UNIVERSITY OF CALICUT

SCHEME AND SYLLABI

FOR

EIGHTH SEMESTER

OF

BACHELOR OF TECHNOLOGY

IN

PRODUCTION ENGINEERING

FROM 2004 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

EIGHTH SEMESTER

Code	Subject	Hours/Week			Internal Marks	University Examination	
		L	T	P/D		Hrs	Marks
PE04 801	Quality Engineering Management	3	1	-	50	3	100
PE04 802	Operations Research	3	1	-	50	3	100
PE04 803	Industrial Engineering	3	1	-	50	3	100
PE04 804	Elective – II	3	1	-	50	3	100
PE04 805	Elective – III	3	1	-	50	3	100
PE04 806 (P)	Seminar	-	-	3	50	3	100
PE04 807 (P)	Project Work	-	-	7	100	-	-
PE04 808 (P)	Viva Voce	-	-	-			100
		15	5	10	400		700
Total Aggregate Marks for 8 Semesters = 8300					3000		5300

ELECTIVE –II	ELECTIVE –III
PE 04 804 (A) Industrial Tribology PE 04 804 (B) Machine Tool Design PE 04 804 (C) Facility planning &Plant layout PE 04 804 (D) Supply Chain Management PE 04 804 (E) Technology Management PE 04 804 (F) Robotics	PE 04 805 (A) Operation Research II PE 04 805 (B) Concurrent Engineering PE 04 805 (C) Human Resources Management PE 04 805 (D) Marketing Management PE 04 805 (E) Artificial Intelligence in Manufacturing PE 04 805 (F) Modern Manufacturing Concepts

EIGHTH SEMESTER

PE04801 :QUALITY ENGINEERING AND MANAGEMENT ,
3 hours lecture & I hour tutorial per week

Objective
To impart knowledge on the concept of quality ,tools for analysing quality ,Statistical tools in quality acceptance sampling and Hie testing

Module 1(10 hours)
Introduction to the concept of quality - quality control - quality assurance quality management - quality and total quality - small q and big Q - concept of total quality management - TQM axioms - major contributions of deming,juran and crossby to quality management - enablers for total quality - strategic quality management'

ModuleII(18homs)
Quality costs - analysis of quality costs - loss function - Taguchi methods total quality tools - pareto chart - fishbone diagram - checksheet - histograms scatter diagrams - run, charts - flow diagram - Bench Marking-Overview of Iso 9000:2000 certification-Quality circles. Experimental design-GuideJines-Overview of Factoral experiments,replication, General Idea on Process optimizationProcess Robustness Studies, Quality function deploYment, failure mode, effect and criticality analysis, continuous process improvement- The PDSA cycle-Kaizen.

Module III(12 hours)
Statistical tools in quality - making predictions using the normal, poisson and binomial probability distributions - statistical process control - control charts for variables -' X imd R charts - process capability indices - control charts for attributes - P, np, c and u charts

Module IV (12 hours)
Acceptance sampling – lot by lot acceptance using single sampling by attributes - OC curve - average outgoing quality and the AOQL - double sampling multiple and sequential sampling - ATI and AFI - introduction to life testing and reliability,MTBF ,MTTR,system reliability-components in series and parallel

Text books

1. Bester Field, Dale H,Carol Boeterfreld~Muchna,Glen H,Boeterfreld Mery Boeterfeld-Scare, 2003, Total Quality Management, 3rd edition, Pearson Education, New Delhi.
2 Juran J.M., Gryna I.M., "Quality Planning and Analysis", Tata McGraw Hill Publishing Company.
3. Montgomery,douglas C2001,Introduction to statical quality control,fourth editiori,John Wiley&sons Inc, New Delhi
4. Gerals MSmith-2004, Statistical Process Control and Quality Improvement-~lh edition ,Pearson Education, New Delhi
5. Grant, Statistical Quality Control, McGraw Hill

Sessional work assessment:
2 Assignments=15 marks
2 Tests   (2 x 15) =30 marks
Regularity   =05 marks
Total   =50 marks

University examination pattern

Q I   - 8 short type questions of 5 marks each, 2 from each module Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one, numerical problems expected

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one, numerical problems expected

Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one, numerical problems Expected

PE04 802 : OPERATIONS RESEARCH – I

3 hours lecture and 1 hour tutorial per week

Objectives:

The subject gives a quantitative perspective to the decision making process. The student is equipped with a body of knowledge that employs scientific methods which aids the decision making process. After doing this course the student should be able to approach the decision making problem in a scientific manner.

Module I (13 hours)
History and development of O.R. – Linear programming – formulation – graphical solution – Simplex method – two phase method – dual and its solutions – sensitivity analysis

Module II (13 hours)
Transportation and assignment problems – formulation and solutions – tests for optimality – cases of degeneracy – Network techniques – net works : PERT / CPM – Critical path – crashing and resource leveling – minimal spanning tree, shortest route and maximal flow problems

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

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

Reference books
1. P.C.Tulsian "*Quantitative Techniques*" Pearson Education.
2. Taha.H.A., *Operations Research,* PHI
3. Kalavathy "*Operation Research*" Vikas Publications.

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one, numerical problems expected
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one, numerical problems expected
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one, numerical problems Expected
(QII to V should contain 2 subdivisions. At least 60% weightage for numerical problems.)

PE04 803 : INDUSTRIAL ENGINEERING
3 hours lecture and I-hour tutorial per week

Objectives :
A basic knowledge of Industrial Engineering activities is essential for production engineers. This course is intended for providing a basic knowledge on various industrial engineering principle and tools and need for analyzing engineering activities. It is concerned with the design improvemen~ and installation of
- integrated systems of men, materials and equipments.

Module I (13 hours)
Introduction t9 Industrial Engineerilig - Defmition - Functions- Historical Development of Industrial engineering - Applications of Industrial Engineering - Productivity - Input output model - factors affecting Productivity Productivity Ratios -Improving productivity - Indian Industry- Productivity of Indian industry

Module n (13 hours)
Product design and development - Good Product Design - Product planningProduct development - Product life Cycle - Products and services - Product StaI,1datdization, Simplification, Specialization and Interch~~eabi1ity - Value Analysis - Value Engineering

Module m (13 hours)
Work Study - Scope and Objectives - Method Study Procedure - Process Charts -Flow diagram- Principles of motion economy - Micro motion study   Cycle graph": Chronocyclegraph - SIMO Chart - Work Measurement - Time study - Performance rating - standard time - allowances - Work sampling PMTS – Standard data

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

Reference books
1 Donald R Herzog, *Industrial Engineering Methods and .controls,* Prentice
   Hall .
2 H.B. Maynard, *Industrial Engineering Handbook,* McGraw-Hill Publishers

3 W Grant Ireson, Eugene L Grant, *Handbook of Industrial Engineering
   management-* Prentice Hall .
4 Marvin Mundel, *Motion and Time Study,* Prentice Hall. India
5 ILO, Introduction to Work Study, Universal Book Corporation
6 Harold T Amrine,John A Ritchey etal.., *Manufacturing Organization & management,* Pearson Education
.. .
İnternal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments / Term project/any other mode decided by the teacher.

10 % - Other measures like Regularity and Participation in Class.   .
Total marks = 50
University examination pattern
Q I - 8 short type questions of 5 marks each; 2 from each module
Q II - 2 questions of 15 marks each from module I with choice to answer anyone Q III - 2 questions of 15 marks each from module II with choice to answer anyone
Q IV - 2 questions of 15marks each from module IIi with choice to answer anyone Q V - 2 questions of 15 marks each from module IV with choice to answer any o,e (QII to V can have 2 subdivisions .Preferably all questions are of descriptive type..)

PE04 804(A) : INDUSTRIAL TRIBOLOGY

3 hours lecture and 1 hour tutorial per week

Objectives: The syllabus for the subject "Industrial Tribology" is prepared with the prime objective of giving an exposure to the fundamentals of Tribology , viz friction ,wear and lubrication .After completing the subject the student is expected to have knowledge about the various modes of friction ,wear mechanisms ,types of lubrication and bearings and also the various surface engineering techniques .The subject is relevant since any production industry needs their application of the above techniques for smooth running of production line and implementation of its maintenance programmes.

Module I (13 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 (13 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 (12 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 (14hours)
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 Books 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 work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 sub divisions .Preferably all questions are of descriptive type..)

PE04 804(B) : MACHINE TOOL DESIGN

3 hours lecture and 1 hour tutorial per week

Objectives:

A basic knowledge of design of conventional tools is essential for a Production Engineer.In this course design consideration of various machine components and the Installation and Testing of machine tools are introduced. After completion of this course students will be able to select machine tools suitable for different types of requirements,the installation and manufacture of the machine tools.

Module I (13 hours)
Machine beds and columns - relative merits of different types of beds and columns as regards to materials - construction - stiffness and rigidity - design considerations of beds and columns - concrete and metallic foundation - sources and effects - equipment for the study of vibration - vibration isolation
Module II (13 hours)
Slides ways - different types of slide ways - wear adjustments - design consideration - lubrication surface finish - straightness and hardness requirements of slide way
Module III (13 hours)
 Drive systems - selection of range of feeds and speeds - layout in AP, GP and LP - standardisation of speeds and feeds - ray diagram for machine tool gear boxes - various types of drives such as sliding and clutched drives - ruppert drives - feed gear box analysis - norton and meander drives - stepless drive
Module IV (13 hours)
Erection and testing - equipment needed for erection - erection procedure - commissioning - check list - safety - I.S. specification for testing machine tools - acceptance tests for lathe - milling - drilling - grinding machines - maintenance and reconditioning of machine tool - need for maintenance - maintenance policies - maintenance organisation - principles of reconditioning - repair methods for beds - slides - spindles - gears - lead ,screw and bearings

Text books
1. Mehta N.K., *Machine Tool Design,* Tata McGraw Hill
2. *Machine Tool Design Hand Book*, CMTI
Reference books
3. *Machine Tool Design,* Achorkhan (ED) Mir Publications
4. Sen & Bhatacharyya, *Principles of Machine Tools*, New Central Book Agency
5. Koenigsberger, Pergamon, *Design and Construction of Metal Cutting Machine Tools*
6. Garg M.P., *Industrial Maintenance*

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V should contain 2 subdivisions. At least 20% weightage for numerical problems.)

PE04 804(C).: FACILITIES PLANNING & PLANT LAYOUT
3 hours lecture and 1 hour tutorial per week

Objectives:

Plant layout is one of the field which affects the efficiency and productivity of an organization to a great extent. The objective of this subject is to introduce various techniques and tools of layout and other facilities planning in detail so that the student can approach a layout study in tbe most systematic and scientific way.

Module I (13 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 (13 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 softwares like CRAFT, CORELAP, ALDEP etc - simple problems

Module III (13 hours)   .
Production and physical plapt 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 handting systems to layout - integrated handling systems. ~ material handling and operation research - transportation problems and sequencing - loading Johnsons Rule - CDS algorithm - simple problems.

Reference books
1. Moore J.M., *Plant Layout and Design,* Macmillan 2 Rosaler & Rice, *Standard H Plant Engg.*
3. Garg H.P., *Plant. Maintenance*
4. Immer J.R., *Materials Handling,* McGraw Hill

Internal work assessment
60 % - Test papers (minimum 2)   .
30 % - Assignments/Term project/any other mode decided by the teacher. 10 % - Other measures like Regularity and Participation in Class.
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
Q II - 2 questions A and B of 15marks each from module I with choice to answer anyone Q III - 2 questions A and B of 15marks each from module II with choice to answer anyone,

numerical problems expected

Q IV - 2 questions A and B of15marks each from module III with choice to answer anyone, numerical problems expected

Q V - 2 questions A and B of 15marks each trom module IV with choice to answer anyone, numerical problems Expected

(Q II to V should contain 2 subdivisions. At least 50% weightage for numerical problems.)

PE04 804(D) : SUPPLY CHAIN MANAGEMENT

(3 hours lecture and 1 hour tutorial per week)

Objectives:

The supply chain management deals with the entire activities involved in fulfilling a customer need. This subject deals with the inventory control methods, purchasing and supply chain management practices followed in industries. After completing this course students will be able to understand the inventory control techniques, purchasing functions and supply chain strategies of different kinds of industries.

Module I (13 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 (13 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
1. 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
10. Sunil Chopra, Peter Meindl ., *Supply Chain Management,* Pearson Education

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III   - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV   - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 sub divisions. Preferably all questions are of descriptive type..)

PE04 804(E) :TECHNOLOGY MANAGEMENT

3 hours lecture and 1-hour tutorial per week

Objectives:

Technology is the know-how for the creation of goods and services or the way of doing things or the means by which objectives of an organization are achieved. Engineers in particular are the people who are to manage the change in technology as an important resource. This subject deals with fundamental aspects related to Technology management viz... Technology - Evolution, Environment. Diffusion Innovation, Intelligence and Technology Strategy.

Module I (13 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 (13 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 Book

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

Reference books

Tarek Khalil, *Management of Technology – The key to competitiveness and Wealth creation* , McGraw-Hill International Edition

Frederick Betz, *Strategic Technology Management,* McGraw-Hill International Edition

Norma Harrison, Danny Samson, *Technology Management*, Text and International Casers, McGraw-Hill

Sessional work assessment	
2 Assignments	2x10=20
2 Tests	2x15=30
Total	50

University examination pattern
 Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
 Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one
 (QII to V can have 2 subdivisions.Preferably all questions are of descriptive type..)

PE04 804(F) : ROBOTICS

3 hours lecture and 1 hour tutorial per week

Objectives:

Robotics plays an important part not only in advanced manufacturing and also in several other modern applications. The paper deals with fundamental concepts, design, programming etc.related to robots.

Module I (10 hours)
Introduction :- Fundamentals of Robotics – Classification – overview of drives, sensors, grippers and manipulators – selection of robot
Module II (12 hours)
MOdelling of Robot Manipulator :- Direct and inverse kinematics – Homogeneous transformation matrix – simple problems in direct and inverse kinematics – differential kinematics and static – trajectory planning – motion control – interaction control – rigid body mechanics
Module III (16 hours)
Programming of Robots & Vision systems :- Methods of robot programming – lead through programming – robot languages – vision system – robot intelligence
Module IV (14 hours)
Application of Robotics :- Robot cell layouts – Multiple robots - application of robotics in machine shop, assembly, automation - tele-operated robot – MHS – Processing operation – Safety in Robotics – Economic and social aspects of Robotics

Text book
1.   Mikell.P.Groover, Mitchell Weis, Roger.N.Nagel, Nicholas.G.Odrey, *Industrial Robotics Technology,*
     Programming and Applications, Mc Graw Hill, 1986

Reference books
1. Richard.D.Klafter, Thomas.A.Chmielewski, Machine Negin, *Robotics Engineering – An Integrated Approach,* PHI, 1984

2. K.S.Fu, R.C.Gomaler, C.S>G.Lee,*Robotics control, sensing, vision and intelligence*, Mc Graw Hill, 1987
3. Lorenzo Scarvicco,*Modelling and control of Robot Manipulator*, Tata Mc Graw Hill, 1999
4. James.G.Kerames,*Robot technology fundamentals*, Delmia publisher,2000
5. Deb.S.R, *Robotics Technology and Flexible Automation*, Tata Mc Graw Hill, 1994
6. John J.Craig, *Introduction to Robotics,* Pearson Education

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher. (At least one assignment should be computer based using spread sheet or suitable tools)
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
All Questions are of Descriptive type. No numerical problems are expected.
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions. Preferably all questions are of descriptive type)

PE04 805(A)   OPERATIONS RESEARCH – II

(3 hours lecture and 1 hour tutorial per week)

Objectives:

This course is deigned as a supplement to PE04 801.It aims to bring the student closer to the real situations by dropping various assumptions that were made to simplify the situations in the course PE04 801.

Module I (13 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 (13 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

Reference books
1. Sharma S.D., *Operations Research*, Kedarnath Ramnath
2. Taha H.A., *Operations Research,* Prentice Hall of India

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher. (At least one assignment should be computer based using spread sheet or suitable tools)
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one, numerical problems expected

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one, numerical problems expected

Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one, numerical problems Expected

(QII to V should contain 2 subdivisions. At least 60% weightage for numerical problems.)

PE04 805(B) : CONCURRENT ENGINEERING

3 hours lecture and 1 hour tutorial per week

Objectives:

It is necessary that a Production Engineer should be aware of new concepts in manufacturing areas. The subject topic covers principles, implementation, scheduling , evaluation of products , design cost and application of expert systems is relation to Concurrent Engineering.

Module I (13 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 (13 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.
Modeling 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 Book
1.   Hamid R. Parasaeie, William. G. Sullivan, *Concurrent Engineering Contemporary Issues and Modern Design tools,* Chapman and Hall, London 1993.
Reference books
 Edward.G.Haug (Editor)*, Concurrent Engineerng Tools and Techonologies for Mechanical*

Systems Design, Springer Verlag Publishing Co., *Proceedings of the nato Advanced system Institute on Concurrent Engineering*, Jowa City, May 25, June 5, 1992.

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions. Preferably all questions are of descriptive type.)

PE04 805(C) : HUMAN RESOURCES MANAGEMENT

3 hours lecture and 1-hour tutorial per week

Objectives:

Human resources are the driving force any industrial Organization and are to be managed like other resources. An Engineer is expected to have basic knowledge on Human resources Management. This subject deals with all fundamental aspects related to Human Resource Management viz. Jobs, Recruitment, appraisal, remuneration and Employee relations.

Module I (13 hours)

Personnel management in organizational context - personnel environment - objectives of personnel management - the role of personnel function - personnel activities - structure of the personnel department - analyzing and design of jobs - job analysis - job description - job specification - role analysis - the job design – Merit Rating

Module II (13 hours)

Recruitment - selection - placement - induction - internal mobility - separations – labor turnover - performance appraisal - performance appraisal system - assessing potential - design of an effective appraisal system – wages and incentives

Module III (13 hours)

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

Module IV (13 hours)

Employee relations - management employee relations - managing discipline - managing grievance - managing stress - counseling - industrial relations implications of personnel policies - nature of employment relationships - place of unions in organizations - industrial conflict - managing for good industrial relations

Reference books

1. Venkata Ratnam C.S. & Srivasthava B.K., *Personnel Management and Human Resources*
2. Monappa A., Saiyaddin & Mirza S., *Personnel Management*, Tata McGraw Hill Publishers
3. Hersey Paul & Kenneth H Blanchard, *Management of Organizational Behavior*, Prentice Hall
4. Mc Greger Douglas, *The Human side of Enterprise*, McGraw Hill
5. Subramanyam K.N, Gin V.V., *Industrial Relations in India*
6. Garry Dessler, *Human Resource management*, Person education
7. Biswanatah Ghosh, *Human resource Development and Management*, Vikas Publishing Co,

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions. Preferably all questions are of descriptive type.)

PE04 805(D) : MARKETING MANAGEMENT

3 hours lecture and 1 hour tutorial per week

Objectives:

Marketing is the task of creating promoting and delivering goods and services to customers and business. An Engineer is expected to have basic knowledge on marketing management. This Subject gives an exposure on various aspects of marketing management viz... Environment, Consumer behavior, Product management, Promotion decisions, and marketing research.

Module I (13 hours)
Understanding marketing management – Defining marketing – Company orientation – Adopting markets to new economy – E-business building customer satisfaction, value and retention – Customer value – Customer relation ship management.
Module II (13 hours)
Analyzing market opportunities -   Gathering information & measuring market demand - Marketing research system -Forecasting – Analyzing consumer markets and buyer behavior – Buying decision process – Identifying market segments and selecting target markets – Market segment & targeting.
Module III (13 hours)
Developing market strategies – Positioning & differentiating market through product life cycle – Differentiating tools – Determining new market offerings- Setting the product and branding strategy – Product mix and line – Brand decisions.
Module IV (13 hours)
Managing & defining market program – Managing intergraded marketing communication – Effective communication process – Managers advertising, sales promotion, public relation & direct marketing – Managing the sales force– Personal selling.

Text Book
1. Philip kotler – *Marketing management* – Pearson Education Asia
Reference books
1. Rajan Saxena, *Marketing Management*, Tata McGrawhill Publishing Co.
2. Green P.E. & Tall D.S., *Research for Marketing Decisions*, PHI
3. Czinkota, Kotabe, *Marketing management*, Thomson Sour western
4. M.Govindarajan, *Industrial Marketing Management*, Vikas Publishers

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module

Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV   - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions. Preferably all questions are of descriptive type.)

PE04 805(E) : ARTIFICIAL INTELLIGENCE IN MANUFACTURING

3 hours lecture and 1 hour tutorial per week

Objectives:
This paper aims at imparting knowledge of how knowledge and information can be processed for creating and maintaining automated manufacturing systems.The concepts necessary for designing and intelligent manufacturing system is included in this paper.

Module I (13 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 (13 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, model based approach, design of mechanisms, feature based design, knowledge based design for automated assembly.
PROCESS PLANNING: Feature recognition, machining optimization, knowledge based systems.

Module III (13 hours)
GROUP 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, synapic integration and neuron models, essential vector operators, back propagation algorithms, application of neural networks to process modeling 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 Book
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 work assessment
60 % - Test papers (minimum 2)

30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern
Q I   - 8 short type questions of 5 marks each, 2 from each module
Q II   - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V   - 2 questions A and B of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions. Preferably all questions are of descriptive type.)

PE04 805(F) : MODERN MANUFACTURING CONCEPTS

3 hours lecture and 1 hour tutorial per week

Objectives:

The paper deals with new concepts in manufacturing and energizing trends in modern manufacturing area. This helps the students to know the current scenario in modern manufacturing.

Module I (13 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- strategical quality management- quality circle ,introduction to ISO and QS standard .
Total Productive maintenance,-evaluation ,and maintenance management.

Module II (13 hours)
Green and Agile manufacturing – introduction – agility through group technology,concept of failure mode effect analysis
ERP – evolution ,advantages ,integrated management information ,integrated data modeling

Module III (13 hours)
Rapid prototyping – Stereo lithography,laminated object manufacturing , selective laser sintering , fused deposition modeling , 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
1.   Gibson P, Green Halgh G, Kerr. R. "Manufacturing management" Chapman & Hall, London 1992.
2.   Jack M Wacker, "*Hand book of Manufacturing engineering*", Marcel Deeker Inc, USA 1992.

Internal work assessment
60 % - Test papers (minimum 2)
30 % - Assignments/Term project/any other mode decided by the teacher.
10 % - Other measures like Regularity and Participation in Class.
Total marks   = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

(QII to V can have 2 subdivisions. Preferably all questions are of descriptive type.)

PE04806{P) : SEMINAR
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 - sessional marks are to be awarded on the basis of his/her paper and also active. participation in other seminars

Sessional work assessment

Presentation and discussion= 25

Material content= 10

Report = *10*

Participation and attendance= 5

Total marks= 502

PE04 807(P) : PROJECT

7 hours per week

This is the continuation of PE 708(P) -Each student will be with the same organization for a period of not less than four weeks after the completion of the 7th semester examinations. The academic guide is expected to visit the organization during the training period .A project report has to be prepared on the completion of the project work. The project should also be submitted in a technical paper format with a maximum of 8 pages in single line spacing of 12 point times New Roman font.

Sessional work assessment		
Presentation	=	60
Report	=	40
Total marks	=	100

PE0 808(P) : VIVA-VOCE

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.

Sessional work assessment	
Subjects	: 30
Mini project	: 20
Project	: 30
Seminar	: 20
Total marks	: 100