
5. B. Kuo, Control Systems, Prentice Hall

Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
Objectives

- To provide knowledge on basics of low temperature production and applications

Pre-requisites: Basic knowledge of thermodynamics and refrigeration

Module I (13 hours)
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.

Module II (16 hours)

Module III (12 hours)
Cryogenic Refrigeration systems: Ideal Refrigeration systems- Refrigeration using liquids and gases as refrigerant- Refrigerators using solids as working media, cryogenic fluid storage and transfer systems:

Module IV (13 hours)

Text Books


Reference Books

2. R. B. Scott, Cryogenic Engineering
3. J. H. Boll Jr., Cryogenic Engineering
**Internal Continuous Assessment** (*Maximum Marks-30*)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

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**University Examination Pattern**

**PART A:** *Short answer questions (one/two sentences)*

5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

4 x 5 marks=20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

4 x 10 marks=40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L13: Design of Heat Transfer Equipments

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To impart the concepts of design of heat transfer equipments.
• To develop understanding about design of various heat exchangers

Pre-requisites: Basic knowledge of fluid mechanics and heat transfer

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books

Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
### University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L14: Design of Jigs & Fixtures

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide knowledge on design of different cutting tools
- To develop comprehensive idea on design of jigs and fixtures

Pre-requisites: Metal cutting and Forming

Module I (12 Hours)

Module II (14 Hours)

Module III (14 Hours)

Module IV (14 Hours)

Text books:
University Examination Pattern

PART A:  Short answer questions (one/two sentences)  5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B:  Analytical/Problem solving questions  4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C:  Descriptive/Analytical/Problem solving questions  4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L15: Design of Pressure Vessels and Piping

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

• To provide knowledge on design of pressure vessels and piping.

Pre-requisites: Basic knowledge of solid mechanics

Module I (13 Hours)

Module II (13 Hours)
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. Theory of reinforcement - pressure vessel design.

Module III (14 Hours)
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 - elastic buckling of cylinders - buckling under combined external pressure and axial loading.

Module IV (14 Hours)

Text book

Reference books
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L16: Financial Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart knowledge on financial management of organisations

Module I (14 hours)
Scope of financial management- Investment financing and asset management decisions.
Type of business organisations- sole proprietorship, partnership, private company and public company.
Goals of the firm: Profit maximization, wealth maximization- management verses owners, social responsibility.
Major financial decision areas: Investment financing and dividend decisions. Basic factors influencing financial decisions-internal and external factors.

Module II (14 hours)
Capital budgeting- meaning, importance, difficulties and rationale.
Data requirement: Cash flow patterns
Tax effect, effect on other projects, effect of depreciation and effect of indirect expenses.
Method of appraisal: traditional techniques: Average rate of return (ARR) method-Pay back method.
Discounted cash flow techniques: present value, net present value, internal rate of return. Terminal value and profitability index methods.

Module III (13 hours)
Working capital management: Need for working capital, classification of working capital-Source of fixed and variable working capital.
Components of working capital: Positive and negative working capital-estimation of working capital requirement-Liquidity profitability tangle.

Module IV (13 hours)
Lease financing: Concept and classification-Significance and limitations.

Reference Books
2. Ezera Solomon, Theory of financial management.
3. H Beeman Jr. and S Smdidi, Capital budgeting decisions
4. Prasanna Chandra, Financial management theory and practice
5. M Y Khan & P K Jain, Financial management
**Internal Continuous Assessment** *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

**University Examination Pattern**

**PART A:** *Short answer questions (one/two sentences)*  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L17: Fracture Mechanics

Objectives
• To impart knowledge on linear elastic fracture mechanics, crack tip plasticity, Elastic – Plastic Fracture Mechanics, Fatigue crack growth and application of fracture mechanics concepts to design

Module I (13 hours)
Introduction: Introduction to conventional and fracture mechanics approaches to design – significance of defects in materials – brittle fracture experienced in the past – the effect of material properties on fracture.

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)
Application of fracture mechanics concepts to design: Means to provide fail safety and damage tolerance – application to pressure vessel and pipelines – Leak before break criterion – material selection – use of fatigue crack growth parameters and its application to design.
**Text Books**
1. Prashant Kumar, *Elements of fracture mechanics*, Wheeler publishing

**Reference Books**

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**Internal Continuous Assessment (Maximum Marks-30)**

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

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**University Examination Pattern**

**PART A:** *Short answer questions (one/two sentences)*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objectives
- To impart knowledge on principles of refrigeration, cooling and heating load calculation, design of air conditioning system and selected systems in comfort engineering.

Pre-requisites: Basics of thermodynamics, fluid mechanics, and heat transfer

Module I (14 Hours)

Module II (13 Hours)
Cooling and heating load calculation - selection of design temperatures - sources of heat load- heat transfer through structures - solar radiation - Infiltration and ventilation- Heat generation inside the conditioned space - heat storage, Diversity and stratification.

Module III (13 Hours)
Design of air conditioning system. Continuity equation, Bernoulli’s equation, pressure losses, Duct design - pressure drop in ducts, pressure drop by graphical method- method of duct design- Arrangements of ducts, fan – design, thermal insulation

Module IV (14 Hours)
Heating systems-warm air systems-hot water systems steam heating systems-panel and central heating systems-heat pump circuit. Applications- comfort air conditioning-effective temperature-thermal analysis of human body- Air conditioning systems- evaporate cooling- low humidity applications Automobile and Train car air conditioning.

References:
1. C. P. Arora, Refrigeration and Air Conditioning.
3. W. P. Jones, Air-conditioning Engineering
4. Carriers Handbook system design of Air Conditioning
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L19: Industrial Automation

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To impart knowledge on basics of automation, sensors, robots and its application

Pre-requisites: Nil

Module I (13 Hours)
Introduction to automation: Basic notions and definitions, technical and economic requisites. Automation as a means of control and inspection- Basic control system concepts - control system analysis, systems of automatic control.

Module II (14 Hours)
Sensors: Sensory equipment, range sensing - proximity sensing - touch sensing - force and torque sensing - signal conditioning equipment.
Introduction to machine vision, sensing and digitizing - image processing and analysis - applications.
Introduction to robots: Definition of robot - basic concepts - robot configurations - types of robot drives - basic robot motions - point to point control - continuous path control.

Module III (14 Hours)
Components and operations: Basic actuation mechanisms - robot actuation and feedback, manipulators - director and inverse kinematics, coordinate transformation - brief robot dynamics. types of robot and effectors - grippers - tools as end effectors – robot end - effort interface.
Robot programming: Methods - languages - capabilities and limitation - artificial intelligence – knowledge representation – search techniques - AI and robotics.

Module IV (13 Hours)

Text books:

Refernce Books:
3. Yu.Kozyrev, Industrial Robots,
4. V. Tergan, I. Andreev, B. Liberman, Fundamentals of Industrial Automation,
**Internal Continuous Assessment (Maximum Marks-30)**

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences) 
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions 
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions 
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L20: Industrial Tribology

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart knowledge on theory of lubrication, finite journal and thrust bearings, hydrodynamic gas bearing and theory of friction and wear.

Pre-requisites: Basics of material science and mechanics

Module I (13 Hours)

Module II (13 Hours)

Module III (14 Hours)

Module IV (14 Hours)

Text books:
1. B. C. Majumdar, Introductin to Tribology, A H Wheeler, Bangalore.

Reference Books:
1. Pinkus and Stermilincht, Theory of hydrodynamic lubrication, John Wiley and Son, Newyork
2. D. F. Moore, Principle and Application of Tribology, Pergamon Press, Newyork
5. T. R. Thomas, Rough Surfaces, Longman Inc.
Internal Continuous Assessment (Maximum Marks-30)

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L21: Logistics and Supply Chain Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To equip students with a comprehensive understanding of supply chain management
- To understand how the environment affects the design, implementation and management of supply chains.
- To develop competence in distribution and logistics management

Pre-requisites: nil

Module I (13 hours)
Concept of Supply Chain – Decision phases in Supply Chain – Process view of Supply Chain - Supply Chain flows - Supply Chain and competitive performance – performance measures of Supply Chain – Strategic fit – Drivers and Obstacles

Module II (14 hours)
Demand forecasting in Supply Chain – Components of forecast and forecasting methods – Managing supply, Managing demand and Managing variability – Inventory Management in Supply Chain – Uncertainties of demand

Module III (13 hours)
Sourcing decisions in Supply Chain – Pricing and revenue management in Supply Chain – Coordination in Supply Chain – IT and Supply Chain

Module IV (14 hours)
Logistics Management – Definition of Logistics and concept of Logistics – Logistic activities – Functions of Logistics system – Transportation in Supply Chain – Design options for a transportation network – Trade offs in transportation design – Designing distribution network

Text Books

Reference Books
1. Janat Shah, Supply Chain Management: Text and Cases, Pearson Education South Asia, 2009
4. Christopher M., Logistics and Supply Chain Management, Pitman Publishing Company
5. John Mortimer (Editor), Logistics in Manufacturing: An IFS Executive Briefing, IFS Publications, U.K. & Springer-Verlag
6. Raghuram G. & Rangaraj N., Logistics and Supply Chain Management: Cases and Concepts, Macmillan India Limited
### Internal Continuous Assessment (Maximum Marks-30)

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

**PART A:**  
**Short answer questions (one/two sentences)**  
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:**  
**Analytical/Problem solving questions**  
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:**  
**Descriptive/Analytical/Problem solving questions**  
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L22: Quality Engineering and Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To analyse key definitions of quality, focusing on a customer-centric approach.
- To provide knowledge on the managerial tools and techniques on quality
- To analyze the relationship of statistics to a process and to use the statistical tools
- To analyze and generate acceptance sampling plans
- To provide knowledge on the reliability and life testing of components and systems

Module I (14 hours)
Concepts of quality: Quality – Quality control – Quality assurance – Quality management- Quality costs

Module II (13 hours)
Management tools and techniques: Benchmarking – ISO quality management systems – Quality function deployment – Quality by design – Failure mode and effect analysis – Affinity diagram – Block diagram – Pareto chart – Fish bone diagram – Flow chart – Run chart – Scatter diagram – Tree diagram – Matrix diagram

Module III (14 hours)
Statistical tools 1-control charts: Basic concepts - Attributes and variables - Random and assignable causes of variations- Patterns of variation - Measures of central tendency and dispersion - Probability distributions: Binomial, Poisson and Normal
Control charts for variables : X , R and sigma charts – Details of construction and uses Control charts for attributes: p, np, c and u charts – Details of construction and uses
(Numerical problems included)

Module IV (13 hours)
Statistical tools 2- Acceptance sampling, Reliability and Life testing: Sampling Vs inspection - OC curve - Single and double sampling plans - ATI - AOQL - Life testing - Bathtub curve – MTBF - OC curve for Life testing - System reliability (Numerical problems included)
Reference Books


Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
ME09 L23: Industrial Safety Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

• To provide on concept of safety in industry, principle of accident prevention, major hazards, consequences and concept of reliability.

Pre-requisites: Nil

Module I (14 Hours)
Introduction to the concept of safety-Need-safety provisions in the factory Act-Laws related to the industrial safety-Measurement of safety performance, Safety Audit, Work permit system, injury and accidents-Definitions-Unsafe act –unsafe condition- causes, investigations and prevention of accidents, hazards, type of industrial hazards-nature, causes and control measures, hazard identifications and control techniques-HAZOP, FMEA,FMECA etc.

Module II (14 Hours)

Module III (13 Hours)
Logics of consequence analysis-Estimation-Toxic release and toxic effects-Threshold limit values, Emergency planning and preparedness, Air pollution-classification- Dispersion modeling -pollution source and effects- -control method and equipments-Gravitational settling chambers-cyclone separators-Fabric filter systems-scrubbers etc.

Module IV (13 Hours)
Concept of reliability-Definition-Failure rate and Hazard function, System reliability models-series, parallel systems, reliability hazard function for distribution functions-exponential-normal –lognormal-weibull and gamma distribution.

Text books
3. C.S.Rao, Environmental Pollution Control Engineering, New Age International Limited
Reference books


Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
Objectives

- To impart knowledge on fundamentals of marketing, marketing environment market oriented strategic planning, marketing research and marketing communications.

Pre-requisites: Basic knowledge of principles of management

Module I (13 hours)
Introduction to marketing: Defining marketing for the twenty first century, marketing – scope, tasks, concept of market and marketing, company orientations towards the market place – production, product, selling, marketing, customer and societal marketing concepts.
Marketing environment: Controllable factors, identifying and responding to the major macro environment – uncontrollable factors – demographic, economic, natural technological, political-legal and social – cultural environment.

Module II (13 hours)

Module III (13 hours)

Module IV (15 hours)
Marketing communications – process – developing effective communications – Identification of the target audience, determination of communication objectives, Designing the message, select the communication channels, establishing the total marketing communications budget – Deciding on the marketing communications mix – promotional tools an over view – advertising, sales promotion, public relations and publicity, sales force and direct marketing- developing and managing an advertising program – setting objectives, deciding budget, choosing message – an overview on measuring effectiveness of a media – sales promotion – purpose, major decisions.

Text Books

Reference Books
### Internal Continuous Assessment (Maximum Marks-30)

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### University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
ME09 L25: Energy Engineering and Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide knowledge on energy conservation and management.
- To impart the basics of renewable energy technology

Pre-requisites: Nil

Module I (13 hours)

Module II (14 hours)
Energy conservation: Industrial energy use – energy surveying and auditing – energy index – energy cost – energy conservation in engineering and process industry, in thermal systems, in buildings and non conventional energy resources schemes.

Module III (14 hours)

Module IV (13 hours)

Text Books

Reference Books
1. O. Callaghn, Design and Management for energy conservation, Pergamon Press, Oxford
2. D. Merick, Energy - Present and Future Options, vol 1 and 2, John Wiley and Sons

Scheme and Curriculum – B.Tech. Mechanical Engineering 144
### Internal Continuous Assessment *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

5 x 2 marks = 10 marks

**PART B:** *Analytical/Problem solving questions*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

4 x 5 marks = 20 marks

**PART C:** *Descriptive/Analytical/Problem solving questions*

Two questions from each module with choice to answer one question.

4 x 10 marks = 40 marks

*Maximum Total Marks: 70*
PE09 L25: Entrepreneurship

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objectives
• To give an idea on entrepreneurial perspectives

Module I (14 hours)
Entrepreneurial perspectives- understanding of entrepreneurship process- entrepreneurial decision process- entrepreneurship and economic development- characteristics of entrepreneur- entrepreneurial competencies- managerial functions for enterprise.

Module II (14 hours)
Process of business opportunity identification and evaluation- industrial policy- environment- market survey and market assessment- project report preparation-study of feasibility and viability of a project-assessment of risk in the industry

Module III (13 hours)
Process and strategies for starting venture- stages of small business growth- entrepreneurship in international environment- entrepreneurship- achievement motivation- time management creativity and innovation structure of the enterprise- planning, implementation and growth

Module IV (13 hours)
Technology acquisition for small units- formalities to be completed for setting up a small scale unit-forms of organizations for small scale units-financing of project and working capital-venture capital and other equity assistance available- break even analysis and economic ratios technology transfer and business incubation

Text Books
5. Dr. Patel V.G., Seven Business Crisis, Tata McGraw hill
7. Rao C.R., Finance for small scale Industries
### Internal Continuous Assessment *(Maximum Marks-30)*

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### University Examination Pattern

**PART A:** Short answer questions *(one/two sentences)*  
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
EC09  L25: Biomedical Instrumentation

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart knowledge about the principle and working of different types of bio-medical electronic equipments/devices

Module I (14 hours)
Electrical activity of excitable cells-SD curve-functional organization of the peripheral nervous system-electrocardiogram (in detail with all lead systems)-electroencephalogram-electromyogram -electroneurogram- electrode –electrolyte interface-polarisation-polarisable and non polarisable electrodes- surface electrodes –needle electrodes-micro electrodes- practical hints for using electrodes-‘skin- electrodes’ equivalent circuit-characteristics of ‘bio-amplifiers’

Module II (14 hours)

Module III (13 hours)

Module IV (13 hours)
Physiological effects of electricity-important susceptibility parameters-macro shock hazards-micro shock hazards-protection against shock-electrical isolation- electrical safety analyzers-measurements of pH,pC2, and PO2

Text Books
2. Handbook of Biomedical Instrumentation, Tata-Migraw Hill, New Delhi

Reference Books
2. Encyclopedia of Medical Devices and Instumentation Wiley
Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation using any of the tools

University Examination Pattern

**PART A:** Short answer questions *(one/two sentences)*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

5 x 2 marks = 10 marks

**PART B:** Analytical/Problem solving questions

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

4 x 5 marks = 20 marks

**PART C:** Descriptive/Analytical/Problem solving questions

Two questions from each module with choice to answer one question.

4 x 10 marks = 40 marks

Maximum Total Marks: 70
CS09 L23 : Simulation and Modelling

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

- To teach the students how to reproduce real-world events or process under controlled laboratory conditions, using mainly mathematical models.

Module I (10 hours)
Introduction - systems and models - computer simulation and its applications - continuous system simulation - modeling continuous systems - simulation of continuous systems - discrete system simulation - methodology - event scheduling and process interaction approaches - random number generation - testing of randomness - generation of stochastic variates - random samples from continuous distributions - uniform distribution - exponential distribution m-Erlang distribution - gamma distribution - normal distribution - beta distribution - random samples from discrete distributions - Bernoulli - discrete uniform - binomial - geometric and poisson

Module II (12 hours)
Evaluation of simulation experiments - verification and validation of simulation experiments - statistical reliability in evaluating simulation experiments - confidence intervals for terminating simulation runs - simulation languages - programming considerations - general features of GPSS - SIM SCRIPT and SIMULA.

Module III (15 hours)

Module IV (15 hours)

Reference Books
1. C. Deo N., System Simulation And Digital Computer, Prentice Hall of India.
Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

**Note:** One of the assignments shall be computer based simulation of continuous systems using any technical computing software
One of the tests must be computer based (practical).

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**University Examination Pattern**

**PART A:** Short answer questions *(one/two sentences)*
5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions
4 x 5 marks=20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions
4 x 10 marks=40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
Objective
To make students aware of various measurement techniques and experimental planning and procedures adopted in laboratory

Module I (14 hours)
Strain gauges - definition of gauge length - sensitivity and range - characteristics of an ideal strain gauge - different types of mechanical strain gauges, optical strain gauge - acoustic strain gauge - pneumatic strain gauge - merits and demerits - electrical strain gauges - inductance, capacitance and piezo electric gauges - bonded and unbonded resistance gauges and their application in stress analysis - fixing techniques and measurement of strains - rosettes - determination of principal stress - construction of stress, strain circles - analytical solution

Module II (13 hours)
Photo elasticity - basics of optics, stress optic law - plane and circularly polarized light and their use in photos elasticity - polariscopes - diffusion type - lens type polariscopes - isoclinics and isochromatics

Module III (14 hours)
Model materials - calibration methods for finding material fringe values - model fringe values - examples of beam flexure and diametrically loaded circular plates.
Computer based data acquisition systems.

Module IV (13 hours)
Model analysis - direct and indirect models - laws of structural similitude - choice of scales - limitation of model studies - buckingham pi-theorem - dimensional analysis - model materials - Begg’s deformater and its use - simple design of direct and indirect models

Text Books
1. Dally, J. W. and Raliley W.F., Experimental Stress Analysis, McGraw Hill.
2. Srinath L.S., Experimental Stress Analysis, Tata McGraw Hill
3. Roy, T.K., Experimental Analysis of stress and strain

Reference Books
1. Dove and Adams, Experimental Stress Analysis and Motion measurement, Prentice Hall
Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences)  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
EE09 L22: Soft Computing Techniques

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To acquaint the students with the important soft computing methodologies- neural networks, fuzzy logic, genetic algorithms and genetic programming

Module I (12 Hours)
Artificial Intelligent systems – Neural Networks, Fuzzy Logic and Evolutionary Programming concepts.

Module II (14 Hours)

Module III (14 Hours)

Module IV (14 Hours)

Text Books
Reference Books

1. Fakhreddine O. Karray, Clarence De Silva, Intelligent Systems Design, Theory, Tools and Application, Pearson Education

Internal Continuous Assessment (Maximum Marks-30)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments may be simulation of systems using any technical software

University Examination Pattern

PART A: Short answer questions (one/two sentences) 5 x 2 marks = 10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions 4 x 5 marks = 20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks = 40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
EE09 L25: Robotics and Automation

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To give an introduction of industrial robotics and automation

Module I (14 Hours)

Module II (13 Hours)

Module III (14 Hours)

Module IV (13 Hours)

Text Books
2. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Robotics, Control, Sensing and Intelligence, McGraw Hill
### Internal Continuous Assessment *(Maximum Marks-30)*

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### University Examination Pattern

**PART A:**  *Short answer questions (one/two sentences)*  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:**  *Analytical/Problem solving questions*  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:**  *Descriptive/Analytical/Problem solving questions*  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
CH09 L22: Nuclear Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart the basic concepts of nuclear fusion and fission as energy source
- To develop understanding about feed processing and fuel recovery for nuclear reactors

No Pre-requisites

Module 1 (13 Hours)
Nuclear fission and fusion, types and classification of nuclear reactors, nuclear fuels, other reactor materials, fuel processing flow sheet, chemical processes for nuclear power industries, separation of reactor products, nuclides, radioactivity, decay chains, neutron reactions, fission process, growth and decay of fission products in a reactor with neutron burnout and continuous processing. Make up of reactor, reactor fuel process flow sheet, irradiation schemes, neutron balance, feed requirements and fuel burn up for completely mixed fuels with no recycle.

Module 2 (13 Hours)

Module 3 (13 Hours)

Module 4 (13 Hours)

References:
1. Vanson benedict and Thomas H Pigford “Nuclear chemical Engineering ”Mcgraw hill

**Internal Continuous Assessment** *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.  

5 x 2 marks = 10 marks

**PART B:** Analytical/Problem solving questions  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.  

4 x 5 marks = 20 marks

**PART C:** Descriptive/Analytical/Problem solving questions  
Two questions from each module with choice to answer one question.  

4 x 10 marks = 40 marks

**Maximum Total Marks:** 70
**Objectives**

- To impart the basic concepts of industrial pollution control
- To develop understanding about water, air, light pollution control

**No Pre-requisites**

**Module 1 (13hours)**
Classification of industrial wastewater - types of pollutants and their effects - monitoring and analysis methods - water pollution laws and standards - industrial wastewater treatment - processes and equipment

**Module 2 (13hours)**
Water pollution control in industries - pulp and paper, textile processing, tannery wastes, dairy wastes, cannyery wastes, brewery, distillery, meat packing, food processing wastes, pharmaceutical wastes, chlor-alkali industries, fertilizer industry, petrochemical industry, rubber processing industry, starch industries, metal industries, nuclear power plant wastes, thermal power plant wastes.

**Module 3 (13hours)**

**Module 4 (13hours)**

**References:**

5. Rao C.S., Environmental Pollution Control Engineering, New Age Int. Pub.
7. Babbitt H.E, Sewage & Sewage Treatment, John Wiley
8. Abbasi S.A. & Ramasami E, Biotechnical Methods of Pollution Control, Universities Press(India) Ltd.
### Internal Continuous Assessment (Maximum Marks-30)

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- **10%** - Regularity in the class

### University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*  
5 x 2 marks = 10 marks  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*  
4 x 5 marks = 20 marks  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*  
4 x 10 marks = 40 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
CH09 L25: Project Engineering

Teaching scheme

Credits: 4
3 hours lecture & 1 hour tutorial per week

Objectives

- To impart the basic concepts of project management

No Pre-requisites

Module 1 (13 hours)
Scope of project engineering - the role of project engineer - R & D - TEFR - plant location and site selection - preliminary data for construction projects - process engineering - flow diagrams - plot plans - engineering design and drafting

Module 2 (13 hours)
Planning and scheduling of projects - bar chart and network techniques - procurement operations - office procedures - contracts and contractors - project financing - statutory sanctions

Module 3 (13 hours)
Details of engineering design and equipment selection I - design calculations excluded - vessels - heat exchangers - process pumps - compressors and vacuum pumps - motors and turbines - other process equipment

Module 4 (13 hours)
Details of engineering design and equipment selection II - design calculations excluded - piping design - thermal insulation and buildings - safety in plant design - plant constructions, start up and commissioning

References:
1. Rase & Barrow, Project Engineering of Process Plants, John Wiley
2. Peter S. Max & Timmerhaus, Plant design and economics for chemical engineers.
7. Frederick B. Plummer, Project Engineering, BH
**Internal Continuous Assessment (Maximum Marks-30)**

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<td>C</td>
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<td>4 x 10 marks=40 marks</td>
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*Maximum Total Marks: 70*
**BM09 L24: Virtual Instrumentation**

**Teaching scheme**

3 hours lecture and 1 hour tutorial per week

**Credits:** 4

**Objectives**

- To impart knowledge on the concepts of virtual instrumentation.
- To provide knowledge on the data acquisition

**Module I (13 hours)**

Review of Virtual Instrumentation, Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

**Module II (14 hours)**

Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input. Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation

**Module III (13 hours)**

Common Instrument Interfaces for Current loop, Rs 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control.

**Module IV (14 hours)**

Use of Analysis Tools, Fourier transforms, Power spectrum, Correlation methods, windowing & flittering. Application of VI: Application in Process Control Designing of equipments like Oscilloscope, Digital Millimeter using Lab view Software, Study of Data Acquisition & control using Lab view Virtual instrumentation for an Innovative Thermal Conductivity Apparatus to measure the Thermal Conductivity Apparatus- to measure the conductivity of non Newtonian fluids while they are subjected to shearing force.

**Text Books**


**Reference Book**

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

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

10% - Regularity in the class

Note: One of the assignments shall be a term-project. The term project shall consist of Design of following Virtual Instruments (any two) using a graphical Programming software.

1. Data Acquisition using Virtual Instrumentation from Temperature transducer.
2. Data Acquisition using Virtual Instrumentation from a Pressure Transducer.
3. Creation of a CRO using Virtual Instrumentation.

University Examination Pattern

**PART A:** Short answer questions (one/two sentences)  
5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
University of Calicut

IT09 L24: Management Information Systems

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

• This course will introduce the methods and the influence of the information systems in management milieu and use MIS as an effective tool in management and decision making.

Module - I: (12 hours)
Information systems - functions of management - levels of management - framework for information systems - systems approach - systems concepts - systems and their environment - effects of system approach in information systems design - using systems approach in problem solving - strategic uses of information technology

Module - II: (10 hours)
An overview of computer hardware and software components - file and database management systems - introduction to network components - topologies and types - remote access - the reasons for managers to implement networks - distributed systems - the internet and office communications

Module - III: (14 hours)
Application of information systems to functional - tactical and strategic areas of management, decision support systems and expert systems

Module - IV: (16 hours)
Information systems planning - critical success factor - business system planning - ends/means analysis - organizing the information systems plan - systems analysis and design - alternative application development approaches - organization of data processing - security and ethical issues of information systems

Text Books

Reference Books
2. Sadagopan S, Management Information Systems, Prentice Hall of India
### Internal Continuous Assessment *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

**PART A:** *Short answer questions (one/two sentences)*

5 x 2 marks = 10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** *Analytical/Problem solving questions*

4 x 5 marks = 20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** *Descriptive/Analytical/Problem solving questions*

4 x 10 marks = 40 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
AM09 L25: Technology Forecasting

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

• To provide knowledge on basics of forecasting techniques

Pre-requisites: nil

Module I (16 hours)

Module II (12 hours)
Macro economics – Micro economics – communications and social feed back – technological diffusion and innovation.

Module III (12 hours)

Module IV (14 hours)
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)

Reference Books

2. Selected readings on Technology assessment – IIT Bombay, and Dept. of Science and Technology, N.Delhi
### Internal Continuous Assessment *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

#### PART A:
- **Short answer questions** *(one/two sentences)*
  - All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
  - $5 \times 2$ marks = **10 marks**

#### PART B:
- **Analytical/Problem solving questions**
  - Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
  - $4 \times 5$ marks = **20 marks**

#### PART C:
- **Descriptive/Analytical/Problem solving questions**
  - Two questions from each module with choice to answer one question.
  - $4 \times 10$ marks = **40 marks**

**Maximum Total Marks: 70**
BT09 L25: Bio Materials

Teaching Scheme:

3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives:

- To study the structure and characteristics of biomaterials of synthetic and natural origin
- To give an idea on the effective uses of these biomaterials

Prerequisite: Nil

Module I


Module II

Hard tissue replacement implant: orthopaedic implants (hip, knee), dental implants, adhesives and sealants. Soft tissue replacement implant. Skin implant, burn (wound), dressings/synthetic skin, dialysis membranes, scaffolds, vascular implants, heart valve implants. Artificial kidneys and livers. Sutures, biomaterials for gene delivery. Hydrogel as stimuli-sensitive biomaterials, ophthalmologic implants, biomaterials for drug delivery

Module III


Module IV

Biopolymers, definition, plant and animal biopolymers- polynucleotide, polyamides, polysaccharides, polyisoprene, lignin, polynucleotide and polyhydroxyl alkanoates. Application and chemical synthesis of super absorbent polymers, polyethylene glycol, polypropylene glycol, poly tetra methylene glycol, polyglycerine. Bioplastics and environment, commercial bioplastics. Natural fibers like silk, wool, flax, jute, linen, cotton, sisal, bamboo. Biocomposite-properties and applications

Reference Books

1. Ratner, Hoffman, Schoen  Biomaterial science- an introduction to materials in medicine Academic press
2. Park J.B. Biomaterials-science and engineering, Plenum press
4. R.M. Johnson, R.M. Mwaikambo, Tucker Biopolymers Rapra technology
**Internal Continuous Assessment** *(Maximum Marks - 30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

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**University Examination Pattern**

**PART A:** Short answer questions *(one/two sentences)*  \( 5 \times 2 \text{ marks} = 10 \text{ marks} \\ All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  \( 4 \times 5 \text{ marks} = 20 \text{ marks} \\ Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  \( 4 \times 10 \text{ marks} = 40 \text{ marks} \\ Two questions from each module with choice to answer one question.

Maximum Total Marks: 70
Module I (11 hours)

Module II (13 hours)

Module III (16 hours)

Module IV (12 hours)
Microsystem packaging - General considerations - The three levels of microsystem packaging – die level, device level and system level – essential packaging technologies – die preparation – surface bonding wire bonding and sealing - Three dimensional packaging, assembly of microsystems – selection of packaging materials.

**Text Book**

**Reference Books**

**Internal Continuous Assessment (Maximum Marks-30)**

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

**University Examination Pattern**

**PART A:** Short answer questions (one/two sentences)  5 x 2 marks=10 marks
   All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  4 x 5 marks=20 marks
   Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  4 x 10 marks=40 marks
   Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*
AN09 L25: Research Methodology

Teaching scheme
3 hours lecture and 1 hour tutorial per week credits 4

Objective:
To give an exposure to the major aspects of research and research approaches.

Module 1 (13hours)
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

Module II (14hours)
Defining research problem- what is a research problem- selecting the problem- necessity of defining the problem- literature review – importance of literature review in defining a problem- critical literature review – identifying gap areas from literature review

Module III (14hours)
Research design–meaning of research design-need–features of good design- important concepts relating to research design- different types – developing a research plan
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 (13hours)

Reference books

5. J.H. Ansari, Mahavir – ITPI Reading Material on Planning Techniques
Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Short answer questions *(one/two sentences)*  
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**PART B:** Analytical/Problem solving questions  
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

**PART C:** Descriptive/Analytical/Problem solving questions  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 70*