SCHEME AND SYLLABI FOR

EIGHTH SEMESTER

OF

BACHELOR OF TECHNOLOGY IN

PRODUCTION ENGINEERING

FROM 2009 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

8th Semester

Code	Subject	Hours/week			Marks		Sem- end duration- hours	Credits
		L	T	P/D	Inte- rnal	Sem- end		
PE09 801	Financial Management	4	1	-	30	70	3	5
PE09 802	Computer Integrated Manufacturing	2	1	-	30	70	3	3
PE09 Lxx	Elective IV	3	1	-	30	70	3	4
PE09 Lxx	Elective V	3	1	-	30	70	3	4
PE09 805(P)	Seminar	-	-	3	100	-	-	2
PE09 806(P)	Project	-	-	11	100	-	-	7
PE09 807(P)	Viva Voce	-	-	-	100	-	-	3

	Total	**12**	**4**	**14**				**28**

Electives

PE09 L06 Engineering Materials
PE09 L07 Linear System Analysis
PE09 L08 Safety Engineering
PE09 L09 Industrial Triblolgy
PE09 L10 Supply Chain Management
PE09 L11 Tehnology 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 Artficial Intellegence 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

PE09 801: Financial Management

Teaching scheme **Credits:** 5

4 hours lecture and 1 hour tutorial per week

Objectives

- *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)

Management accounting – cost concepts – elements of cost and cost sheet – cost-volume-profit analysis – costing for decision making – control and responsibility accounting – budgetary control

Module III (18 hours)

Time value of money – Capital budgeting – methods of appraisal – cost of Capital and its measurement – capital structure planning - valuation of firms – dividend policy

Module IV (18 hours)

Management of current assets – management of receivables – inventory costs – introduction to international finance

Text books

1. I.M.Pandey., *Financial Management* Vikas Publications
2. I.M.Pandey., *Management Accounting* Vikas Publications
3. Khan & Jain, *Financial Management*, TMH

Reference books

1. Prasannachandra, *Financial Management*, TMH
2. Dhameja & Sastry, *Finance & Accounting*, Wheeler Publishing
3. A A Atkinson *Management Accounting* Pearson Education
4. Jame C.Van Horne, *Financial 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)* 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 802: Computer Integrated Manufacturing

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

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)

Robotics and automated assembly - types of robots and their performance capabilities - programming of robots - hardware of robots - kinematics of robots - product design for robotized manufacturing - selecting assembly machines - feeding and transfer of arts - applications of robots in manufacture and assembly - sensors - simulation and automated quality control - types of simulation - simulation methodology - simulation languages and packages - applications - statistical process control - objectives of CAQC - types of CMM - non-contact inspection methods - in process and post process metrology - flexible inspection systems

Module IV (9hours)

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

1. David Bedworth et al., *Computer Integrated Design and Manufacturing*, McGraw Hill Book Co.
2. Radhakrishnan P., *Computer Integrated Manufacturing*, Dept. of Production Engineering, PSG College of Technology

Reference Books

1. Eric Teicholz & Joel Orr, *Computer Integrated Manufacturing Handbook*, McGraw Hill Book Co.
2. Ranky P.G., *Computer Integrated Manufacturing*, Prentice Hall of India
3. Mikell.P.Groover, *Automation, Production systems and Computer Integrated Manufacturing*, 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 questions4 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 805 (P): Seminar

Teaching scheme **Credits:** 2
3 hours per week

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

Scheme of evaluation
Presentation and discussion = 25
Material content = 10
Report = 10
Participation and attendance = 5
Total marks = 50

PE09 806 (P): Project

Teaching scheme **Credits:** 7

6 hours per week

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

Scheme of Evaluation	
Thesis defence	= 60
Report	= 40
Total marks	= 100

PE09 807 (P): Viva Voce

Teaching scheme **Credits:** 3

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.

Scheme of Evaluation	
Subjects	: 40
Project	: 30
Seminar	: 20
Industrial Training/Industrial visit/ Industrial tour or paper presented at national level	: 10
Total marks	: 100

PE09 L06: Engineering Materials

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

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)
Physical properties of metals:- Melting point – density – Thermal properties – Electrical properties – Magnetic properties – Optical properties – Mechanical properties:- Tensile strength – Modulii of elasticity – Hardness – Brinell, Rockwell and Vickers hardness – Impact Strength – Izod and Charpy tests – Toughness – Fatigue - Creep

Module II (14 hours)
Ferrous metals: – Iron-Carbon equilibrium diagram – Time-Temperature Transformation curves – Heat treatment of carbon steels: – Annealing – Spheroidising – Normalizing – Tempering – Hardening – Effect of alloying elements – Stainless steel –cast iron.

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)
Ceramics :– Mechanical properties – Brittle fracture – Static fatigue – Creep – Thermal shock – Optical properties – Refractive index – Reflectance - Transparency – Translucency and opacity
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
3. Sidney H Avener, *Physical Metallurgy*, Mc Grow Hill
4. R A Higgins, *Engineering Metallurgy*, VIVA (Low Priced Student Edition)
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)* 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 L07: Linear System Analysis

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

Objectives

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

Module I (14 hours)

System concepts and modeling of systems: Systems – system variables & parameters - classification of systems – continuous-time/discrete-time, static/dynamic, linear/non-linear, distributed/lumped, time invariant/variant, stochastic/deterministic systems – system modeling & approximations - superposition principle — modeling of electrical systems - dynamic equations using KCL & KVL of RL, RC and RLC circuits – transfer function – impulse response – development of block diagrams of electrical networks – block diagram reduction – signal flow graphs – Mason's gain formula

Module II: (14 hours)

Modeling of mechanical systems**:** Modeling of translational and rotational mechanical systems – differential equations for mass, spring, dashpot elements – D'Alembert's principle – rotational inertia, stiffness & bearing friction - dynamic equations & transfer function for typical mechanical systems – analogous systems – force-voltage & force-current analogy - toque-voltage & torque-current analogy - gear trains – equivalent inertia & friction referred to primary and secondary shafts – resistance & capacitance of thermal system, liquid level system & pneumatic systems – dynamic equations & transfer function for simple systems – electromechanical systems.

Module III: (13 hours)

Time domain analysis **:** Open loop & closed loop control systems – response to arbitrary inputs – convolution integral – convolution theorem - Time domain analysis – standard test signals - step, ramp, parabolic, impulse – transient and steady state response – first order systems – unit impulse, step & ramp responses of first order systems - second order systems – under damped and over damped systems - unit step response – time domain specifications - time response of higher order systems – steady state error – static position, velocity & acceleration error constants.

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 invarient 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

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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 **Credits:** 4

3 hours lecture and 1 hour tutorial per week

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-ergonomichazards-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
3. James D.,*Fire Prevention Handbook*, Butterworths,london 1996

Reference Books

1. Welding institute, U.K., Health *and Safety in welding and Allied processes*,high Tech. Publishing ltd.,London
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

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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 **Credits:** 4
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)
Surfaces and Friction: - Topography of Engineering surfaces – Contact between surfaces – Sources of sliding Friction – Adhesion Ploughing – Energy dissipation mechanisms – Rolling friction – Sources of Rolling Friction – Stick slip motion – Measurement of Friction

Module II (14 hours)
Wear: - Types of wear – Simple theory of Sliding - Wear Mechanism of sliding wear of metals – Abrasive wear – Materials for adhesive and abrasive situations – Corrosive wear – Surface Fatigue wear situations – Brittle fracture wear – wear of ceramics and polymers – wear measurements

Module III (13 hours)
Lubricants and Lubrication types :- Types and properties of Lubricants – Testing methods – Hydrodynamic Lubrication – Elasto hydrodynamic lubrication – Boundary Lubrication – Hydrostatic Lubrication – Solid lubrication

Module IV (13 hours)
Surface Engineering and Materials for Bearings :- Surface modifications – Transformation Hardening, Surface fusion – Thermo chemical processes – Surface coatings – Plating and anodizing – Fusion processes – Vapour Phase processes – Materials for rolling Element bearings – Materials for fluid film bearings – Materials for marginally lubricated and dry bearings

Text Books

1. I.M.Hutchings, "*Tribology, Friction and Wear of Engineering Material"* Edward Arnold 1992

Reference Books

1. Ernest rabinowicz *"Friction and wear of materials"* , John wiley& sons
2. E.P.Bowden and Tabor.D., *"Friction and Lubrication"*,Heinemann Educational Ltd.,1974
3. A.Cameron, "*Basic Lubrication theory*, Longman, U.K.1981
4. M.J.Neale (Editor), "*Tribology Handbook"*, Newnes.Butter worth,Heinemann,U.K.,1975

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 L10: Supply Chain Management

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

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)
Design of the supply chain network – role of distribution – factors influencing the distribution network design – Design options – Value of distributions – Network design in supply chain – role of network, factors to be considered – impact of uncertainty – discounted cash flow analysis – planning demand and supply in a supply chain – demand forecasting – characteristics of forecasting – role of forecasting – aggregate planning strategies. Planning of supply & demand - predictable variability – managing supply, demand.

Module III (13 hours)
Planning & Managing Inventories – role of cycle inventory – Economics of scale to exploit fixed costs & quantity discount – safety Inventory – supply uncertainty – optional level of product availability – Managerial levers to improve the supply chain profitability – sourcing in a supply chain – supplier selection – procurement processes – Transportation in supply Chain – modes of transportation – transportation network design.

Module IV (13 hours)
Revenue management for multiple customer, perishable assets, seasonal demand, bulk & spot contracts - Co-ordinators in supply chain – bull whip effect, Lack of co-ordination on performance, obstacles to co-ordination, Managerial levers to achieve co-ordination .Strategic partnership & thrust – IT in Supply Chain – Customer Relationship Management, Internal Supply Chain Management, Supply Relationship Management – Future of IT in supply chain – role of e-business in supply chain.

Text Books

Chopra S. & Meindl P., *Supply Chain Management: Strategy, Planning, and Operation*, Pearson Education.,Asia

Reference Books

1. Christopher M., *Logistics and Supply Chain Management*, Pitman Publishing Company
2. John Mortimer (Editor), *Logistics in Manufacturing: An IFS Executive Briefing*, IFS Publications, U.K. & Springer-Verlag.
3. Narasimhan S.L., Mcleavy D.W. & Billington P.J., *Production Planning and Inventory Control*, Prentice Hall of India.
4. Raghuram G. & Rangaraj N., *Logistics and Supply Chain Management: Cases and Concepts*, Macmillan India Limited
5. Dobler D.W. & Burt D.N., *Purchasing and Supply Management: Text and Cases*, Tata McGraw Hill Publishing Company Limited
6. Tersine R.J., *Principles of Inventory and Materials Management*, Fourth Edition , Prentice Hall Inc.
7. Starr M.K. & Miller D.W., *Inventory Control: Theory and Practice*, Prentice Hall of India.
8. David Taylor & David Brunt, *Manufacturing Operations and Supply Chain Management;The Lean Approach*,Vikas Publishers
9. Arjan J van Weele,*Purchasing and Supply chain Management Analysis,Planning and Practice 2nd Edition*,Vikas Publishers

Vollmann, *Manufacturing Planning & Control for Supply Chain Management*, Tata Mc Graw Hill Publishers
Joel D Wisner, *Principles of Supply Chain Management A Balanced Approach*, 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 L11: Technology Management

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

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)
Management of Technology- Definition and Characteristics- Technological environment- Developments in Technological environment- Innovation-components of innovation – Innovation dynamics at firm level – Technology Evolution – S-Curve- Levels of Technology Development – Characteristics of innovative firms

Module II (14 hours)
Technology Diffusion- Dynamics of diffusion – Factors affecting process of diffusion – Influence of environmental trends – Technology and Competition – Competitive consequences of technological change – Characteristics of competitive domains – Dynamics of change in competitive domains – Influence of environmental trends

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)
Technology Strategy- Definition – Technology Business Connection – Key Principles – Technology Strategy types – Framework for formulating technology strategy – Appropriation of Technology - - Evolution – Third Generation approach – External sourcing of technology portfolio – Productivity of In-house Research and Development.

Text Books

1. V K Narayanan, *Managing Technology and Innovation for Competitive Advantage*, Pearson Education Asia

Reference Books

1. Tarek Khalil, *Management of Technology – The key to competitiveness and Wealth creation* , McGraw-Hill International Edition.
2. Frederick Betz, *Strategic Technology Management*, McGraw-Hill International Edition.
3. Norma Harrison, Danny Samson, *Technology Management*, Text and International Casers, 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

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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 L12: Software Engineering

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

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 - behaviour 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

1. Pressman R.S., *Software Engineering*, McGraw Hill
2. Mall R., *Fundamentals of Software Engineering*, Prentice Hall of India
3. Behferooz A. & Hudson F.J., *Software Engineering Fundamentals*, Oxford University Press.
4. Jalote P., *An Integrated Approach to Software Engineering*, Narosa

Internal Continuous Assessment *(Maximum Marks-30)*

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

*PART A: Short answer questions (one/two sentences)5 x 2 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 questions4 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 **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

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

Module I (14 hours)

Planning - Capital Expenditures – Phases of Capital Budgeting – Levels of decision Making – Facets of Project analysis- Feasibility Study – Objectives of Capital Budgeting – Resource Allocation framework- Key Criteria- Elementary Investment strategies – Portfolio planning tools – Generation of project Ideas – Monitoring the environment – Corporate appraisal – Scouting for project ideas – Preliminary Screening – Project rating index – Sources of Positive net present value

Module II (14 hours)

Analysis – Market and demand analysis – Situational analysis and specification of objectives – Collection of secondary information - Conduct of market survey – Characterization of Market – demand Forecasting – Market planning – Technical analysis- Material inputs and utilities – Manufacturing process/technology – Product Mix – Plant capacity – Location and site -machineries and equipments – Structures and civil works – Project charts and layouts – Work schedule – Financial Analysis – Cost of project – means of finance – Estimates of sales and Production – Cost of production – Working capital requirements and its financing – Profitability projections – Break even point – projected cash flow statements and balance sheets

Module III (13 hours)

Project Cash flows – Basic Principles for measuring cash flows – Components of cash flow – Cash flow illustrations – Viewing a project from different points of view – Time value of money – Future Value of a single amount – Future value of an annuity – Present value of a single amount – Present Value of an annuity- Cost of capital – Cost of debt capital – cost of preference capital – Rate of return – Cost of external equity and retained earnings - Determination of weights – Appraisal criteria – Net present value – Cost benefit ratio- Internal rate of return- Urgency – payback period

Module IV (13 hours)

Implementation- Forms of Project organization – Project planning – Project control – Human Aspects of Project management – Network Techniques – Development of Network – Time estimation – Critical path determination – Scheduling under limited resources – PERT Model – CPM Model – Network Cost System – Project review- Initial; review – Performance evaluation – Abandonment analysis

Text Books

1. Prasanna Chandra, *Projects Planning, Analysis, Selection, Implementation and Review, Fourth Edition*, Tata McGraw -Hill

Reference Books

1. Dennis Lock, *Project Management*, Grower Publications
2. Prasanna Chandra, *Financial Management Theory and Practice*, Tata McGraw -Hill Publishers
3. Parameswar P Iyer, *Engineering Project management*, Vikas Publishers
4. Gido & Clements, *Successful Project Management*, Vikas Publishers
5. Harold.T..Amrine John.A.Ritchey, *Manufacturing Organisation and 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*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 questions4 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

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

Objectives

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

Module 0 (2 hours)
Review : Matrices and matrix operations – solution of system of linear equations – Gauss elimination. Basic equations of elasticity – strain-displacement relations – compatibility - stress-strain relationship – boundary condition – St. Venant's principle - theorem of minimum potential energy – principle of virtual work. Steady state heat conduction equation – Fourier's law – boundary conditions.
(No direct questions from the above part)

Module I (13 hours)
Introduction: Finite element method as a numerical tool for design – basic concepts – formulation procedures – historical development – current trends – free and commercial FE packages.
FE modelling Direct approach: 1-D bar element – element stiffness – assembly of elements – properties of [K] matrix – treatment of boundary conditions – temperature effects – stress computation – support reaction – simple problems. Analogous (1-D) problems of torsion, heat conduction and laminar pipe flow.
Beam element: Beam relationships – 1-D beam element FE formulation - element stiffness matrix – load considerations – boundary conditions – member end forces.

Module II (13 hours)
FE modelling Direct approach : Plane truss element formulation – coordinate transformation – local and global coordinates – element matrices – assembly of elements – treatment of boundary conditions – stress calculation – simple problems - band width of the stiffness matrix – node numbering to exploit matrix sparsity – conservation of computer memory.
Interpolation – shape function – Lagrange interpolation - 1D linear and quadratic, 2D linear triangle and bilinear rectangular elements.
FE formulation from virtual work principle – B-matrix – element matrices for bar and CST elements – load considerations – consistent nodal loads – simple problems.

Module III (13 hours)
Variational methods : – Functionals – weak and strong form – essential and non- essential boundary conditions - Principle of stationary potential energy – Rayleigh-Ritz method –simple examples.
FE formulation from a functional: 2-D steady state heat conduction – element matrices for a triangular element – boundary conditions – simple problems. FE formulation for 2-D stress analysis from potential energy - element matrices - plane bilinear element.
Convergence requirements – patch test – modelling aspects – symmetry – element size and shape – sources of error.

Module IV (13 hours)
Weighted residual methods: Galerkin FE formulation – axially loaded bar – heat flow in a bar.

Isoparametric formulation: Natural coordinates – linear and quadratic bar element – linear triangle and plane bilinear elements for scalar fields – jacobian matrix – element matrices - Gauss quadrature – requirements for isoparametric elements – accuracy and mesh distortion.

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
5. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, *Concepts & Applications of Finite Element Analysis*, John Wiley & Sons
6. S. S. Bhavakatti, *Finite Element Analysis*, New Age International

Reference Books

5. J. N. Reddy, *An Introduction to the Finite Element Method*, McGraw Hill International Edition
6. S. S. Rao, *The Finite Element Method in Engineering*, Butterworth Heinemann
7. K. J. Bathe, *Finite Element Procedures in Engineering Analysis*, Prentice Hall of India
8. O. C. Zienkiewics, R. L. Taylor, *The Finite Element Method*, Vol I & II, 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 L15: Design for Manufacture

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

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)
Component design-machining considerations**:** Design features to facilitate machining-drills-milling cutters-keyways-Doweling procedures, countersunk screws-Reduction of machined areas-simplification by separation-simplification by amalgamation –Design for machinability-Design for economy-Design for clampability-Design for accessibility-design for assembly.

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
1. Harry peck, *"Design for manufacture"*, Pitman Publication, 1983
2. Robert Matousek, "*Engineering Design- A systematic approach*", Blackie&sons Ltd.,1963
3. James G.Bralla, "*Handbook of Product design for manufacturing*", Mcgraw hill co.,,1986
4. Swift K.G. "*Knowledge based design for manufacture*, Kogan Page Ltd.,1987
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)* 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 L16: Operations Research II

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

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)
Advanced linear programming: - LP in matrix form – convex sets – revised Simplex method – bounded variables algorithm – decomposition algorithm – duality – parametric linear programming – Karmarker – Interior point algorithm

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)
Dynamic programming: - forward and backward recursion – application in deterministic situations – classical optimization theory – unconstrained problems – constrained problems

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

Text Books
1. N Ramanathan, Operations Research, Tata McGraw Hill Publishers
2. Sharma S.D., *Operations Research*, Kedarnath Ramnath
3. Taha H.A., *Operations Research*, Prentice Hall of Ind

Reference Books
1. Anderson, *Quantitative Methods for Business*, Cengage Publications

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 L17: Concurrent Engineering

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

Objectives

- *To impart knowledge about principles, implementation, scheduling , evaluation of products , design cost and application of expert systems is 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

1. Hamid R. Parasaeie, William. G. Sullivan, *Concurrent Engineering Contemporary Issues and Modern Design tools*, Chapman and Hall London 1993

Reference Books

1. Edward., .G.Haug (Editor), *Concurrent Engineerng Tools and Techonologies for Mechanical Systems Design*, Springer Verlag Publishing Co.
2. *Proceedings of the nato Advanced system Institute on Concurrent Engineering*, Jowa 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)* 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 L18: Artificial Intelligence in Manufacturing

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

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)
Application of artificial neural networks, fuzzy logic and genetic algorithms in manufacturing, ANN for tool wear monitoring, fuzzy control of machine tools, Introduction to neural networks, synaptic integration and neuron models, essential vector operators, back propagation algorithms, application of neural networks to process modelling control, neural network based feed forward active control systems, neural network application to tool condition monitoring in turning machine, condition monitoring in tapping, neural networks in robotics.

Text Books
1. Andrew Kusiak, *Intelligent Manufacturing Systems*, Prectice Hall, 1990

Reference Books
1. Mohammed Jamshidi, *Design and Implementaton of Intelligent Manufacturing Systems*. Prectice Hall, 1995
2. Mitsuogen Runwelding, *General Algorithms in Engineering Design*, John Wiley.1997
3. Ibrahim Zeid. *CAD/CAM Thoery and Practice*, MacGraw Hill, 1991
4. Elaine Rich. *Artificial intelligence*. Tata McGraw Hill, 1995

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 L19: Modern Manufacturing Concepts

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

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)
Material application – Nano materials – shape memory alloys – working of SMA,SMART material – applications - Micro machining introduction – Laser micro machining – surface micro machining processing techniques – bonding techniques – precision machining – micro assembly techniques – micro manipulators, bulk micro machining.

Reference Books

1. Gibson P, Green Halgh G, Kerr. R. Manufacturing management Chapman & Hall,
2. Jack M Wacker, *Hand book of Manufacturing engineering*, Marcel Deeker Inc, USA 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)* 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 L20: Facilities Planning and Plant Layout

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

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 Mterial Handling*, Khanna Publishers
3. Moore J.M., *Plant Layout and Design*, Macmillan

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. James J Pa*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)* 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 L21: Simulation of Manufacturing Systems

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

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)
Random number generation: Properties of random numbers-generation of pseudo random numbers-techniques for generating random numbers-tests for random numbers. Random Variable generation: Inverse transforms technique, Exponential-uniform-weibull-triangular-empirical-continous-discrete distribution-direct transformation for the normal distribution-acceptance-rejection technique-Poisson-gamma

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., *Carson,Discrete Event System Simulation,*Prentice, Hall of India
2. Gordon G.,*Systems Simulation,* Prentice Hall of India Ltd.
3. Narsingh Deo,*Systems simulation with digital computer,* Prentice Hall of India

Reference Books

1. A.M & Kelton W.D, *Simulation Modelling and Analysis*, McGraw Hill
2. Carrle A, *Simulation of Manufacturing Systems*, John Wiley and Sons Inc.,

Internal Continuous Assessment *(Maximum Marks-30)*

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

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* 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 L22: Integrated Product Development

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

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-

Product Development Organization: - Concurrent engineering - Definition – CE Design Methodologies – CE organization – collaborative product development – co design -

Requirement definition- product requirement and definition- UML diagram

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

Product data management – Concept – function – architecture- product structure – product process – configuration management – product lifecycle management- Use of UML in PDM system design

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,
4. Andrew Kusaik, *Concurrent Engineering: Automation Tools and Technology*, Wiley, JOhn and Sons Inc.
5. Grady Booch, James Rumbaugh, Ivar Jacobson, *The unified modeling language user guide*, Pearson Education
6. Ibrahim Zeid, *CAD/CAM Theory and Practice* , 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 L23: Total Quality Management

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

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)
Definition of quality-internal and external customers- vision statement – mission statements – objectives – goals – targets- evolution of TQM – Defining TQM – stages in TQ M implementation-TQM models

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)
Quality and cost-characteristics of quality cost-micro analysis of quality cost-measurement of quality-TQM road map- ISO 9000 series certification-ISO 9001:2000 certification-ISO 14000 certification-QS 9000 auditing-Quality auditing- quality awards

Text Books

1. L Suganthi, Anand A Samuel, *Total Quality Management*, PHI
2. Lt.Gen. Lal H, *Total Quality Management*, Wiley Eastern Limited

Reference Books

1. Greg Bounds, *Beyond Total Quality Management*, McGraw Hill Publishers
2. Menon H G, *TQM in New Product Manufacturing*, McGraw 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)* 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 L24: Industrial Psychology

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To give awareness on the Human and Industrial Psychology*

Module I (14 hours)

Introduction- psychology as a science- area of applications – study of individual- individual differences- study of behaviour- stimulus- response behaviour- heredity and environment- human mind- cognition- character- thinking- attention- memory- emotion- traits- attitude- personality

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

1. Schermerhorn J.R.Jr.,Hunt J.G &Osborn R.N.,Managing, *Organizational Behaviour*,John Willy
2. Luthans,*Organizational Behaviour*, McGraw Hill,International
3. Morgan C.t.,King R.A.,John Rweisz &John Schoples, *Introduction to Psychology*, McHraw Hill
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)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 L25: Enterpreunership

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

Objectives

- *To give an idea on entrepreneurial perspectives*

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

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

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

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

Text Books

1. Harold Koontz & Heinz Weihrich,*Essentials of Management*, McGraw hill International
2 Hirich R.D. &Peters Irwin M.P., *Entrepreneurship*, McGraw Hill
3. Rao t.V., Deshpande m.V.,Prayag Metha &Manohar S. Nadakarni, *Developing Entrepreneurship A Hand Book*, Learning systems
4. Donald Kurado & Hodgelts R.M., *Entrepreneurship A contemporary Approach*,The Dryden Press
5. Dr. Patel V.G.,*Seven Business Crisis*, Tata McGraw hill
Timmons J.A., *New venture Creation- Entrepreneurshipfor 21 st century*,McGraw hillInternational
6. Patel J.B.,Noid S.S., *A manual on Business Oppurnity Identification*, selections,EDII
7. Rao C.R.,*Finance for small scale Industries*
8. Pandey G.W., *A complete Guide to successful Entrepreneurship*,Vikad Publishing

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

Global Electives

CH09 L23 NANOMATERIAL AND NANOTECHNOLOGY

Teaching scheme **Credits:** 4

3 hours lecture & 1 hour tutorial per week

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, Al_2O_3, TiO_2, 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
3. Transport in Nanostructures, D.K. Ferry and S.M. Goodmick, Cambridge university press 1997.
4. Optical properties of solids, F. Wooten, Academic press 1972
5. Micro and Nanofabrication, Zheng Cui, Springer 2005
6. Nanostructured materials, Jackie Y. Ying, Academic press 2001
7. Nanotechnology and nanoelectronics, W.R, Fahrner, Springer 2005
8. Nanoengineering of structural, functional and smart materials, Mark J. Schulz, Taylor & Francis 2006.
9. Hand book of Nanoscience, Engineering, and Technology, William A. Goddard, CRC press 2003.
10. Nanoelectronics and Information Technology, Rainer Waser, Wiley-VCH 2003.

11. The MEMS Handbook Frank Kreith, CRC press 2002.

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 **Credits:** 4

3 hours lecture & 1 hour tutorial per week

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)

Air pollution control in industries: source and classification of industrial air pollutants - monitoring equipment and method of analysis - damages to health, vegetation and materials - air pollution laws and standards - treatment method in specific industries - thermal power plants - cement - fertilizers - petroleum refineries - iron and steel - chlor-alkali - pulp and paper

Module 4 (13hours)

Industrial odour control - sources and solutions - odour control by adsorption and wet scrubbing - industrial noise control methods - sludge treatment and disposal - industrial hazardous waste management, waste minimization. Environmental Impact Assessment and risk assessment-Environmental Audit and Environmental management system- Concept of common effluent treatment plants.

References:

1. Nelson & Nemerow, Industrial Water pollution-Origin, Characteristics and treatment, Addison, Wesley Publishing Co.
2. Gerard Kiely,Environmental Engineering, McGraw Hill
3. Rao M.N. & Rao H,Air Pollution, Tata McGraw Hill
4. Sincero A.P.& Sincero G.A., Environmental Engineering, A Design Approach, Prentice Hall of India

5. Rao C.S., Environmental Pollution Control Engineering, New Age Int. Pub.
6. Mahajan S.P., Pollution Control in Process Industries, Tata McGraw Hill
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 **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

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

Module I (12 Hours)
Artificial Intelligent systems – Neural Networks, Fuzzy Logic and Evolutionary Programming concepts. Artificial Neural Networks – Biological neural networks – Model of an artificial neuron- Comparison between biological neuron and artificial neuron– Basic models of artificial neural network –Learning methods – - Activation function and terminologies of ANN- - Mc Culloch Pitts Neuron – Linear Separability – Hebb network – Perceptron Networks , Adaline, Madaline.

MODULE II (14 Hours)
Back propagation Networks : Architecture - Multi layer perceptron –Back propagation learning – Input layer, Hidden Layer , Output Layer computations, Calculation of error, Training of ANN, Back propagation Algorithm, Momentum and Learning rate, Selection of various parameters in BP networks- Radial Basis Function Networks [T. B. 1].
Variations in standard BP algorithms – Decremental iteration procedure, Adaptive BP, GA based BP, Quick prop training, Augmented BP networks, Sequential learning Approach for single hidden layer Neural networks.

Module III (14 Hours)
Fuzzy sets and crisp sets-Fuzzy sets –Fuzzy set operations-Fuzzy relations-Membership functions – Features of the membership functions-Fuzzification-Methods of membership value assignments-Defuzzification- Defuzzification methods-Fuzzy Rule Base and approximate reasoning- Truth values and tables in fuzzy logic, Fuzzy propositions, Formation of rules, Decomposition of rules, Aggregation of fuzzy rules- Fuzzy Inference Systems- Construction and Working Principle of FIS- Methods of FIS- Mamdani FIS and Sugeno FIS- Fuzzy Logic Control Systems- Architecture and Operation of FLC System- FLC System Models-Application of FLC Systems.

Module IV (14 Hours)
Genetic Algorithms- Basic Concepts- Creation of off- springs- Working Principle- Encoding-Fitness function- Reproduction- Roulette- Wheel Selection, Boltzmann Selection- Tourna-

ment selection- Rank Selection- Steady- State Selection- Elitism- Generation gap and steady state replacement- Inheritance operators- Cross Over- Inversion and deletion- Mutation Operator- Bit- wise operators- Generational Cycle- Convergence of Genetic Algorithm- Differences and Similarities between GA and other traditional methods- Applications.

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Text Books

1. S. N. Sivanandam, S. N. Deepa, *Principles of Soft Computing*, Wiley India Pvt. Ltd.[Module I& III]
2. R.Rajasekharan and G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms- Synthesis and Applications,* Prentice Hall of India. [Module II, & IV]

Reference Books

1. Fakhreddine O.Karray, Clarence De Silva, Intelligent Systems Design, Theory, Tools and Application, Pearson Education
2. S. Haykins, Neural Networks – A Comprehensive Foundation , Prentice Hall 2002.
3. L. Fausett, Fundamentals of Neural Networks, Prentice Hall 1994.
4. T.Ross, Fuzzy Logic with Engineering Applications, Tata McGrawHill, New Delhi 1995.
5. D.E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Addison Wesley MA, 1989.

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) *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 25 ROBOTICS AND AUTOMATION

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To give an introduction of industrial robotics and automation*

Module I (14 Hours)

Automation and Robotics - Robotics in Science Fiction - A Brief History of Robotics - The Robot and Its Peripherals-Robot Activation and Feedback Components - Position Sensors - Velocity Sensors - Actuators - Power Transmissions Systems - Robot Joint Control Design- Introduction to Manipulator Kinematics - Homogeneous Transformations and Robot Kinematics -Manipulator Path Control - Robot Dynamics - Configuration of a Robot Controller.

Module II (13 Hours)

Types of End Effectors - Mechanical Grippers - Other Types of Grippers - Tools as End Effectors - The Robot/End Effector Interface - Considerations in Gripper Selection and Design - Sensors in Robotics - Tactile Sensors - Proximity and Range Sensors - Miscellaneous Sensors and Sensor-Based Systems - Uses of Sensors in Robotics - Introduction to Machine Vision - The Sensing and Digitizing Function in Machine Vision - Image Processing and Analysis - Training and Vision System - Robotic Applications.

Module III (14 Hours)

Methods of Robot Programming – Lead through Programming Methods - A Robot Program as a Path in Space - Motion Interpolation - WAIT, SIGNAL, and DELAY Commands - Branching - capabilities and Limitations of Lead through Methods - The Textual Robot Languages - Generations of Robot Programming Languages - Robot Language Structure - Constants, Variables, and Other Data Objects - Motion Commands - End Effector and Sensor Commands - Computations and operations - Program Control and Subroutines - Communications and Data Processing - Monitor Mode Commands.

Module IV (13 Hours)

Introduction to robot intelligence and task planning- state space search-problem reduction-use of predicate logic-means –end analysis-problem-solving –robot learning-robot task planning-expert systems and knowledge learning.

Text Books

1. Mikell P. Groover- et. Al, *Industrial robotics, Technology, programming and Applications*, McGraw Hill

2. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, *Robotics, Control, Sensing and Intelligence*, Mc-Graw 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 **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

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

Pre-requsites: *Nil*

Module I (13 hours)
Energy and environment: Introduction – fossil fuel reserves – world energy consumption – green house effect – global warming – renewable energy sources – environmental aspects utilization – energy prices – energy policies

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)
Energy technologies: Fluidized bed combustion – fluidized bed boilers – waste heat recovery systems – heat pump and refrigerators – wind energy collectors and storage systems – insulated pipe work systems.

Module IV (13 hours)
Energy management: Energy management principles – energy resources management – energy management information systems – computerized energy management. Costing techniques – cost optimization – optimal target investment schedule – financial appraisal and profitability.

Text Books

1. W. R. Murphy, G. Mc Kay, *Energy Management*, Butterworths, London

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
3. N. A. Chaigier, *Energy Consumption and Environment*, McGraw Hill

Internal Continuous Assessment *(Maximum Marks-30)*

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

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

AI09-L23 Micro Electro Mechanical Systems

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

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)

MEMS and microsystems: MEMS and microsystem products – evaluation of microfabrication – microsystems and microelectronics – applications of microsystems – working principles of microsystems – microsensors – microactuators – MEMS and microactuators – microaccelerometers.

Scaling laws in miniaturization: Introduction – scaling in geometry – scaling in rigid body dynamics – the Trimmer force scaling vector – scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection.

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_3N_4 and polycrystalline Silicon – Silicon piezoresistors – Gallium arsenside, quartz – piezoelectric crystals – polymers for MEMS – conductive polymers.

Engineering mechanics for microsystems design: Introduction – static bending of thin plates – circular plates with edge fixed, rectangular plate with all edges fixed and square plates with all edges fixed. Mechanical vibration - resonant vibration – microaccelerometers – design theory and damping coefficients. Thermomechanics – thermal stresses. Fracture mechanics – stress intensity factors, fracture toughness and interfacial fracture mechanics.

Module III (16 hours)

Basics of fluid mechanics in macro and mesco scales: Viscosity of fluids – flow patterns Reynolds number. Basic equation in continuum fluid dynamics – laminar fluid flow in circular conduits – computational fluid dynamics – incompressible fluid flow in microconducts, surface tension, capillary effect and micropumping - Fluid flow in submicrometer and nanoscale – rarefield gas, Kundsen and Mach number and modelling of microgas flow – heat conduction in multilayered thin films – heat conduction in solids in submicrometer scale - Thermal conductivity of thin films - heat conduction equation for thin films.

Microsystem fabrication process: Photolithography – photoresist and applications – light sources. Ion implanation – diffusion process – oxidation – thermal oxidation – silicon diode – thermal oxidation rates – oxide thickness by colour - Chemical vapour deposition - principle – reactants in CVD – enhanced CVD physical vapour deposion – sputtering – deposition by epitaxy – etching – chemcial and plasma etching.

Module IV (12 hours)

Micromanufacturing and microsystem packaging: Bulk Micromachining - Isotropc And Danisotropic Etching, Wet etchants, etch stops, dry etching comparison of wet and dry etching - Surface micromachining, process in general – problems associated surface micromachining - The LIGA process – description – materials for substrates and photoresists – electroplating – The SLIGA process. Microsystem packaging - General considerations - The three levels of microsystem packaging – die level, device level and system level – essential packaging technologies – die preparation – surface bonding wire bonding and sealing - Three dimensional
packaging, assembly of microsytems – selection of packaging materials.

Text Book

1 Tai-Ran Hsu, *MEMS and Microsystems Design and Manufacture*, Tata McGraw Hill, New Delhi, 2002

Reference Books

2 Mark Madou, *Fundamentals of Microfabrication*, CRC Press, 1997.
3 J. W. Gardner, *Microsensors: Principles and Applications*
4 S. M. Sze, *Semiconductor Sensors*, McGraw Hill, New York, 1994

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 **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

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

Module I (12 hours) Introduction to Probability Theory

Experiments – sample spaces and Events – axioms of Probability – Assigning Probabilities – joint and conditional probabilities –Baye's thorem – independence - Dicrete random variables – Bernoulli – Binomial – poisson - Geometric

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

The Cumulative distribution function - Probability density function – gaussian Random variable – Uniform random variable – exponential –Laplace – gamma – erlang –Chi – squared –Rayleigh –Rician -Cauchy

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

Definition and classification of Processes – Mathematical tools for studying random processes – stationary and ergodic random processes – Properties of the Auto correlation function – gaussian random processes- Definition and examples of Markov Processes - calculating transition and state probabilities in Markov chains

Text Books

1 Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,2009

2 Jean Jacod, Philip Protter, Probability Essentials, Springer 2008

Reference Books

3. Peyton Z. Peebles, Probability, Random Variables and Random signal Principles, Tata McGraw – Hill Publishing Limited, New Delhi, 4TH Edition

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 **Credits:** 4
3 hours lecture and 1 hour tutorial per week

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)

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

Reference books

1. Coley.S.M and Scheinberg C.A 1990 , *Proposal writing*, Newbury-Sage Publications.
2. Leedy.P.D, *Practical research planning and Design*, 4th edition ,MW Macmillan publishing company.
3. Day Ra,1989 "*How to write and publish a scientific paper*", Cambridge University Press .
4. Earl Babbie,1994, *The practice and Social Research*,Wordsworth Publishing Company,
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 **Credits:** 4
3 hours lecture and 1 hour tutorial per week

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)
History of aviation and space flight- anatomy of airplane and space vehicle with emphasis on control surfaces- airfoil nomenclature- basics of aerodynamics to illustrate lift and drag- types of drag – finite wings – swept wings –flaps. Airplane performance- thrust –power- rate of climb- absolute and service ceiling- range and endurance. Introduction to turbojet and turbofan engines. Space vehicle trajectories- kepler's laws- rocket engines, propellents and staging.
(Introductory treatment of the above topics is only expected, no detailed derivations)

Module II (11 Hours)
Basic engine instruments- Capacitive fuel content- Gauges. Standard atmosphere- Altimeters- Aneroid and radio altimeters. Aircraft compass- Remote indicating magnetic compass- Rate of climb indicator- Pitot static system- Air speed indicator- Mach meters- Integrated flight instruments- Flight testing- Recording of flight tests.

Module III (13 hours)
Command and homing guidance systems- Introduction to classical and modern guidance laws- Satalite 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

1. John D Anderson Jr., *Introduction to Flight* , McGraw-Hill
2. Pallet.E.H.J, *Aircraft instruments- Principles and applications*, Pitman Publ.
3. Nagararja.M.S, *Elements of electronic navigation*, Tata McGraw Hill
4. San Darite, *Radio aids to navigation*.,
5. John.H. Blakelock; *Automatic control of aircraft and missiles*, John wiley and sons. inc 1991.
6. Keyton.M and Walker.R. Fried,*Avionics navigation systems* ,John Wiley. 1996, 2 Ed
7. Siouris.G.M, *Aerospace avionics system*, A modern synthesis, academic press. 1993
8. Lin.C.F. ,*Modern guidance, navigation and control processing*, Prentice hall-1991

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

CE09 L23 EXPERIMENTAL STRESS ANALYSIS

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

Objective
To make students aware of various measurement techniques and experimental planning and procedures adopted in laboratory

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

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

Module III (14 hours)
Model materials - calibration methods for finding material fringe values - model fringe values - examples of beam flexure and diametrically loaded circular plates.
Non Destructive Testing Methods – Ultrasonic Methods – Hardness methods – Rebound Hammer – Detection of embedded reinforcement.
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 Raliey 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
2. Hetenyi M., Hand book of Experimental Stress Analysis, John Wiley
3. Bently JP – Principles of Measurement Systems, Longman, 1983
4. Nakra & Chowdhary – Instrumentation Measurement & Analysis – Tata McGraw Hill, 1995

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