SCHEME AND SYLLABI

FOR

THIRD TO EIGHTH SEMESTERS

OF

BACHELOR OF TECHNOLOGY

IN

PRODUCTION ENGINEERING

FROM 2009 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM
## PRODUCTION ENGINEERING

### 3rd Semester

<table>
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<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/week</th>
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### 5th Semester

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### Elective I

- PE09 L01 Human Resource management
- PE09 L02 Marketing Management
- PE09 L03 Machine Tool Design
- PE09 L04 Mechatronics
- PE09 L05 Advanced Materials and Processing

### 7th Semester

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Electives

PE09 L06  Engineering Materials
PE09 L07  Linear System Analysis
PE09 L08  Safety Engineering
PE09 L09  Industrial Tribology
PE09 L10  Supply Chain Management
PE09 L11  Technology Management
PE09 L12  Software Engineering
PE09 L13  Project Management
PE09 L14  Finite Element Methods
PE09 L15  Design for Manufacture
PE09 L16  Operation Research II
PE09 L17  Concurrent Engineering
PE09 L18  Artificial Intelligence in Manufacturing
PE09 L19  Modern Manufacturing Systems
PE09 L20  Facilities Planning and Plant Layout
PE09 L21  Simulation of manufacturing systems
PE09 L22  Integrated Product development
PE09 L23  Total Quality Management
PE09 L24  Industrial Psychology
PE09 L25  Entrepreneurship

Global Electives

CH09 L23  Nano material and Nanotechnology
CH09 L24  Industrial Pollution Control
EE09 L22  Soft Computing
EE09 L25  Robotics & Automation
ME09 L25  Energy Engineering and Management
AI09 L23  Microelectronic Electro-mechanical Systems
AI09 L25  Probability and Random Processes
AN09 L25  Research Methodology
IC09 L25  Aerospace Engineering and Navigation Instrumentation
CE09 L25  Experimental Stress Analysis
EN09 301: Engineering Mathematics III  
(Common for all branches)

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- 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: \( Z^n \), \( \sin z \), \( \cos z \), \( \sinh z \), \( \cosh z \), \( \frac{(z+1)}{z} \) – Mobius Transformation.

Module II: Functions of a Complex Variable (13 hours)

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

Module IV: Fourier Transforms (13 hours)

Text Books

Module I:

Module II:

Module III:

Module IV:
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 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
EN09 302: Humanities and Communication Skills
(Common for all branches)

Teaching scheme

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2 hours lecture and 1 hour tutorial per week

**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 (11 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 (11 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. Technical report writing: Synopsis writing, formats for reports. Introductory report, Progress report, Incident report, Feasibility report, Marketing report, Field report and Laboratory test report 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. Senses of ethics – variety of moral issues – Moral dilemma – Moral autonomy – Attributes of an ethical personality – right action – self interest

Reference Books

3. Subrayappa, *History of Science in India*, National Academy of Science, India
11. Encyclopedia Britannica, *History of Science, History of Technology*

**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*
PE09 303: Electrical Drives and Automation

Teaching scheme

4 hours lecture and 1 hour tutorial per week

Objectives

- To impart the basic concepts of Electric drives
- To give concepts on microprocessors, PLC automation
- To give awareness on specific applications in industries

Module I (18 Hours)

D.C Machines and Transformers:
D.C. machines: D.C. Generators – construction details – e.m.f.equation – different types – magnetization and load characteristics – D.C. motors – Principle of operation – torque and speed equations – back e.m.f. – Performance characteristics and applications of shunt, series and compound motors.

Module II (18 hours)

Synchronous and Induction machines – Only the basic concepts and equations
Synchronous machines – construction details – types – rotating magnetic field (concepts only) – chording factor and distribution factor (no derivation) - e.m.f. equation - Synchronous motors – principle of operation.

Module III (18 hours)

Digital systems and Microprocessors

Module IV (18 hours)

Industrial drives and control
Introduction to Electric drives – control schemes – Speed control – Components of Electric drives: Motors, Power electronic controllers (Block diagram approach)
Text Books
Module I & II
D.P. Kothari, I.J. Nagarath, Electric Machines, Tata Mcgraw Hill.
J.B. Gupta, Theory and Performance of Electrical machines, S.K. Kataria and Sons
Module III
B.RAM, Microporocessors, Dhanpat Rai & Sons
Module IV
N.K. De, P.E. Sen, Electric drives, Prentice hall India
W. Bolton, Programmable Logic Controllers, Academic Press.

Reference Books
H. Cotton, Electrical technology, ELBS

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
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 (14 hours)


Module II (14 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 homework, 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

PE09 305: Metallurgy and Material Science

Objectives

- To provide basic knowledge in metallurgical aspects of material and its properties
- To give an exposure on materials and their structures
- To create general awareness regarding instruments and techniques used for material characterization

Module 1 (14 hours)
History of materials, Metallic Materials, Non-metallic Materials, Composites- Structure of solids- Crystal Structure, Metallic crystal structures, Directions & Planes
Crystallization of pure metals- Nuclei Formation, Crystal growth, Grain size.
Crystal defects- Point defects, Line defects, planar defects

Module II (14 hours)
Alloys & phase diagrams- Solid solutions-Phase rule-Lever rule-Equilibrium Diagram of Binary system-Eutectic, Peritectic & Eutectoid reactions-Iron carbon diagrams

Module III (13 hours)
Heat treatment of steels- Isothermal transformation – TTT diagrams-CCT diagrams, Annealing Normalizing, Hardening, Tempering, Austempering, Martempering, Carburizing, Nitriding etc., Diffusion mechanisms, strengthening mechanisms

Module IV (13 hours)

Text Books

References
1. William D. Callister, Material Science and Engineering, John Wiley and sons Inc
3. R.A.Higgins, Engineering Metallurgy applied to physical Metallurgy, VIVA (Low Priced)

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, ec.
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*
PE09 306: Machine Tool Technology

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To impart basic knowledge about different machine tools

Module I (14 hours)
Lathe - Different classifications - constructional features - driving mechanisms - tool and work holding devices - operations - speed, feed, depth of cut and machining time calculations – specifications - Capstan, turret and automatic lathes - constructional features - tool layout - tool and work holding devices – operations

Module II (14 hours)

Module III (13 hours)
Milling, Drilling and boring machines - Classification - constructional features - driving mechanisms - tool and work holding devices - types of tools - operations – specifications - Gear generation methods - Gear shaping, gear hobbing, gear shaving, gear grinding, gear lapping - bevel gear generators

Module IV (13 hours)
Shaper, planer, slotter and broaching machines - Different types and their field of application - constructional features - driving mechanisms - tools used - tool and work holding devices - operations – specifications

Text Books

Reference Books
ASME Tool Engineering Handbook

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

<table>
<thead>
<tr>
<th>PART A: Short answer questions (one/two sentences)</th>
<th>5 x 2 marks = 10 marks</th>
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<th>PART C: Descriptive/Analytical/Problem solving questions</th>
<th>4 x 10 marks = 40 marks</th>
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</thead>
<tbody>
<tr>
<td>Two questions from each module with choice to answer one question.</td>
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*Maximum Total Marks: 70*
PE09 307(P): Production Engineering Drawing

Teaching scheme  Credits: 2
3 Hours drawing per week

Objectives
- To impart the basic concepts of production drawing
- To develop understanding about how to draw a machine assembly
- To help the students how to translate design concepts to drawing

Module I (12 hours) Sketching:
Preparation of freehand, dimensioned sketches of the following. Hexagonal bolt and nut with washer
- Square headed bolt -Common types of bolts- various types of nuts for locking -locking of bolt head -
foundation bolts - various types of screw heads -studs - various types of keys -pipe joints and fittings

Module II (12 hours)
Joints: cotter, knuckle, spigot and socket, flanged coupling, and universal coupling, muff coupling.
Preparation of drawings Bearings: - Footstep - Plummer block, swivel, self-aligning ball bearing, and
stuffing box. Valves - simple stop valve and non-return valve.

Module III (12 hours) Production machines and jigs.
Lathe tailstock, chuck, tool post, bench vice and machine swivel vices, and jigs for milling and drilling,
drill holder.

Text Books

Reference Books
2. Laxmi narayana, Machine drawing,
3. N.Sidheswar, Machine drawing, Tata McGraw Hill

Internal continuous assessment (Maximum Marks 50)
60%  - Minimum of three sheets from module I and 7 sheets from Module II & III
30%  - Test/s
10%  - Regularity in the class

End Semester Examination (Maximum Marks 50)
70%  - Preparation of sketches with dimensions of the assembly/explored view of
components, Final drawing
20%  - Viva Voce
10%  - Fair record - Minimum 8 sheets (properly filed) drawn for internal continuous
assessment shall be submitted.
PE09 308: Machine Tool Lab-I

Teaching scheme
3 hours practical per week

Credits: 2

Objectives
- To develop the machining skills
- To have clear understanding of working of machine tools
- To have an idea about the difficulty and work content in machining operations

2. Selection of cutting parameters - speed, feed and depth of cut based on work - tool combination - coolant types.
3. Exercise on plain - step, taper turning and eccentric turning.
5. Inspection and measuring of machined lathe components using vernier caliper – micrometer - thread plug and ring gauges - dial indicators and surface finish measuring instruments.
6. Turret lathe and copying lathe operation/ demonstration.

Internal Continuous Assessment (Maximum Marks-50)
- 60%-Laboratory practical and record
- 30%- Test/s
- 10%- Regularity in the class

Semester End Examination (Maximum Marks-50)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
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 + qv + F(p,q) , F(z,p,q) = 0 , F(x,q) = F(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: Richard A Johnson, CB Gupta, Miller and Freund’s Probability and statistics for Engineers, 7e, Pearson Education- Sections: 6.1, 6.2, 6.3, 6.4, 7.2, 7.4, 7.5, 7.8, 8.1, 8.2, 8.3, 9.5

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

Reference books

3. 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 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
EN09 402: Environmental Science  
(Common for all branches)

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-m 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.
1. Raghavan Nambiar, K Text book of Environmental Studies, Nalpat Publishers Kochi
2. Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, 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

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 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
PE09 403: Theory of Machines

Teaching scheme
4 hours lecture and 1 hour tutorial per week

Credits: 5

Objectives
- The student shall learn to conduct the kinematic analysis of machinery
- The paper exposes the student to various kinds of mechanisms used in machines
- This paper should serve as a primer for learning dynamic analysis of machinery

Module I (18 hours)
Introduction- definition and explanations of link - kinematic pair - mechanism and machine - Kinematic chains – classification - Inversions of four bar - single slider and double slider crank chains - Slotted lever and Whitworth quick return mechanisms – Mechanisms :- Pantograph - Exact and approximate straight-line mechanisms.
Kinematics - Velocity and acceleration in mechanisms - graphical solution - Corioli’s component of acceleration – instantaneous centres – Kennedy’s theorem – velocity analysis using instantaneous centres

Module II (18 hours)
Toothed gearing - Law of gearing - Cycloidal and involute profiles - gear terminology and standard proportions - length of arc of contact - path of contact and contact ratio - Interference and number of teeth to avoid interference - Gear trains - simple, compound, epicyclic and reverted gear trains - Gear ratio calculations.

Module III (18 hours)
Cams - classification of cams and followers - graphical determination of profiles for different followers and different types of motion
Belt and rope drives – open and crossed belt drives- velocity ratio- length of belt-ratio of centre-power transmitted – centrifugal tension – initial tension and creep

Module IV (18 hours)
Vibration - kinematics of vibratory motion - vibration systems - vibration systems having single degree of freedom - undamped free vibration - forced vibration without damping - transverse vibrations of shafts - Dunkerly’s method - energy method - critical or whirling speeds - torsional vibrations.
Balancing – Static and dynamic balancing – balancing of several masses in a plane - balancing of masses rotating in several transverse planes- balancing machines.

Text Book
1. S S Rattan, Theory of Machines, Tata McGraw Hill

Reference Books
2. P L Ballaney, Theory of Machines, Khanna Publishers
3. R K Bansal, Theory of Machines, Dhanpat Rai Publicaitons

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*
PE09 404: Fluid Mechanics and Machinery

Objectives

- To develop understanding about the basic principles, concepts, mathematical and analytical tools of Fluid Mechanics.
- To develop understanding about the construction, working principle and characteristics of Hydraulic Machines.

Module I (14 hours)
Definitions and properties of fluids: – Density, gas laws, equations of state, viscosity, vapour pressure, compressibility, surface tension and capillarity etc.
Fluid pressure and its measurement: - intensity of pressure, Pascal’s law, Variation of pressure in static fluid:- compressible and incompressible fluids, pressure head – manometers
Fluid statics: - hydrostatic forces on submerged surfaces, buoyancy and floatation, Archimedes principle, metacentre, stability of submerged and floating bodies.

Module II (14 hours)
Types of flow – stream line, path line, streak line-continuity equation- Bernoulli’s theorem for the flow of incompressible fluids-
Flow through pipes – laminar and turbulent flow- critical Reynolds number- Hagen Poiseuille Law, development of boundary layer in pipes-pipe losses
Fluid flow measurements: - pitot tube, venturimeter, orifice meter, nozzle meter

Module III (13 hours)
Dimensional analysis - Physical dimensions - dimensional homogeneity - Buckingham's theorem - geometric, kinematic and dynamic similarities - theory of models
Pumps :- reciprocating pumps - principle of working, work done, effect of acceleration, frictional resistance, separation, air vessel etc.
Hydraulic devices - Hydraulic ram, accumulators, and intensifier - principles of working, gear pumps

Module IV (13 hours)
Impact of jets: - force exerted by fluid jet on (i) stationary curved vane (ii) moving curved vane.
Turbines - classification - reaction and impulse turbines - Pelton wheel, Francis, Kaplan, turbines etc.
Centrifugal pumps - work done by the impeller, - head and efficiency - specific speed - testing of pumps. (Simple problems)

Text Books

Reference Books
1. Daugherty and Franzini - Fluid mechanics with engineering applications, McGraw Hill
2. Massey - Mechanics of fluids,-ELBS
**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

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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*
PE09 405: Design of Machine Elements

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To acquaint the students with the analytical and mathematical tools of mechanical design.
- To familiarise the students with practical consideration used for the design and selection of the machine components

Module I (14 hours)
Principles of mechanical design - estimation of design load - design for steady, fluctuating and dynamic stresses - effects of stress concentration - consideration of creep and thermal stresses in design - influence of production processes in design - tolerances and fits per I.S specifications - principles of standardization - selection of materials - considerations like wear environment - human and aesthetic aspects.

Module II (14 hours)
Welded joints - stresses welded joints - strength of welded joints - fatigue loading of welded joints - design of bolts and screws.

Module III (16 hours)
Mechanical springs - design of helical springs - helical torsion spring - critical frequency of helical springs - energy storage capacity - common types of leaf springs - shafts - stresses in shafts - equivalent twisting and bending moments - effect of keyways - transmission shafts - determination of shaft size for strength - design of shafts for deflection - critical speeds for shafts - operating speeds - shafts subjected to steady and alternating loads.

Module IV (10 hours)
Couplings - rigid and flexible coupling - common types of keys, pins and retainers and their applications

The following data books may be permitted for the examination
1. Prof. Narayana Iyengar & Prof. Lingiah, Design Data book Vol 1 & 2
2. Design Data book of PSG College of Technology

Text Books

Reference Books
2. Johnson, Optimum Design of Mechanical Elements, John 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
### University Examination Pattern

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<th>PART</th>
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<th>Marks Distribution</th>
<th>Notes</th>
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<td>$5 \times 2 \text{ marks} = 10 \text{ marks}$</td>
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<td>B</td>
<td>Analytical/Problem solving questions</td>
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<td>C</td>
<td>Descriptive/Analytical/Problem solving questions</td>
<td>$4 \times 10 \text{ marks} = 40 \text{ marks}$</td>
<td>Two questions from each module with choice to answer one question.</td>
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*Maximum Total Marks: 70*
Objectives

- To acquaint the students with the fundamental concepts of Thermodynamics and Heat Transfer
- To equip the students to analyse and interpret various thermodynamic cycles and heat energy transfer systems

Module I (14 hours)
Introduction concept of thermodynamic property and state – intensive and extensive properties – control volume approach – laws of thermodynamics – zero’th law and temperature – energy transfer as work – first law of thermodynamics and internal energy — second law of thermodynamics – reversibility and availability – entropy as a property – enthalpy – absolute entropy and third law of thermodynamics (problems of elementary nature)

Module II (14 hours)

Module III (13 hours)
Compressors and refrigeration systems - air compressors - reciprocating and rotary compressors - principle of operation of compressors – refrigeration - vapor compression and absorption systems - principle of operation of refrigeration systems (problems of elementary nature)

Module IV (13 hours)
Conduction - Fourier heat conduction equation - thermal conductivity - one-dimensional heat

Text Books

Reference Books
M. Achuthan, *Engineering Thermodynamics*, PHI

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*
PE09 407(P): Electrical and Electronics Lab

Teaching scheme
3 hours laboratory classes per week

Credits: 2

Objectives
- The lab provides an opportunity to understand the basic electrical theories by conducting experiments. This will also provide them with sufficient experience in designing experiments to demonstrate or validate electrical theory.

1. Study of starters (i) 3 point and 4 point starters for DC motors (ii) Star-delta, auto-transformer, DOL and rotor resistance starters for induction motors.

2. (a)(i) Obtain the Open Circuit Characteristics of the DC shunt generator at the rated speed and determine the shunt field critical resistance. (ii) Pre-determine the OCC at the given speed (b) Perform load test on the given DC shunt generator and plot the external characteristics.

3. Perform Break test on DC shunt and series motors and plot the following characteristics (i) output v/s efficiency (ii) output v/s line current (iii) speed v/s torque (iv) line current v/s torque.

4. (a) Perform OC and SC test on single phase transformer and pre-determine the following (i) equivalent circuit (ii) efficiency (iii) regulation.

(b) Perform load test on single phase transformer and determine efficiency and regulation.

5. Perform load test on three phase cage induction motor and plot the following characteristics (i) efficiency v/s output (ii) slip v/s output (iii) power factor v/s output (iv) torque v/s output.

6. Calibrate the given single phase energy meter by (i) direct loading (ii) Phantom loading.

7. (i) Familiarization with electronic components, devices and equipments (ii) Study of CRO.

8. Set up full-wave bridge rectifier circuit with and without capacitor filter. Observe the input and output waveforms. Calculate ripple factor and regulation.

9. Design and set up following OP-Amp circuits (i) inverting and non-inverting amplifier (ii) Adder (iii) subtractor (iv) differentiator (V) integrator (vi) comparator

10. Design and set up half adder and full adder circuit.

11. Design and set up astable multivibrator using 555 timer.


13. Study the given 8085 microprocessor kit. Write and execute an assembly language program to add N numbers.

14. (i) Study the SCR converter circuit (ii) Control the speed of the given DC motor.

Objectives

- To plan and conduct experiments to study and validate the performance of various measuring instruments and equipment
- To train the students to plan experiments for evaluating practical situations
- To understand how experiments shall be set up for experimental studies

1. Estimation of hydraulic coefficients of orifices and mouth pieces
2. Calibration of venturimeter, orifice meter and flow nozzle meter
3. Calibration of triangular and rectangular notches
4. Performance test on rotodynamic and reciprocating pumps
5. Performance test on two stroke and four stroke petrol and diesel engine
6. Calibration of pressure gauge
7. Calibration and use of temperature sensing devices – thermo couple, resistance thermo meters and pyrometers
8. Calibration and use of vibration pickups, displacement pickups and accelerometers

PE 09 501: Industrial Automation

Teaching scheme
4 hours lecture and 1 hour tutorial per week

Credits: 5

Objectives

- To impart the concept of Automation, hardware generally used logics related to Automation

Module I (18 hours)
Fundamental concepts in manufacturing automation – Definition – reasons-types of production, types of automation strategies, levels, automated flow line, work piece transport, transfer mechanisms, buffer storages, part feeders

Module II (18 hours)
Low cost automation, use of hydraulics and pneumatics in automation, fluids selection and study of hydraulic components and hydraulic power pack, counter devices and other elements – Simple sequential logical circuits design for single – multi cylinders, fluidic elements and programmable logic controllers – electro pneumatic circuits – simple circuit design

Module III (18 hours)
Computer Numerical control, advantages, open and closed loop control, classification of CNC machine tools, structural features-turning and machining centers, Automatic tool changers, pallet changer and NC Tooling, CNC drives.

Module IV (18 hours)
Manual and computer aided part programming, canned cycles, APT. Introduction into CNC, Flexible manufacturing system, robotics and computer aided quality control, CMM, automated inspection and computer integrated manufacturing.

Reference books

2. Radhakrishnan P. Computer numerical controlled machines

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 \times 2 \text{ marks} = 10 \text{ marks} \\
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| PART B: | Analytical/Problem solving questions | \( 4 \times 5 \text{ marks} = 20 \text{ marks} \\
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| PART C: | Descriptive/Analytical/Problem solving questions | \( 4 \times 10 \text{ marks} = 40 \text{ marks} \\
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*Maximum Total Marks: 70*
PE09 502: Computational Methods in Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To develop analytical capabilities
• To formulate and solve real engineering situation

Module I (14 hours)

Module II (14 hours)
Solutions of system of linear algebraic equations - Gauss elimination methods - Crout’s triangularization methods - Gauss - seidel iteration method - relaxation methods - power method for the determination of Euigen values - polynomial interpolation – Lagrange’s interpolation polynomial - divided differences - Newton’s divided differences interpolation polynomial - finite differences - Gregory - Newton - forward and backward differences interpolation formula (elementary treatment only)

Module III (13 hours)
Numerical differentiation - differentiation formulas in the case of equally spaced points - numerical integration - trapezoidal and Simpson’s rule - errors of interpolation and integration formulas - 2 points and 3 points Gauss Legendre and Gauss-Chebyshev quadratic formulas - numerical solution of ordinary differential equations - single step methods Taylor series methods - Euler’s method - modified Euler’s method - Picards iteration method - Runge-Kuta methods - 4th order formulae - multi step methods - Milne’s predictor-corrector formula

Reference Books:
Narayanan S., Manichavachagom Pillai & Dr Ramanaiah G., Advanced Mathematics for Engineering Students Vol III, S Viswanathan Publishers
Sasthri S S Numerical Analysis, Prentice Hall of India Publishers

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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<tr>
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<td>Descriptive/Analytical/Problem solving questions</td>
<td>4 x 10 marks = 40 marks</td>
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<td>Two questions from each module with choice to answer one question.</td>
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</table>

**Maximum Total Marks: 70**
Objectives

- To understand different joining techniques, metallurgical aspects of welding, testing and quality control of weldments

Module I (14 hours)

Introduction - classification of processes – soldering, brazing, welding, gouging, arc and gas cutting

Welding symbols - joints - terminology - weldability of materials - distortion - residual stresses - and welding metallurgy.

Module II (14 Hours)

Gas and arc welding processes, equipment, electrodes, power source etc. of carbon arc, shielded metal arc, TIG, MIG, submerged, electro slag, plasma arc, stud and EBM - applications.

Module III (13 Hours)


Module IV (13 Hours)

Defects in welds - inspection and testing of welds - destructive and non destructive testing - visual, radiography, magnetic particle, eddy current and dye penetrant testing.

Text Books:


Reference books

5. R.Halmshaw, *Non destructive testing*, Edward Arnold 1987

### 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*
PE09 504: Metal Casting

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To acquaint the student with the fundamental aspects related to metal casting viz. melting, solidification, pattern making, sand casting and special casting process

Module I (14 hours)
Melting - Melting and Pouring of Metals - Crucible, Cupola, Oil Fired Furnaces - Electrical Furnaces - Induction Furnaces - Arc Fired Furnaces - Calculation of Cupola Charges - Temperature Control and Measurements in Furnaces - Degasification of Metals - Inoculation.

Module II (14 Hours)

Module III (13 Hours)

Module IV (13 Hours)
Sand Casting, Pressure Die Casting, Centrifugal Casting, Investment Casting, Shell Moulding, Carbon Dioxide Process, Continuous Casting etc. - Quality Control In Castings - Inspection and Testing in Castings - Salvaging - Mechanization of Foundries - Material Handling Equipments used in Foundry - Introduction to Casting of Non-Ferrous Metals like Aluminium, Copper etc. - Introduction to Steel Castings.

Text Book

Reference Books
1. Wulf, Taylor and Flemings - Foundry Engineering, Wiley Eastern
3. Ekey and Winter - Foundry Technology, 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) 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
PE09 505: Machining of Materials

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To give the student basic concepts, processes and analysis of machining processes

Module I (14 hours)
History and development of tool materials - general requirements of tool materials-tool geometry-systems of cutting tool nomenclature- single point and multipoint tools- different machining processes and selection of tools. - Simple problems.

Module II (14 hours)

Module III (13 hours)
Temperature in machining – temperature distribution - effect of machining variables on temperature – measurement of temperature.

Module IV (13 hours)
Economics of machining – choice of parameters – metal removal rates.
advanced machining processes – introduction – operating principles – process parameters and application of USM,AJM,WJM,ECM,ECG,EDM,EBM,LBM,PAM and chemical milling.

Text Books
1. Shaw M.C., Metal cutting principles, Oxford university press.

Reference books
2. Sen and Bhattacharya, Principles of metal cutting, New central publishers.

**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.

\[ 5 \times 2 \text{ marks} = 10 \text{ marks} \]

**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.

\[ 4 \times 5 \text{ marks} = 20 \text{ marks} \]

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

\[ 4 \times 10 \text{ marks} = 40 \text{ marks} \]

Maximum Total Marks: 70
PE 09 506: Engineering Economics & Principles of Management

Teaching scheme
3 hours lecture per week

Credits: 3

Objectives
- To have a basic knowledge on economic theories, and their applications, management concepts, functions of management, human behaviour at work etc.

Module I (9 hours)

Module II (9 hours)
Factors of production, Concepts of Total product, average product, Marginal product. Concept of Productivity and its measurement, Laws of returns, Input-output analysis, Production function analysis (Cobb-Douglas and CES), Internal and external economies of scale Analysis of costs, Accounting and economic costs, Total/Average/Marginal costs, Sunk cost, Private and Social cost, Opportunity cost. Characteristic features of Perfect competition, Monopolistic competition and Monopoly.

Module III (9 hours)

Module IV (9 hours)
Human behaviour and management - skills of manager at various levels in an organisation-


**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 understand the operation of equipment
- To evaluate and calibrate various equipment
- To understand how experiments shall be set up for experimental studies

Module I

**Shaping, planing and slotting:** Working principles of crank shapers - hydraulic shaper - speeds and feeds in shaping - planing operations - shaper and planer tools - types of planers and their relative merits - Differences between vertical shaper and slotter - description of slotting machines and types of work done.

Exercises - Shaping and planing, surfacing, T-slots, grooving, dove tail cutting and keyways in flat and cylindrical surfaces. Slotting: - Keyway cutting and grooving.

Module II

**Milling:** Types of milling machines - principles of milling - milling machine attachments - speeds and feeds in milling operations - grooves, splines, dove tail and cam milling, climb and conventional milling, string and gang milling.

Exercises - Indexing head, simple and differential indexing, plain milling, cutting of spur and helical gears.

Module III

**Grinding and Drilling:** Types of grinding machines, surfaces, cylindrical, universal, selection of grinding wheels, - tool and cutter grinders – live and dead centre grinding – taper grinding.

Drill geometry – drilling - boring and reaming – types of drilling machines

Exercises – demonstration of cylindrical and taper grinding operations and drilling operation.

[Note: - At least four models to be prepared]
Objectives

- To provide the Students an opportunity to verify the theoretical concepts they have learned and also the complexity and requirements of planning experts in this area.

1. Tension test on M.S. rod
2. Shear test on M.S. rod
3. Hardness test - Brinell, Rock well, Vickers and rebound
4. Impact test - Izod and Charpy
5. Torsion test on M.S. rod
6. Spring test
7. Torsional pendulum - determination of ‘N’ of wires
8. Compression tests - bricks, concrete cubes


Teaching scheme

- Credits: 2
  - 3 hours laboratory classes per week

Internal Continuous Assessment (Maximum Marks-50)

- 60%-Laboratory practical and record
- 30%- Test/s
- 10%- Regularity in the class

Semester End Examination (Maximum Marks-50)

- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
PE09 601: Tool Engineering

Teaching scheme
4 hours lecture and 1 hour tutorial per week

Credits: 5

Objectives
- To give an exposure on different cutting tools, clamping and fixing methods, jigs used for different operations like turning, milling, drilling etc
- To give exposure to piercing and blanking operations

Module I (18 hours)
Design of Cutting Tools: - Brief history of metal cutting process - design of single point cutting tools for turning, boring, shaping, planning and slotting - design of multi point cutting tools: milling cutters, drills, reamers, taps and dies - classification of multipoint cutting tools - simple problems

Module II (18 hours)
Principles of location and clamping - locating and clamping methods and devices - design of drill jig - types of drill jigs - general considerations in the design of drill jig - drill bushings - methods of construction - jigs in modern manufacturing - problems on design of simple jigs

Module III (18 hours)
Design of Fixtures: - Fixtures and fixture economics - types of fixtures - Vice fixtures - Milling fixtures - Boring fixtures - Broaching fixtures - Lathe fixtures - grinding fixtures - problems on design of simple fixtures.

Module IV (18 hours)
Design of sheet metal blanking and piercing dies: - Introduction to die cutting operations - Presses - Cutting action in punch & die operations - die clearance - blanking & piercing die construction - pilots - strippers & pressure pads - simple problems

Text Book

Reference Books
1. ASTME, Fundamentals of tool design
2. HMT, Production Technology, Tata Mc Graw Hill Publishers

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
PE09 602: Metal Forming

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To provide an exposure to the basic concepts of plasticity which is essential for in the analysis of metal forming processes
- To get familiar with the metal forming techniques, tools and processes

Module I (14 hours)

Module II (14 hours)

Module III (13 hours)

Module IV (13 hours)
Introduction to powder metallurgy

Text Books
1. L S Srinath, *Advanced Mechanics of solids*, Prentice Hall of India

Reference books
2. Dr.Sadhu Singh, *Theory of Plasticity*, Khanna
3. L.S.Srinath, *Theory of Plasticity*
5. Dieter, *Principles of Mechanical Working of Metals*
6. Johnson, *Forging Products*
7. Pearson, *Extrusion of Metal*
8. G.W. Row, *Fundamentals of Metal Forming*
9. Dr. R Narayanaswamy, *Metal forming 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

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
PE09 603: Industrial Engineering

**Teaching scheme**
3 hours lecture and 1 hour tutorial per week

**Credits:** 4

**Objectives**
- To provide a basic knowledge on various industrial engineering principle and tools and need for analyzing engineering activities.
- To familiarise the students with the design, improvement and installation of integrated systems of men, materials and equipments

**Module I (14 hours)**

**Module II (14 hours)**
Product design and development – Good Product Design – Product planning – Product development – Product life Cycle - Products and services – Product Standardization, Simplification, Specialization and Interchangeability – Value Analysis - Value Engineering
Module III (13 hours)
Work Study – Scope and Objectives – Method Study Procedure – Process Charts – Flow diagram-
Principles of motion economy – Micro motion study – Cycle graph- Chronocyclegraph – SIMO
Work sampling – PMTS – Standard data

Module IV (13 hours)
Industrial safety – Safety management – Industrial accidents and accident prevention- Safety
Organization, Councils and safety meetings, safety audits – Safe workplace layout- personal
protective equipments - Safety motivation – Hazard analysis – Industrial pollution and pollution
control – Environmental impact assessment- Environmental Management Systems

Reference books
Donald R Herzog, Industrial Engineering Methods and Controls, Prentice Hall
W Grant Ireson, Eugene L Grant, Handbook of Industrial Engineering management- Prentice Hall
Marvin Mundel, Motion and Time Study, Prentice Hall India
ILO, Introduction to Work Study, Universal Book Corporation
Harold T Amrine, John A Ritchey etal., Manufacturing Organization &management, 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
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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
PE09 604 Instrumentation and Control

Objectives

- To give an exposure to the concepts and techniques of control systems
- To create knowledge about the various instruments and instrumentation techniques

Module I (14 hours)

Module II (13 hours)
State space analysis of systems – introduction to state concept – state space representation - state equations of linear continuous data systems – matrix representation of state equation – solution of time invariant state equations – introduction to sample data and digital control systems

Module III (13 hours)
Functional elements of measuring system – various types and classification of transducers, modifying systems and display systems

Module IV (14 hours)
Measurement of pressure – manometers – diaphragms – bourdon gage – strain gage pressure cell and electrical resistance pressure cell
Measurement of force and torque – elastic transducers – strain gage load cells – mechanical and hydraulic dynamometers
Measurement of flow – obstruction meters – variable area meters – magnetic and ultrasonic flow meters- strain gage flow meters – turbine type flow meters
Measurement of temperature – bimetallic thermometers – thermo couples – pressure thermometers – optical and radiation pyrometers
Measurement of vibration – micrometers – accelerometers – seismic instruments

Text Books
2. K.Ogata, Modern Control Engineering, Pearson Edition

Reference Books
1. Kuo, Automatic Control Systems, Prentice Hall Of India
2. Eugene Xavier S.P, Joseph Cyril Babu J, Principles of Control Systems, S. Chand & Company
3. S.Palani, Control Systems Engineering TMH
4. Nakra BC & Choudhary K K , Instrumentation, Measurements And Analysis
5. Beckwith, Mechanical Measurements, Oxford & IBH

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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Maximum Total Marks: 70
PE09 605: Inspection and Quality Control

Teaching scheme

2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives

- To provide an insight to various methods of measurements and inspection
- To provide an understanding of the statistical methods of quality control

Module I (9 hours)


Module II (11 hours)
Geometric features – basic definition of straightness, flatness, parallelism, roundness, circularity, squareness etc. – principles and equipments for measurement – principles of interferometry
Gears – measurements and inspections of spur gears – tooth thickness, pitch, base pitch etc. – gauging of gears. Screws – Terminology – measurement and inspection of threads – major, minor, effective diameters, pitch. – gauging of screws.

Module III (8 hours)

Module IV (8 hours)
Acceptance sampling –lot by lot acceptance using single sampling by attributes – OC curve – average out going quality and the AOQL – double sampling – multiple and sequential sampling – ATI and AFI

Text 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
PE09 L01: Human Resource Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To have an insight into fundamental aspects related to Human Resource Management viz. Jobs, Recruitment, appraisal, remuneration and Employee relations

Module I (14 hours)
personnel department - analyzing and design of jobs - job analysis - job description - job specification - role analysis - the job design – Merit Rating

Module II (14 hours)

Module III (13 hours)
Pay and benefits - pay structures - methods of payments - fringe benefits - occupational health and safety - working conditions occupational health and safety - social background and working conditions - ergonomics - regulatory environment - organization commitment - measures for occupational health and safety

Module IV (13 hours)
Employee relations - management employee relations - managing discipline - managing grievance - managing stress - counselling - industrial relations implications of personnel policies - nature of employment relationships - place of unions in organizations - industrial conflict - managing for good industrial relations

Text Books
Venkata Ratnam C.S. & Srivasthava B.K., Personnel Management and Human Resources

Reference Books
4. Subramanyam K.N, Gin V.V., Industrial Relations in India
5. Garry Dessler, Human Resource management, Person education
7. Snell, Bohlander, Human Resource Management, Cengage Publishers

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
PE09 L02: Marketing Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objectives

• To give an exposure on various aspects of marketing management viz. Environment, Consumer behaviour, Product management, Promotion decisions, and marketing research

Credits: 4
Module I (14 hours)

Module II (13 hours)

Module III (14 hours)
Developing market strategies – Positioning & differentiating market through product life cycle – Differentiating tools – Determining new market offerings- Setting the product and branding strategy – Product mix and line – Brand decisions.

Module IV (13 hours)
Managing & defining market program – Managing intergraded marketing communication – Effective communication process – Managers advertising, sales promotion, public relation & direct marketing – Managing the sales force– Personal selling.

Text Books
1. Philip kotler – *Marketing management* – Pearson Education Asia

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
PE09 L03: Machine Tool Design

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objectives
• To give knowledge about various machine components and installation and testing of machine tools

Module 1 (14 hours)
Machine beds and columns - relative merits of different types of beds and columns as regards to materials - construction - stiffness and rigidity - design considerations of beds and columns -

concrete and metallic foundation - sources and effects - equipment for the study of vibration - vibration isolation

Module II (14 hours)
Slides ways - different types of slide ways - wear adjustments - design consideration - lubrication surface finish - straightness and hardness requirements of slide way

Module III (13 hours)
Drive systems - selection of range of feeds and speeds - layout in AP, GP and LP - standardisation of speeds and feeds - ray diagram for machine tool gear boxes - various types of drives such as sliding and clutched drives - Rupert drives - feed gear box analysis - Norton and meander drives - stepless drive

Module IV (13 hours)
Erection and testing - equipment needed for erection - erection procedure - commissioning - check list - safety - I.S. specification for testing machine tools - acceptance tests for lathe - milling - drilling - grinding machines - maintenance and reconditioning of machine tool - need for maintenance - maintenance policies - maintenance organisation - principles of reconditioning - repair methods for beds - slides - spindles - gears - lead ,screw and bearings

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 acquire an understanding of sensors, actuating devices, signal processing etc to have a clear idea about advanced manufacturing systems

Module I (10 hours)
Module II (14 hours)

Module III (16 hours)

Module IV (14 hours)
Advanced Applications in Mechatronics: - Sensors for condition monitoring – Mechatronic control in automated manufacturing – Artificial Intelligence

Text Books

Reference Books
3. Mechatronic, Edited by HMT, Bangalore, 1998

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 give exposure to newer materials used in manufacturing
• To give exposure to the advanced techniques used in manufacturing
• To enable the student to select the appropriate process according to the materials used
Module I (14 hours)
Introduction – conventional materials, limitation, need for composites, classification and characteristics of composites, resin matrices, reinforcements, other constituents of fibre, fibre reinforced plastics, ceramics and metal matrix composites – manufacturing of metal matrix composites, solid and liquid state processing – testing of composites – applications

Module II (14 hours)
Introduction to powder metallurgy (P/M) processes – design considerations for P/M tooling – types of compaction – sintering at different atmospheres – liquid phase sintering – secondary processes – P/M applications specifically to cutting tool, bearing and friction materials – nano materials and their applications.

Module III (13 hours)
Special material removal processes – chemical machining, electro chemical machining, electrical discharge machining wire EDM, water jet machining – high speed machining – micro machining-casting of non-ferrous metals

Module IV (13 hours)
Surface structure and properties – surface coatings, hard facing, thermal spraying, vapour deposition, ion implantation, hot dipping – coating of cutting and forming tools

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
PE09 607(P): Manufacturing Sciences Lab

Teaching scheme
3 hours practical per week

Credits: 2

Objectives
- To train students to conduct experiments in manufacturing sciences

To train the students to plan experiments for evaluating practical situations

1. Specimen preparation for microscopic inspection
2. Study and use of metallurgical microscope, microstructure of ferrous and non-ferrous materials
3. Heat treatment processes - study of various parameters - hardness
4. Determination of cutting forces in turning - lathe tool dynamometer
5. Determinations of tool wear - tool makers microscope
6. Preparation of specimen for sand mould testing - tension, compression, hardness, porosity
7. Sand sieve analysis
8. Spark testing & scratch testing of materials
9. Preparation of specimens for welding - gas, arc welding processes - specifications
10. Measurement of HAZ - structural changes, NDT of welded joints

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

- 60% - Laboratory practical and record
- 30% - Test/s
- 10% - Regularity in the class

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

- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record

**PE09 608 (P): CAD/CAM Lab**

**Teaching scheme**

3 hours practical per week

**Credits:** 2

**Objectives**

- Experiments are aimed at providing the student an atmosphere in which he will be exposed to some of the basic CAD/CAM techniques
University of Calicut

**CAD - Laboratory**
1. Modelling of machine components
2. Assembly modelling
3. Preparation of detail drawing from solid model
4. Finite element modelling and analysis
5. Mechanism modelling and analysis

**CAM – Laboratory**
1. Programming of CNC Lathes
2. Programming of machining centres
3. NC Programming from CAD models
4. Design of moulds from CAD models

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

- 60% - Laboratory practical and record
- 30% - Test/s
- 10% - Regularity in the class

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

- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record

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**PE09 701: Production Management**

- **Teaching scheme**: 4 hours lecture and 1 hour tutorial per week
- **Credits**: 5

**Objectives**
- To give an exposure to the different aspects of Production Management, viz., Production Planning and Control, materials Management and Quality management

Module I (18 hours)
Production and Operations planning - Production Systems - Forecasting of Demand- Variables – Opinion and Judgmental Methods - Time series methods – Regression & Correlation – Aggregate planning- Objectives - Aggregate planning Methods - Master Scheduling – Objectives – Methods of Master Scheduling

Module II (18 hours)

Module III (18 hours)

Module IV (18 hours)
Materials handling – principles of material handling – basic handling systems – handling systems to layout – integrated handlings – material handling equipments

**Text Books**

   International edition
2. Setharama, L Narasimhan etal., *Production Planning and Inventory Control*, Prentice Hall India

**Reference Books**

2. Panneerselvam, *Production management*, Prentice Hall of India

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

**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*
PE09 702: Operations Research

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objectives
• To give a quantitative perspective to the decision making process

Credits: 4

Module I (14 hours)

Module II (14 hours)

Module III (13 hours)
Queueing theory – types of queues - Poisson arrival exponential service – single server and multiple server queues
Introduction to simulation techniques – Monte Carlo simulation (No Problems)

Module IV (13 hours)
Decision theory: - Environments – decision making under certainty – decision making under risk, decision making under uncertainty – Game theory – two persons zero sum games – pure strategy and mixed strategy – Decision Tree.

Text Books

Reference Books
4. Anderson Sweeney Williams,*Quantitative Methods for Business*,Cengage learning

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
PE09 703: Maintenance Engg. & Management

Teaching scheme
2 hours lecture and 1 hour tutorial per week

Credits: 3

Objectives

- To expose the students how the deterioration of plant machinery equipment and other facilities are taking place
- To make them aware of various testing methods, preventive/corrective and timely actions to take including repair replacement etc

Module I (9 hours)
Corrosion - harmful effects – electrochemical mechanism of corrosion - forms of corrosion - corrosion by special environments in industries such as chemical, petrochemical, iron and steel industry - corrosion prevention and control - material selection for corrosion environments - corrosion inhibitors - cathodic and anodic protection –corrosion testing and measurements

Module II (9 hours)
Wear of machine parts - mechanism of wear - different types of wear - effect - factors influencing wear –wear measurements - bearing and lubrication – Types of bearings - bearing material and their requirements - lubricants - basic properties - additives - synthetic lubricants.

Module III (9 hours)

Module IV (9 hours)

TextBooks
1. Collacott, Vibration Monitoring and Diagnosis - Technique for Cost Effective Plant Maintenance, John Willey

Reference Books
2. Uhlig H.H., Corrosion & Corrosion Control, John Wiley Publishers
4. Maj Gen Apthe S.S., Plant Maintenance, Delhi Productivity Council
5. Srinath, Concept of Reliability, Affiliated East West Publishers

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*

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**PE09 704: Management Information Systems**

**Teaching scheme**

- **Credits:** 3
- 2 hours lecture and 1 hour tutorial per week
Objectives

• To give an awareness of information sources, flow and its processing for making correct decisions.

Module I (9 hours)
Information systems-functions of management—levels of management-framework for information system—sequence of development of MIS—systems approach—systems concepts—systems and their environment—effects of system approach in information system design—using systems approach in problem solving—strategic use of information technology

Module II (9 hours)
A brief overview of computer hardware and software components—file and database management systems—communication system elements—introduction to network components-topologies and types—remote access—reasons for managers to implement networks—distributed systems—the internet and office communications.

Module III (9 hours)
Application of information system to functional, tactical and strategic areas of management, decisions support systems and expert systems

Module IV (9 hours)
Information system planning—critical success factor—business system planning—ends/means analysis—organising the information systems plan—systems analysis and design—alternate application development approaches—organisation of data processing—security and ethical issues of information systems

TextBooks
1. Schultheis R. & Mary Sumner, Management Information Systems-the Manager’s View, Tata McGraw Hill

Reference Books
2. Sadagopan S., Management Information Systems, Wheeler Publishing

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
PE09 707 (P): Industrial Engineering Lab

Teaching scheme
3 hours Practical per week

Credits: 3
Objectives

- To plan and conduct experiments to study and evaluate theoretical concepts in industrial engineering and quality control
- To train the students to plan experiments for evaluating practical situations

1. Study and Experimentation on Central Limit Theorem - for different population distributions, Triangular Distribution, Rectangular Distribution and Normal Distribution
2. Factorial Experimentation - Analysis of variance and test of Significance on different process/product parameters.
3. Motion Study – Preparation of Flow process charts, outline process charts flow diagram and multiple activity charts, two handed process charts, for industrial operations.
4. Application of Principles of Motion economy – determination of time savings by improving work methods
5. Time Study – Determination of standard time of an operation by stopwatch method.
6. Plant layout and material handling – Layout planning and optimization of material handling using techniques of string diagram travel charting etc.
8. Attribute Control charts – Plotting and interpretation of attribute control charts P-Charts and C-Charts
9. Acceptance sampling by attributes – Plotting and interpretation of Operating Characteristic curves, determination of AQL, LTPD, Risks and AOQL
11. Measurement and analysis of productive Skills - Direct and indirect eye hand co ordination measurement using co ordination testers
12. Measurement and analysis of dexterity, speed, skill, visual sensation and tactile sensation abilities – Using coin sorters and match board equipments

Internal Continuous Assessment (Maximum Marks-50)
- 60% - Laboratory practical and record
- 30% - Test/s
- 10% - Regularity in the class

Semester End Examination (Maximum Marks-50)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record

PE09 708(P): Metrology Lab

Teaching scheme: 3 hours practical per week

Credits: 3
Objectives

- To provide information of how actual measurements are conducted and also about the selection of measuring instruments for different purposes

1. Testing of gears
2. Determination of cutting forces on tool bits - lathe, drilling machine, milling machine and grinding machine
3. Measurement of tool signature – single point tools using tool makers microscope
4. Measurement of surface roughness
5. Use of comparators - mechanical, optical, electrical & pneumatic
6. Determination of cutting tool temperature using thermocouples
7. Use of profile projectors
8. Acceptance Test of machine tools - lathe, shaper, milling and grinding machines
9. Measurement of straightness and flatness
10. Measurement of vibrations
11. Measurement of area
12. Measurement of sound
13. Measurement of speed

<table>
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<td>60% - Laboratory practical and record</td>
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<td>10% - Regularity in the class</td>
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</table>

<table>
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<th>Semester End Examination (Maximum Marks-50)</th>
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<tr>
<td>70% - Procedure, conducting experiment, results, tabulation, and inference</td>
</tr>
<tr>
<td>20% - Viva voce</td>
</tr>
<tr>
<td>10% - Fair record</td>
</tr>
</tbody>
</table>
The project work should enable the student to take up an engineering problem. Analyse it and suggest solutions. The student can take up an industrial problem or can work in house.

He is expected to be under an academic guide and an industrial guide depending on whether the project is in house or in an industry.

The student is expected to undertake a project in the areas like design, maintenance, manufacturing, management etc after due consultation with academic guide and industrial guide as per the situation.

During the 7th semester he is expected to finalise the project topic and do the necessary literature survey. He shall submit a report of the work done at the end of the semester. Based on this internal evaluation will be done.
Objective

- To give an insight into various aspects of financial management and management accounting

Module I (18 hours)
Introduction to Financial Management – functions and role – fundamentals of accounting – understanding financial statements and its analysis – ratio analysis

Module II (18 hours)

Module III (18 hours)

Module IV (18 hours)
Management of current assets – management of receivables – inventory costs – introduction to international finance

Textbooks
1. I.M. Pandey., Financial Management Vikas Publications
2. I.M. Pandey., Management Accounting Vikas Publications

Reference Books
1. Prasannachandra, Financial Management, TMH
2. Dhameja & Sastry, Finance & Accounting, Wheeler Publishing
3. A A Atkinson Management Accounting 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*
PE09 802: Computer Integrated Manufacturing

Objectives

- To give an idea of advanced manufacturing and various elements and sub systems that go into it

Module I (9 hours)
Introduction - evolution of CAD/CAM and CIM - scope of CIM - segments of generic CIM - computers and workstations - an overview of CIM software - product development through CAD and CAE - geometric modelling techniques - automated drafting - graphic standards - engineering analysis - optimization - principles of concurrent engineering

Module II (9 hours)
Automated process planning - process planning - general methodology of group technology - code structures variant and generative process planning methods - AI in process planning - process planning software - CNC technology - principle of numerical control - types of CNC machines - features of CNC systems - programming techniques - capabilities of a typical NC CAM software - integration of CNC machines in CIM environment - DNC - flexible manufacturing systems

Module III (9 hours)

Module IV (9 hours)
Data communications and technology management - technology issues - configuration management - database systems - management of technology - networking concepts LAN, MAN and WAN - SQL fundamentals - MAP/TOP fundamentals - CIM models - IBM - Siemens, DEC, ESPRIT - CIM OSA model - economics of CIM - implementation of CIM - Product data management and Product lifecycle management

Text Books
2. Radhakrishnan P., Computer Integrated Manufacturing, Dept. of Production Engineering, PSG College of Technology

Reference Books
2. Ranky P.G., Computer Integrated Manufacturing, 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**
Each student shall prepare a paper on any topic of production engineering and after scrutiny and approval by a faculty member, shall present it – each student is expected to participate actively in all seminars – evaluation to be done on the basis of his/her paper and also active participation other seminars

<table>
<thead>
<tr>
<th>Scheme of evaluation</th>
<th></th>
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<tbody>
<tr>
<td>Presentation and discussion</td>
<td>25</td>
</tr>
<tr>
<td>Material content</td>
<td>10</td>
</tr>
<tr>
<td>Report</td>
<td>10</td>
</tr>
<tr>
<td>Participation and attendance</td>
<td>5</td>
</tr>
<tr>
<td>Total marks</td>
<td>50</td>
</tr>
</tbody>
</table>
This is the continuation of PE 09 709 (P) The student shall conduct the data collection and analysis for the project. After the completion the students shall prepare a project report and submit it

<table>
<thead>
<tr>
<th>Scheme of Evaluation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis defence</td>
<td>= 60</td>
</tr>
<tr>
<td>Report</td>
<td>= 40</td>
</tr>
<tr>
<td>Total marks</td>
<td>= 100</td>
</tr>
</tbody>
</table>

Credits: 7
Each student is required to appear for a viva-voce examination - the student shall bring his/her project reports and seminar paper for this examination. The relative weightage of questions shall be as follows.

<table>
<thead>
<tr>
<th>Scheme of Evaluation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>40</td>
</tr>
<tr>
<td>Project</td>
<td>30</td>
</tr>
<tr>
<td>Seminar</td>
<td>20</td>
</tr>
<tr>
<td>Industrial Training/Industrial visit/</td>
<td></td>
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<tr>
<td>Industrial tour or paper presented at national level</td>
<td>10</td>
</tr>
<tr>
<td>Total marks</td>
<td>100</td>
</tr>
</tbody>
</table>
PE09 L06: Engineering Materials

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To give a detailed exposure of various materials used in Engineering.
- To have knowledge about Ferrous as well as non ferrous materials like Ceramics, Composite, polymer etc.

Module I (14 hours)

Module II (14 hours)

Module III (13 hours)
Non-ferrous metals – Copper and its alloys – Aluminium and its alloys – Nickel and its alloys – Titanium and its alloys

Module IV (13 hours)
Polymers: – Polymerization – Structural features of polymers – Thermoplastics and thermosetting polymers – additives – Mechanical properties – Optical properties
Composites: – Fiber reinforced composites – Aggregate composites – Mechanical properties

Text Books
1. William D Calister Material Science and Engineering, John Wiley and sons Inc
2. Donald R Askeland, The Science and Engineering of materials, PWS-KENT Publishing co
5. Kingeri, Introduction to Ceramics,

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*
PE09 L07: Linear System Analysis

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

- To enable the students to model mechanical systems and also to analyze different linear time-invariant systems.

Module I (14 hours)

Module II: (14 hours)

Module III: (13 hours)

Module IV: (13 hours)
State space analysis and stability of systems: Concept of state - state space and state variables - advantage over transfer function approach - state equation for typical electrical, mechanical and electromechanical systems - representation for linear time varying and time invariant systems - solution of state equation for test inputs - zero state and zero input response - concept of stability - bounded input bounded output stability - Routh-Hurwitz criterion of stability for single input, single output linear systems described by transfer function models.

Text Books
1. Tripathi A.N., Linear Systems Analysis, New Age International (P) Limited

Reference Books
1. Nagrath & Gopal, Control Systems Engineering, New Age International (P) Limited
2. Cheng D.K. Addison Wesley, Linear Systems Analysis, Addison Wesley
3. Katsuhiko Ogata, Modern Control Engineering, 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*
PE09 L08: Safety Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart an awareness about the importance of safety in industrial operations
- To understand various techniques available for ensuring safety in industries

Module I (14 hours)
Importance of safety in industrial operations-Safety information systems-Accident information and reporting-safety performance and reporting-safety education and training

Module II (14 hours)
Hazards-physical-chemical-electrical-biological-ergonomic hazards-risk analysis-map method-tabular method-fault tree analysis-hazop analysis

Module III (13 hours)
Fire protection systems-Fire chemistry-industrial fire protection system-water sprinkler-fire hydrant, alarm and detection system-explosion protection system-suppression system-carbondioxide system foam system-halon system-portable extinguisher

Module IV (13 hours)
Safety in engineering industry-safety in metal working machinery-principles of machine guarding-safety in welding and gas cutting-safety in cold forming and hot working of metals-safety in finishing-inspection and testing

Text Books
1. N.V. Krishnan, Safety in industry, Jaico publishing house
2. Gupta R.S., Handbook of fire technology, Orient Longman

Reference Books
2. John V. Grimaldi and Rollin H. Simonds, Safety management, All India Travellers Book Seller, New 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 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 LPE09: Industrial Tribology

Teaching scheme
3 hours lecture and 1 hour tutorial per week

**Objectives**
- To have knowledge about the various modes of friction, wear mechanisms, types of lubrication and bearings and also the various surface engineering techniques.

**Module I (14 hours)**

**Module II (14 hours)**

**Module III (13 hours)**

**Module IV (13 hours)**

**Text Books**

**Reference Books**
1. Ernest rabinowicz “Friction and wear of materials”, John wiley& sons

**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*
PE09 L10: Supply Chain Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To understand the inventory control techniques, purchasing functions and supply chain strategies of different kinds of industries.

Module I (14 hours)
Supply chain management (SCM) - concept of logistics and SCM - decision phases - design, planning and operation - decision areas - type of supply chain views - flows in supply chain - supply chain and competitive performance - performance measures for SCM - strategic fit - drivers of supply chain

Module II (14 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*
# PE09 L11: Technology Management

## Teaching scheme
3 hours lecture and 1 hour tutorial per week

## Credits: 4

### Objectives
- To give exposure to the fundamental aspects related to Technology management viz. Technology - Evolution, Environment. Diffusion Innovation, Intelligence and Technology Strategy

### Module I (14 hours)

### Module II (14 hours)

### Module III (13 hours)
Process innovation – value chains and organization – Modes of value chain configuration – Value chain configuration and organizational characteristics – Technology Intelligence – Mapping Technology Environments – Analytical Tools

### 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
Objectives

• To provide basic concepts and requirements regarding the design validation, implementation and evaluation of Software systems

Module I (14 hours)
Introduction - FAQs about software engineering - professional and ethical responsibility - system modelling - system engineering process - the software process - life cycle models - iteration - specification - design and implementation - validation - evolution - automated process support - software requirements - functional and non-functional requirements - user requirements - system requirements - SRS - requirements engineering processes - feasibility studies - elicitation and analysis - validation - management - system models - context models - behaviour models - data models - object models - CASE workbenches

Module II (14 hours)
Software prototyping - prototyping in the software process - rapid prototyping techniques - formal specification - formal specification in the software process - interface specification - architectural design - system structuring - control models - modular decomposition - domain-specific architectures - distributed systems architecture - object-oriented design - objects and classes - an object oriented design process case study - design evolution - real-time software design - system design - real time executives - design with reuse - component-based development - application families - design patterns - user interface design - design principles - user interaction - information presentation - user support - interface evaluation

Module III (13 hours)
Dependability - critical systems - availability and reliability - safety - security - critical systems specifications - critical system development - verification and validation - planning - software inspection - automated static analysis - clean room software development - software testing - defect testing - integration testing - object-oriented testing - testing workbenches - critical system validation - software evolution - legacy systems - software change - software maintenance - architectural evolution - software re-engineering - data re-engineering

Module IV (13 hours)
Software project management - project planning - scheduling - risk management - managing people - group working - choosing and keeping people - the people capability maturity model - software cost estimation - productivity estimation techniques - algorithmic cost modelling, project duration and staffing quality management - quality assurance and standards - quality planning - quality control - software measurement and metrics - process improvement - process and product quality - process analysis and modelling - process measurement - process CMM - configuration management - planning - change management - version and release management - system building - CASE tools for configuration management

Text Books
1. Ian Sommerville, Software Engineering, Pearson Education India

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
PE09 L13: Project Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To give exposure to the major aspects of project viz. Project, Planning, Analysis, Selection, Implementation and review

Module I (14 hours)

Module II (14 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
1. Dennis Lock, Project Management, Grower Publications
3. Parameswar P Iyer, Engineering Project management, Vikas Publishers
### 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*
**PE09 L14: Finite Element Methods**

**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
4. T. R. Chandrupatla, *Finite Element Analysis for Engineering and Technology*, University Press

Reference Books
7. 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 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*
PE09 L15: Design for Manufacture

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
To impart knowledge about the manufacturing concerns that should be considered while designing a component so as to create a manufacturable design

Module I (14 hours)
Introduction: General design principles for manufacturability-strength and mechanical factors, mechanisms selection, evaluation method, Process capability-Feature tolerances-Geometric tolerances- Assembly limits-Datum features-Tolerance stacks.

Module II (14 hours)
Factors influencing form design: Working principle, Material, Manufacture, Design-Possible solutions-Materials choice-Influence of materials on form design-form design of welded members, forgings and castings – Design and manufacturing of gauges – Go gauge, No Go gauge

Module III (13 hours)

Module IV (13 hours)
Component design –Casting considerations: Design of casting based on parting line considerations-Minimizing core requirements, machined holes, redesign of cast members to obviate cores.
Re-design for manufacture and case studies: Identification of uneconomical design –Modifying the design – group technology. Computer Application for DFMA.

Reference Books
5. Yousef Haik.``Engineering Design Process”,VIKAS

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*
PE09 L16: Operations Research II

**Teaching scheme**
3 hours lecture and 1 hour tutorial per week

**Credits:** 4

**Objectives**
*To bring the student closer to the real situations by dropping various assumptions that were made to simplify the situations in the course Operations Research I*

**Module I (14 Hours)**

**Module II (14 Hours)**
Goal programming – single Vs multiple goals – goal programming formulation – algorithms – Integer linear programming – branch & bound algorithms – cutting plane algorithm

**Module III (13 Hours)**

**Module IV (13 Hours)**
Non-linear programming: - Unconstrained non-linear algorithms – Direct search, gradient methods – constrained algorithms – separable programming – Quadratic programming - geometric programming

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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*
PE09 L17: Concurrent Engineering

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart knowledge about principles, implementation, scheduling, evaluation of products, design cost and application of expert systems in relation to Concurrent Engineering

Module I (14 hours)
Principles of concurrent engineering: Overview, approaches to CE, computer based CE, various models and trends in CE.
Implementation: Common failure modes and success factors, failure modes, causes and structure, overcoming barriers to the implementation of CE, seven common organization/technical barriers, actions to overcome above barriers.

Module II (14 hours)
Scheduling concurrent manufacturing projects: Precedence relaxation, composite allocation factor, a decision based approach to CE, frame of reference, decision support problem technique, application and implementation issues.
Concurrent optimization of product design and manufacture: Concept, simultaneous evaluation of product performance and cost, methodologies for concurrent decision making, a cost based DFM system.

Module III (13 hours)
Evaluating product machinability for concurrent engineering: Generative feature interpretation, process selection, machinability evaluation, design for human factors, controls and displays, use of anthropometry, manual material handling.
Designing to cost: Methodologies to reduce cost, aids in designing for cost, quick cost estimation, designing to a cost goal, activity based costing, economic design in concurrent engineering, approaches, issues, integrated product and process design.

Module IV (13 hours)
Application of expert system to engineering design: knowledge representation paradigms, spatial reasoning, integration with CAD database, a generic approach to DFM system description.
Modelling the design process with Petri nets: Concept, properties, time based Petri nets, neuro computing and concurrent engineering, artificial neural networks, manufacturing feature recognition, contributions of ANN for CE. Introduction to current product development techniques.

Text Books
   Contemporary Issues and Modern Design tools, Chapman and Hall London 1993

Reference Books
2. Proceedings of the nato Advanced system Institute on Concurrent Engineering, Iowa
   City, May 25, June 5, 1992

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*
PE09 L18: Artificial Intelligence in Manufacturing

Objectives
To impart knowledge of how knowledge and information can be processed for creating and maintaining automated manufacturing systems.

Module I (14 hours)
Introduction: Components of knowledge base systems, knowledge representation, types, and comparison of knowledge representation schemes.
Knowledge base system: Inference engine, knowledge acquisition, optimization and knowledge base systems for machines.

Module II (14 hours)
Intelligent manufacturing: System components, system architecture and data flow system operation
Flexible machining system: Flexible assembly systems, tool management.
Technology based systems: Design of mechanical elements, refinement approach, and model based approach, design of mechanisms, feature based design, and knowledge based design for automated assembly.
Process planning: Feature recognition, machining optimization, knowledge based systems.

Module III (13 hours)
G Technology: Group technology, models and algorithms, cluster analysis method, knowledge based systems for GT, models and algorithms for machine layout, knowledge based systems for machine layout, scheduling, models and algorithms.

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.
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Maximum Total Marks: 70
PE09 L19: Modern Manufacturing Concepts

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To acquaint the student about the current scenario in modern manufacturing

Module I (14 hours)
Introduction-product development and strategies-computer automated engineering-simultaneous engineering –JIT,SMED,KANBAN,KAIZEN,FMEA,SCM,ERP.Total quality management, seven statistical tools and seven new tools ,product development- strategically quality management-quality circle ,introduction to ISO and QS standard , Total Productive maintenance,-evaluation, and maintenance management.

Module II (14 hours)
Green and Agile manufacturing – introduction – agility through group technology, concept of failure mode effect analysis
ERP – Evolution, advantages, integrated management information, integrated data modelling

Module III (13 hours)
Rapid prototyping – Stereo lithography, laminated object manufacturing , selective laser sintering , fused deposition modelling , 3 D inkjet printing , application of rapid prototyping – modular and reconfigurable machine system – fixtures and dies – parallel kinematic structure for machine tools , Stewarts platform , hexapod , application of hexapod in robotics and CMM.

Module IV (13 hours)

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.
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*Maximum Total Marks: 70*
PE09 L20: Facilities Planning and Plant Layout

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
• To introduce various techniques and tools of layout and other facilities planning in detail so that the student can approach a layout study in the most systematic and scientific way

Module I (14 hours)
Plant location - factors affecting selection of plant site - influence of location on plant layout - location theory models - plant layout - objectives of good plant layout - types of layout - methods showing flow - design of workstations - line balancing - RPW method - Moodi Young method - storage space requirements - simple problems

Module II (14 hours)
Quantitative and qualitative techniques of plant layout designs cross chart – Activity relationship diagrams, systematic layout planning - spiral analysis - travel charts - plot plan by travel charting - assignment algorithm - sequence demand - Wimmerts method - level curves - general consideration in overall design - basic philosophy and approach to computer software like CRAFT, CORELAP, ALDEP etc - simple problems

Module III (13 hours)
Production and physical plant services - receiving storage - warehousing - shipping, tool room, tool cribs etc. industrial buildings - construction - floor coverings - lighting - heating - ventilation - air conditioning - administration and personnel services - space determination and allocation planning of space for office, production, storage etc. allowance for expansion

Module IV (13 hours)
Material handling - principles of material handling - basic handling systems - handling systems to layout - integrated handling systems - material handling and operation research - transportation problems and sequencing – loading – Johnson’s Rule – CDS algorithm – simple problems.

Text Books
1. G K Agarwal, Plant Layout and Material Handling, Jain Brothers (New Delhi)
2. S C Sharma, Plant Layout and Material Handling, Khanna Publishers

Reference Books
1. Richard L Francis, Facility layout and Location, Prentice Hall of India
2. Theodore H allegri, Materials Handling, CBS Publishers
3. Rosaler & Rice, Standard H Plant Engg
4. Garg H.P., Plant Maintenance
5. Immer J.R., Materials Handling, 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)  
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*
PE09 L21: Simulation of Manufacturing Systems

**Objectives**
- To know about the technique of simulating actual industrial scenario

**Module I (14 hours)**
Introduction to simulation: Areas of application-system and system environment-components of a system-discrete and continuous systems-model of system-types of models-discrete-event system simulation-steps in a simulation study.

**Module II (14 hours)**

**Module III (13 hours)**
Input Modelling: Data collection-identifying the distribution with data-parameter estimation-goodness of fit tests-selecting input models with out data.
Design and evaluation of simulation Experiments: Length of simulation runs variance reduction techniques-experimental layout-validation

**Module IV (13 hours)**
Manufacturing Systems Examples: Simulation of single machine job shop-two machine job shop-simulation of inventory system and simulation of project networks.
Introduction of GPSS: Programming of discrete event using GPSS, case studies

**Text Books**
1. Jerry Banks and John S., *Discrete Event System Simulation*, Prentice, Hall of India

**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.
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*Maximum Total Marks: 70*
Objectives
• To introduce various IT and CAD tools used for integrating various systems of product development

Module I (14 hours)
Introduction: Product Development- product development- conceptual design, embodiment design, detailed design, manufacturing, servicing, discard /recycle-

Module II (14 hours)
Use of Information technology in Product Development
Product modelling – parameter based design, Feature based design, multiple view product modelling, knowledge based engineering

Module III (13 hours)
Manufacturing competitiveness - Checking the design process - conceptual design mechanism - Qualitative Physical approach - An intelligent design for manufacturing system - JIT system – Manufacturability evaluation- Design Manufacturing Integration approaches – Meta data based approach- Feature based approach

Module IV (13 hours)
Product data exchange – standardization- STEP – IGES – web based standards – XML – PDML - Integration of systems CAD/ CAM/CAE -
Design for X –manufacturing, supply chain and logistics, customer service and maintenance, environment Integrated information system- development and design- DABA – Virtual enterprise -

Text Books
1. John W. Priest and Jose M. Sanchez , Product Development and design for manufacturing, Marcel Dekker Inc.
2. Karl T. Ulrich and Steven D Eppinger, Product Design and Development, McGRAW-Hill

Reference Books
3. Rodger J. Burden., Product Data Management,
5. Grady Booch, James Rumbaugh, Ivar Jacobson, The unified modeling language user guide, Pearson Education
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

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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*
PE09 L23: Total Quality Management

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To impart knowledge on the concept of quality tools for analysing quality statistical tools in quality acceptance sampling life tests

Module I (14 hours)

Module II (14 hours)
SWOT analysis-strategic planning-customer focus-quality function deployment-customer satisfaction measurement-seven new management tools-Deming wheel-zero defect concept-bench marking-six sigma concepts-failure mode and effect analysis-poke yoke

Module III (13 hours)
Five S for quality assurance-quality circle philosophy-failure rate analysis-mean failure rate-mean time to failure (MTTF)-Mean time between failure (MTBF)-hazard models-system reliability-availability- maintenance

Module IV (13 hours)

Text Books
1. L Suganthi, Anand A Samuel, Total Quality Management, PHI

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
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**Maximum Total Marks: 70**
PE09 L24: Industrial Psychology

Objectives

• To give awareness on the Human and Industrial Psychology

Module I (14 hours)

Module II (14 hours)
Organizational behaviour- definition –development- fundamental concept- nature of people- nature of organization – an organizational behaviour system- models- autocratic model- hybrid model- understanding a social-system social culture- managing communication- downward, upward and other forms of communication

Module III 13 hours)
Motivation- motivation driver- human needs- behavior modification- goal setting- expectancy model- comparison models- interpreting motivational models- leadership- path goal model- style – contingency approach

Module IV (13 hours)
Special topics in industrial psychology- managing group in organization- group and inter group dynamics- managing change and organizational development- nature planned change- resistance- characteristic of OD- OD process

Text Books
1. Davis K. & Newstrom J.W., Human Behaviour at work, Mcgraw Hill International

Reference Books
2. Luthans, Organizational Behaviour, McGraw Hill, International
4. Blum M.L. Naylor J.C., Horper & Row, Industrial Psychology, CBS Publisher

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*
PE09 L25: Enterpreunership

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- entrepreneurial 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
8. Rao C.R., Finance for small scale Industries

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

<table>
<thead>
<tr>
<th>PART A:</th>
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*Maximum Total Marks: 70*
Global Electives

CH09 L23  NANOMATERIAL AND NANOTECHNOLOGY

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives

• To impart the basic concepts of nanotechnology
• To develop understanding about application of nanomaterials.

No Pre-requisites

Module 1 (13 Hours)
Introduction to nanotechnology, nanoscale, electromagnetic spectrum, top down and bottom up approach, particle size, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum effects.

Module 2 (13 Hours)
Nanomaterials, preparation of nanomaterials like gold, silver, different types of nano-oxides, Al₂O₃, TiO₂, ZnO etc. Sol-gel methods, chemical vapour deposition, ball milling etc. Carbon nanotubes, preparation properties and applications like field emission displays. Different types of characterization techniques like SEM, AFM, TEM & STM.

Module 3 (13 Hours)
Nanocomposites, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Smart materials, self assembly of materials, safety issues with nanoscale powders.

Module 4 (13 Hours)
Nanomanipulation, Micro and nanofabrication techniques, Photolithography, E-beam, FIB etc. Nanolithography, softlithography, photoresist materials. Introduction to MEMS, NEMS and nanoelectronics. Introduction to bionanotechnology and nanomedicines.

References:
1. Nanocomposite science and technology, Pulikel M. Ajayan, Wiley-VCH 2005
2. Nanolithography and patterning techniques in microelectronics, David G. Bucknall, Wood head publishing 2005
5. Micro and Nanofabrication, Zheng Cui, Springer 2005


**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*
CH09 L24 INDUSTRIAL POLLUTION CONTROL

Teaching scheme

3 hours lecture & 1 hour tutorial per week

Credits: 4

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, cannery wastes, brewery, distillery, meet 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)**

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*
**EE09 L 22 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)**


**MODULE II (14 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, 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)*

- 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
EE09 L 25 ROBOTICS AND AUTOMATION

Teaching scheme
3 hours lecture and 1 hour tutorial per week

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)*

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 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

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*
Objective
To introduce the following concepts to the students

- manufacturing of a micro device from material selection to final product design
- the various materials used in microfabrication and their applications
- how basic engineering design can couple with practice manufacturing techniques for getting a MEMS device
- the changes in properties when the dimensions of the system are scaled

Module I (11 hours)

Module II (13 hours)
Materials for MEMS and microsystems: Substrates and wafers – Silicon as a substrate material, ideal substrates for MEMS – single crystal Silicon and wafers crystal structure – mechanical properties of Si – Silicon compounds – SiO$_2$, SiC, Si$_3$N$_4$ and polycrystalline Silicon – Silicon piezoresistors – Gallium arsenide, quartz – piezoelectric crystals – polymers for MEMS – conductive polymers.

Module III (16 hours)
Module IV (12 hours)


Text Book

Reference Books
3 J. W. Gardner, *Microsensors: Principles and Applications*

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*
AI09-L25: Probability and Random Processes

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective

• To impart knowledge on tools and skills in probability theory for solving engineering problems

Module I (12 hours) Introduction to Probability Theory

Module II (14 hours) Random Variables, Distributions and density functions

Module III (14 hours) Operations on a single Random Variable
Expected value of a random variable – expected values of functions of random variable – Moments – central moments – conditional expected values – probability generating functions – Moment generating functions

Module IV (14 hours) Random Processes

Text Books

Reference Books
4. X. Rong Li, Probability, Random Signals, and Statistics

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 2(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 3 (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 4 (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) 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

IC09 L25 Aerospace Engineering and Navigation Instrumentation

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives:
To expose the students to the field of aerospace engineering and to impart basic knowledge of its navigation instrumentation.

Prerequisites
Familiarity with control system theory and basic concepts of instrumentation

Module I (15 Hours)
(Introductory treatment of the above topics is only expected, no detailed derivations)

Module II (11 Hours)

Module III (13 hours)
Command and homing guidance systems- Introduction to classical and modern guidance laws- Satellite navigation systems- GPS and GNSS, Augmented satellite navigation- Hybrid navigation concepts.
Automatic Pilots- Sun sensors- Horizon scanner- Aircraft flight simulation instrumentation.

Module III (15 hours)
Introduction to navigation and guidance instrumentation- Principle, construction and applications of inertial sensors- Gyroscope and accelerometers- Ring laser gyroscope- Fiber optic gyroscope, MEMS gyroscopes and accelerometers- Directional gyros- Rate gyros- Turn and slip indicator. Radar- continuous wave and frequency modulated radar- MTI and pulse Doppler radar

Reference Books

4. San Darite, Radio aids to navigation.,

**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

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

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**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*
CE09 L23 EXPERIMENTAL STRESS ANALYSIS

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

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 - polarisopes - diffusion type - lens type polarisopes - 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 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  
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**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*