UNIVERSITY OF CALICUT

SCHEME AND SYLLABI

FOR

SIXTH SEMESTER

OF

BACHELOR OF TECHNOLOGY

IN

PRODUCTION ENGINEERING

FROM 2004 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

SIXTH SEMESTER

Code	Subject	Hours/Week			Internal Marks	University Examination	
		L	T	P/D		Hrs	Marks
PE04 601	Metal Forming	3	1	-	50	3	100
PE04 602	Industrial Automation	3	1	-	50	3	100
PE04 603	Finite Element Method	3	1	-	50	3	100
PE04 604	Metrology and Instrumentation	3	1	-	50	3	100
PE04 605	Mechatronics	3	1	-	50	3	100
PE04 606	Computer Integrated Manufacturing (CIM)	3	1	-	50	3	100
PE04 607 (P)	CAD/CAM Lab	-	-	3	50	3	100
PE04 608 (P)	Mini Project	-	-	3	50	-	-
	Total	**18**	**6**	**6**	**400**		**700**
***At least two industrial visits and subsequent report presentation compulsory. *Types of Industry –Preferably Forming /Automated units**							

SIXTH SEMESTER

PE04 601 : METAL FORMING

3 hours lecture and 1 hour tutorial per week

Objective

This paper deals with basic concepts of plasticity which is essential in the analysis of metal forming processes. The paper also gives an exposure to the student above the various metal forming techniques, tools and processes.

Module I (13 hours)

Theory of stress – Stress tensor – Spherical and Deviator stress tensors – Transformation equations – Principal stresses – Invariants – Octahedral stress – Maximum shearing stress – Theory of strain – Strain tensor – Spherical and Deviator strain tensors – Transformation equations – Principal Strains – Invariants – Octahedral strain – Compatibility equations

Module II (13 hours)

Theory of Plasticity – Von-Mises and Tresca yield criteria – Failure theories – Plastic stress-strain relations – Saint Venent's theory of plastic flow – Reuss theory of elasto-plastic deformation – Hencky's theory of small plastic deformations – Two dimensional Plastic flow – Equilibrium equations referred to arbitrary Cartesian co-ordinates – Equilibrium equations referred to slip lines

Module III (13 hours)

Forging :- Type of forging operations – design of forging dies – defects in forging – NDT – Extrusion – Equipment for extrusion – Processes of extrusion – Properties of extruded metal – Defects in extruded products – Hot and cold drawing - properties –formability, formability limit diagram, defects – Deep drawing, defects in deep drawing,- stretch forming.

Module IV (13 hours)

Rolling :- Rolling process – Rolling mills – properties of rolled components – stresses in rolling –rolling load calculation - Sheet metal work – Sheet metal and press working – Sheet metal joints – Types of presses and dies – Shearing and spinning of metals

Introduction to powder metallurgy

Reference books

1. Timonshinko & Goodyear, *Theory of Elasticity*, Tata Mc Graw Hill
2. Dr.Sadhu Singh, *Theory of Plasticity*, Khanna
3. L.S.Srinath, *Theory of Plasticity*
4. Hoffman & Sachs, *Introduction to theory of Plasticity for Engineers*, Mc Graw Hill
5. Dieter, *Principles of Mechanical Working of Metals*
6. Johnson, *Forging Products*
7. Pearson, *Extrusion of Metal*
8. G.W. Row, *Fundamentals of Metal Forming*

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 20% weightage for numerical problems.)

PE04 602 : INDUSTRIAL AUTOMATION

3 hours lecture and 1 hour tutorial per week

Objectives:
The paper aims at imparting the concept of Automation, hardware generally used ,logics related to Automation and development of simple circuits. The paper gives necessary ideas for understanding papers like CIM,Robotics,etc. in the later semesters.

Module I (13 hours)
Fundamental concepts in manufacturing automation –Definition – reasons-types of production, types of automation strategies, levels, automated flow line, work piece transport, transfer mechanisms, buffer storages, part feeders

Module II (13 hours)
Low cost automation, use of hydraulics and pneumatics in automation, fluids selection and study of hydraulic components and hydraulic power pack, counter devices and other elements – Simple sequential logical circuits design for single – multi cylinders, fluidic elements and programmable logic controllers – electro pneumatic circuits – simple circuit design

Module III (13 hours)
Computer Numerical control, advantages, open and closed loop control, classification of CNC machine tools, structural features-turning and machining centers, Automatic tool changers, pallet changer and NC Tooling, CNC drives.

Module IV (13 hours)
Manual and computer aided part programming, canned cycles, APT. Introduction into CNC, Flexible manufacturing system, robotics and computer aided quality control, CMM, automated inspection and computer integrated manufacturing.

Reference books

1. Mikell P Groover *" Automation, Production systems and computer aided manufacturing"*, Prentice Hall, 1980
2. Radhakrishnan P. *Computer numerical controlled machines*
3. Kundra & Thiwari, *NC Machine Tools and computer aided manufacturing*, TMH 1991
4. John Pippanger and Tyles Hicks, *Industrial Hydraulics*

Internal work assessment
60 % - Test papers (minimum 2)
40 % - Design and demonstration of simple electro pneumatic circuits using pneumatic/electro pneumatic kit
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 15marks each from module I with choice to answer any one
Q III - 2 questions of 15marks each from module II with choice to answer any one
Q IV - 2 questions of 15marks each from module III with choice to answer any one
Q V - 2 questions 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 603 : FINITE ELEMENT METHODS

3 hours lecture and 1 hour tutorial per week

Objectives:

The course emphasizes on the fundamentals of the finite element methods with some applications. The objective is to make the student capable of formulating a finite element model for a general linear, ordinary or partial differential equation. On satisfactory completion of this subject student will be able to

(i) Demonstrate a basic understanding of FEM in engineering applications

(ii) Utilize computational techniques for the solution of practical problems.

Module I (12 hours)

Introduction to FEM :- Historical background – weighted residual methods – basic concept of FEM – variational formulation of boundary value problems – Ritz method – Finite Element modeling – Element equation – Linear and quadratic shape functions – Bar, Beam elements – application of heat transfer – advantages and limitations of FEM – commercial finite element packages

Module II (12 hours)

Finite Element Analysis of 2D Problems:- General procedure of FEM – Basic boundary problems in 2 dimensions – triangular and quadrilateral elements – weak formulation – element matrices and vectors – applications of heat transfer – basic concepts of plane stress – plane strain – simple problems.

Module III (13 hours)

Solution Methods for Finite Element Equations :- Handling of simultaneous equations – Gaussian elimination method – Choleski method solving of Eigen value problems – Jacobi and subspace iteration methods – direct integration and mode superposition methods – interpolation techniques

Module IV (12 hours)

Dynamic Analysis :- Equation of motion for dynamic problems – Consistent and Lumped mass matrices – Formulation of element mass matrices – Free vibration and forced vibration formulation with simple problems

Text Book

1. S.S.Rao, *The Finite Element Methods in Engineering*, Pergomon Press Oxford, 2nd edition, 1989

Reference books

1. Sagarlind.L.J, *Applied Finite Element Analysis*, John Wiley, 1984
2. Chandrupatla & Belafundu, *Finite Element of Engineering*, Prentice Hall, 1997
3. Reddy.J.N, *An Introduction to Finite Element Methods*, Tata Mc Graw Hill, 1997
4. Cook, Robert, Davis Etal, *Concept & Applications of Finite Element Analysis*, John Wiley & Sons, 1999
5. George.R, Buchanan, *Schaum's Outline of FE Analysis*, Tata Mc Graw Hill, 1994

6. Nathe.K.J, *Finite Element Procedures in Engineering Analysis*, Prentice Hall, 1982

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 of 15marks each from module I with choice to answer any one
Q III - 2 questions of 15marks each from module II with choice to answer any one
Q IV - 2 questions of 15marks each from module III with choice to answer any one
Q V - 2 questions of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions.)

PE04 604 METROLOGY AND INSTRUMENTATION

3 hours lecture and 1 hour tutorial per week

Objectives:
Concepts about measurements and instrumentation are essential for an engineer to measure and evaluate a system. The paper provides relevant concepts and equipments used for selecting measuring instruments and instrumentation procedures.

Module I (13 hours)

Functional elements of a measuring system. Static performance characteristics - accuracy, precision, sensitivity, resolution, threshold, Linearity, Hysteresis, dead band, backlash, drift.. Errors in measurement and statistical analysis of errors.

Dynamic characteristics of instruments. Zero, and first order systems.

Module II (13 hours)

Transducers – equipments and process for measurement of pressure, flow, stress and strain, temperature, sound and vibration.

Module III (13 hours)

Limits, Fits and tolerances – reason for systems of limits – definitions and terminology – shaft based and hole based systems – types of fits – Tolerances – specifications – compound tolerancing – tolerance grades – Taylor's principles – limit gages.

Linear and angular measurements – comparators – tool makers microscope – autocollimator – profile projector .

Module IV (13 hours)

Geometric features – basic definition of straightness, flatness, parallelism, roundness, circularity, squareness etc. – principles and equipments for measurement – principles of interferometry Surface roughness – Definitions – General considerations – Tally surf – Profilometer – roughness indicators – symbols in geometric features.

Gears – measurements and inspections of spur gears – tooth thickness, pitch, base pitch etc. – gauging of gears. Screws – Terminology – measurement and inspection of threads – major, minor, effective diameters, pitch. – gauging of screws.

Reference Books

B C Nakra and K K Choudhry, *Instrumentation, measurement and analysis,* Tata McGraw Hill Publications
R K Jain *Industrial Metrology*, Khanna Publishers.
Gupta I.C , *A Textbook of Engineering Metrology*
Beckwith & Buck, *Mechanical measurements*,Oxford &IBH

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 of 15marks each from module I with choice to answer any one
Q III - 2 questions of 15marks each from module II with choice to answer any one
Q IV - 2 questions of 15marks each from module III with choice to answer any one
Q V - 2 questions of 15marks each from module IV with choice to answer any one
(QII to V can have 2 subdivisions.)
numerical problems up to a max of 15%

PE04 605 : MECHATRONICS

3 hours lecture and 1 hour tutorial per week

Objective

It is essential for a practicing engineer to have an understanding of the sensors actuating devices, signal processing, etc.to have a clear idea of the advanced manufacturing systems. The paper aims at providing the students the basic ideas in these areas.

Module I (10 hours)

Introduction to Mechatronics :- Mechatronics – Integrated Design issues – Key elements – Design process – Advanced approaches in Mechatronics

Module II (14 hours)

Sensors and Transducers :- Introduction to sensors and transducers – Sensors for motion and position measurement – Force, Torque and tactile sensors – Flow sensors – Temperature sensing devices – Ultrasonic sensors – Vibration control using magneto strictive transducers – Fibre optic devices in mechatronics

Module III (16 hours)

Actuating devices, Signals, Systems & Controls :- DC and AC Drives-Stepper motor – Servo motor – fluid power-design elements – piezoelectric actuators – Introduction to Signals – systems and controls – system representation – Linearisation of Non-linear systems – time delays – measures of system performance.

Module IV (12 hours)

Advanced Applications in Mechatronics :- Sensors for condition monitoring – Mechtronic control in Automated manufacturing – Artificial Intelligence and Fuzzy Logic applications in Mechatronics – Micro Sensors and Case studies

Text book

1. Devadas Shetty, Richard.A.Kolk, "Mechatronics System Design", PWS publishing company, 1997

Reference books

1. Bosch, "*Mechatronics Theory and Applications*", 1998
2. W.Bolton, "*Mechatronics*", Longmen, 1999
3. "*Mechatronics*", Edited by HMT, Bangalore 1998
4. Bradly.D.A, Dawson.D, Burd.N.C,Loadeer.A.J, "*Mechatronics, Electronics in Products and Processes*", Chapmall and Hall, 1993

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

Q IV - 2 questions of 15marks each from module III with choice to answer any one
Q V - 2 questions 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 606: COMPUTER INTEGRATED MANUFACTURING
3 hours lecture and 1 hour tutorial per week

Objectives:
The paper deals with the concepts of CIM implementation of CIM and elements of CIM. The course is intended give the student and overall idea of advanced manufacturing and also various elements and subsystem that goes into advanced manufacturing concepts . The paper deals with physical systems concepts and communication systems in CIM.

Module I (13 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 modeling techniques - automated drafting - graphic standards - engineering analysis -optimization - principles of concurrent engineering

Module II (13 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 (13 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 (13 bours)

Data communications and technology management - technology issues configuration management - database systems - management of technology networking concepts LAN, MAN and WAN - SQL fundamentals - *MAPfTOP* fundamentals - CIM models - mM - Siemens, DEC, ESPRIT - CIM OSA model economics ofCIM - implementation ofCIM
Text books

1. David Bedworth et at, ..*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 HandboblC',* McGraw Hill Book Co.

2 Ranky P.G, *"Computer Integrated Manufacturing"*, Prentice Hall ofIndia 3. Mikell.P.Groover, *Automation, Production systems and Computer Integrated Manufacturing,* Pearson Education

Internal work assessment

60 % - Test papers (minimum 2)
30 % - AssignmentsfTerm 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 0£5 marks each, 2 from each module
Q II - 2 questions A and B of15marks each from module I with choice to answer anyone

Q III - 2 questions A and B of15marks each from module II with choice to answer anyone
Q IV - 2 questions A and B ofl5marks each from module III with choice to answer anyone
Q V - 2 questions A and B ofl5marks each from module IV with choice to answer anyone
(QII to V can have 2 sub divisions .Preferably all questions are of descriptive type..)

PE04 607(P) : CAD/CAM LAB 3

3 hours practical per week

Objectives:
Experiments are aimed at providing the student an atmosphere in which he will be exposed to some of the basic CAD/CAM techniques.

CAD - Laboratory

1. Modelling of machine components
2. Assembly modelling
3. Preparation of detai! drawing from solid model 4. Finite element modeJ1ing and analysis
5. Mechanism modelling and analysis

CAM -Laboratory

1. Programming of CNC Lathes
2. Programming of machining centers
3. CNC Programming from CAD models

Internal work assessment
Practicals & Record=25
Test =20
Regularity in Class=5
Total marks=50

PE04 608(P) : MINI PROJECT

3 hours per week

Objectives:
Intended to give an exposure to the application of the techniques and concepts studied in solving a live problem.
Scope of the Project:- The student is expected to work on a problem posed by the Industry in the areas of design, maintenance, manufacturing and management or on a problem suggested by the Department.

Each student shall 'Work on a mini project under the guidance of a faculty member - the problem be anyone of the following or of a similar type:

1. Design and production of items such as jigs, fixtures, dynamom,eters, measuring instruments ,machine components, welded structures
2 Preparation of project reports, feasibility reports involving allied products
3. Process planning and cost estimation involving engineering components
4. Theoretical study (with or without computer application) and preparation

of a report on its basis pertaining to production engineering fields

5. Experimental analysis of Industrial situations.

The student shall prepare a report about the project and present it - each student is expected to participate actively in all presentation. Sessional marks are to be awarded on the basis of his / her work, presentation and also active participation in other seminars

Internal work assessment

Work content	=	30
Report and Presentation	=	20
Total marks	=	50

Atleast two industrial visit subsequent report pesentotion Compulsory in VI th Semester