National Institute of Technology Calicut

Curricula, Scheme of Examinations & Syllabi for Semesters V to VIII of B.Tech. Degree Programme in Mechanical Engineering (Production & Management) with effect from Academic Year 2000-2001
### FIFTH SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject+</th>
<th>Hours/Week</th>
<th>Sessional Marks</th>
<th>University Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P/D</td>
</tr>
<tr>
<td>PM2K 501</td>
<td>Software Engineering</td>
<td>3</td>
<td>1</td>
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<tr>
<td>PM2K 502</td>
<td>Dynamics of Machinery</td>
<td>3</td>
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<tr>
<td>PM2K 503</td>
<td>Metal Cutting</td>
<td>3</td>
<td>1</td>
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<tr>
<td>PM2K 504</td>
<td>Heat &amp; Mass Transfer</td>
<td>3</td>
<td>1</td>
<td>-</td>
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<tr>
<td>PM2K 505</td>
<td>Linear System Analysis</td>
<td>3</td>
<td>1</td>
<td>-</td>
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<tr>
<td>PM2K 506</td>
<td>Elective I</td>
<td>3</td>
<td>1</td>
<td>-</td>
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<tr>
<td>PM2K 507(P)</td>
<td>Heat Transfer Lab</td>
<td>-</td>
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<tr>
<td>PM2K 508(P)</td>
<td>Production Engineering Lab II</td>
<td>-</td>
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<td>3</td>
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**Elective I**
- PM2K 506A - Numerical Analysis
- PM2K 506B - Composite Materials
- PM2K 506C - Multiphase Flow
- PM2K 506D - Finite Element Methods
- PM2K 506E - Object Oriented Programming
- PM2K 506F - Marketing Management
- PM2K 506G - English Language & Literature

**TOTAL**
- 18 L
- 6 T
- 6 P/D
- 400 Hrs
- 800 Marks

### SIXTH SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Sessional Marks</th>
<th>University Examination</th>
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<tr>
<td></td>
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<td>P/D</td>
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<tr>
<td>PM2K 601</td>
<td>Metrology &amp; Instrumentation</td>
<td>3</td>
<td>1</td>
<td>-</td>
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<tr>
<td>PM2K 602</td>
<td>Operations Research</td>
<td>3</td>
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<tr>
<td>PM2K 603</td>
<td>Metal Casting &amp; Joining</td>
<td>3</td>
<td>1</td>
<td>-</td>
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<tr>
<td>PM2K 604</td>
<td>Production Thermal Engineering</td>
<td>3</td>
<td>1</td>
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<tr>
<td>PM2K 605</td>
<td>Machine Design</td>
<td>1</td>
<td>-</td>
<td>3</td>
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<tr>
<td>PM2K 606</td>
<td>Elective II</td>
<td>3</td>
<td>1</td>
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<tr>
<td>PM2K 607(P)</td>
<td>Thermal Engineering Lab</td>
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<tr>
<td>PM2K 608(P)</td>
<td>Mini Project</td>
<td>-</td>
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**Elective II**
- PM2K 606A - Optimisation Techniques
- PM2K 606B - Mechatronics
- PM2K 606C - Fracture Mechanics
- PM2K 606D - Instrumentation Theory & Control
- PM2K 606E - Random Vibrations
- PM2K 606F - Introduction to Social Sciences
- PM2K 606G - Flexible Manufacturing Systems

**TOTAL**
- 16 L
- 5 T
- 9 P/D
- 400 Hrs
- 800 Marks
## SEVENTH SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Sessional Marks</th>
<th>University Examination</th>
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<tbody>
<tr>
<td>PM2K 701</td>
<td>Economics</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 702</td>
<td>Machine Tools</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 703</td>
<td>Industrial Management</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 704</td>
<td>Metal Forming</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 705</td>
<td>Elective III</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 706(P)</td>
<td>Instrumentation Lab</td>
<td>- - 3 L</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 707(P)</td>
<td>Seminar</td>
<td>- - 3 L</td>
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<td>PM2K 708(P)</td>
<td>Project</td>
<td>- - 4 L</td>
<td>50 Hrs</td>
<td>- -</td>
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<td></td>
<td>15 L 5 T</td>
<td>400 Hrs</td>
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**Elective III**
PM2K 705A - Computational Fluid Mechanics
PM2K 705B - Industrial Psychology
PM2K 705C - Artificial Intelligence & Expert Systems
PM2K 705D - Manufacturing Processes of Nonmetals
PM2K 705E - Inventory & Supply Chain Management
PM2K 705F - Entrepreneurship
PM2K 705G - Nonlinear Dynamics & Chaos
PM2K 705H - Nuclear Engineering

## EIGHTH SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Sessional Marks</th>
<th>University Examination</th>
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<tbody>
<tr>
<td>PM2K 801</td>
<td>Operations Management</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
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<tr>
<td>PM2K 802</td>
<td>System Simulation &amp; Modelling</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
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<tr>
<td>PM2K 803</td>
<td>Tool Engineering &amp; Design</td>
<td>3 L 1 T</td>
<td>50 Hrs</td>
<td>3 100</td>
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<tr>
<td>PM2K 804</td>
<td>Quality Engineering &amp; Management</td>
<td>1 - 3 L</td>
<td>50 Hrs</td>
<td>3 100</td>
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<td>PM2K 805</td>
<td>Elective IV</td>
<td>3 L 1 T</td>
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<tr>
<td>PM2K 806(P)</td>
<td>CAD/CAM Lab</td>
<td>- - 3 L</td>
<td>50 Hrs</td>
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<td>PM2K 807(P)</td>
<td>Project</td>
<td>- - 7 L</td>
<td>100 Hrs</td>
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<td>PM2K 808(P)</td>
<td>Viva Voce</td>
<td>- - - L</td>
<td>- Hrs</td>
<td>- 100</td>
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<td></td>
<td>13 L 4 T</td>
<td>400 Hrs</td>
<td>- 700</td>
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**Aggregate marks for 8 semesters = 8300**

**Elective IV**
PM2K 805A - Design of Jigs & Fixtures
PM2K 805B - Internet Technologies
PM2K 805C - Neural Networks & Fuzzy Logic
PM2K 805D - Robotics
PM2K 805E - Modern Engineering Materials
PM2K 805F - Glimpses of World Thought
PM2K 805G - Refrigeration & Air Conditioning
PM2K 805H - Financial Management
UNIVERSITY OF CALICUT
Faculty of Engineering
Syllabi for B.Tech Degree Programme with effect from Academic Year 2000-2001

ME : Mechanical Engineering (Production & Management)
Module I (13 hours)
Introduction - FAQs about software engineering - professional and ethical responsibility - system modeling - 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 - behavior models - data models - object models - CASE workbenches

Module II (13 hours)
Software prototyping - prototyping in the software process - rapid prototyping techniques - formal specification - formal specification in the software process - interface specification - behavior 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 modeling, 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 modeling - process measurement - process CMM - configuration management - planning - change management - version and release management - system building - CASE tools for configuration management

Text book
Ian Sommerville, Software Engineering, Pearson Education Asia

Reference books

Sessional work assessment
Assignments  2x10 = 20
Tests  2x15 = 30
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 any one
Q III  -  2 questions of 15 marks each from module II with choice to answer any one
Q IV   -  2 questions of 15 marks each from module III with choice to answer any one
Q V    -  2 questions of 15 marks each from module IV with choice to answer any one
PM2K 502 : DYNAMICS OF MACHINERY
(common with ME2K 502)

3 hours lectures and 1 hour tutorial per week

Module I (15 hours)
Kinematics and kinetics of rigid bodies - aspects of motion of rigid body referred to local and global reference frames - energy and impulse - momentum methods for rigid bodies - energy methods - impulse -momentum methods - impulse - momentum equations - dynamics of general rigid body motion - Euler's equation of motion - applications - equations of motion using Euler angles - gyroscope - torque - free motion

Module II (13 hours)
Introduction to lagrangian dynamics - work and energy - the principle of virtual work - D'Alembert's principle - generalized coordinates - Lagrange's equation of motion - introduction to calculus of variations - Hamilton's principle

Module III (13 hours)

Module IV (11 hours)
Flywheel analysis - balancing - static and dynamic balancing - balancing of masses rotating in several planes - balancing of reciprocating masses - balancing of multicylinder engines - balancing machines

Text books
3. Greenwood D.T., Classical Dynamics, Prentice Hall of India, Module II
4. Hollowenko, Dynamics of Machinery, McGraw Hill, Modules III & IV
5. Hamilton H., Mabie & Charles F. Reinholtz, Mechanisms and Dynamics of Machinery, John Wiley Modules III & IV

Reference books
2. Meirovitch L., Methods of Analytical Dynamics, McGraw Hill, Module II
5. Forray M.J., Variational Calculus In Science and Engineering, McGraw Hill, Module II

Sessional work assessment
3 Tests 2x15 = 30
4 Assignments = 20
Total marks = 50
Note: Computer based assignments are to be included

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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (13 hours)

Module II (13 hours)
Kinematic elements in metal cutting - tool in hand nomenclature - mechanics of chip formation - orthogonal and oblique cutting - shear angle - velocity relationship - merchant's analysis of cutting forces - cutting power estimation - tool dynamometers - turning, milling, drilling and grinding dynamometers - thermal aspects of machining - measurement of cutting temperature - cutting fluids & their selection

Module III (13 hours)
Failure of cutting tools - tools wear - flank and crater wear - mechanisms of wear Taylor's tool life equation - tool life testing - economics of machining - selection of optimal machining conditions and productivity - machinability - criteria and factors affecting machinability

Module IV (13 hours)
Non-traditional machining processes - principles, process characteristics and application of ECM, EDM, AJM, USM, EBM & LBM - capability analysis

Text & Reference books
1. Bhattacharyya A., Metal Cutting: Theory & Practice, Central book publishers
2. HMT, Production Technology, Tata McGraw Hill
6. ASTME, Fundamentals of Tool Design, Prentice Hall of India
8. Shaw M.C., Metal Cutting Principles, Oxford & IBH
9. Sharma P.C., A Text Book of Production Engineering, S. Chand & Company

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (13 hours)
Introduction to heat transfer - basic modes of heat transfer - conduction heat transfer - energy balance - integral and differential approaches - general heat conduction equation in Cartesian - cylindrical and spherical coordinates - initial and boundary conditions one-dimensional steady state conduction with heat generation - conduction shape factor - temperature dependence of thermal conductivity - applications like extended surface heat transfer and critical insulation thickness - two dimensional steady state heat conduction - examples - unsteady state heat conduction in one dimension - lumped heat capacity system - semi infinite solids with sudden and periodic change in surface temperature - numerical methods in conduction problem

Module II (13 hours)
Convective heat transfer - Newton's law of cooling - thermal boundary layer - prantl number hydrodynamic and thermal boundary layer equations - laminar forced convection heat transfer from flat plates - similarity and integral solutions - internal flow and heat transfer - fully developed laminar flow in pipes - turbulent forced convection - reynolds analogy - empirical relations in free convection - natural convection - similarity and integral formulation of natural convection heat transfer from vertical plates - empirical relations in free convection - condensation and boiling - film and dropwise condensation - film boiling and pool boiling empirical relations for heat transfer with phase change - introduction to multiphase flow and heat transfer

Module III (13 hours)

Module IV (13 hours)
Mass transfer - definition of terms like concentration, mass velocity and mass flux - Fick's law of diffusion - temperature and pressure dependence of mass diffusivity - diffusion in gases at low density - diffusion in liquids - multi-component systems and their governing equations - concentration distribution in solids and in laminar flow - example problems

Text book

Reference books

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I: System concepts and modelling of systems (11 hours)
Systems - subsystems - elements - systems approach - classification of systems - static and dynamic systems - linear and nonlinear systems - distributed and lumped systems - time invariant and time varying systems - stochastic and deterministic systems - system modeling and approximations - superposition principle - homogeneity and additivity - modelling of electrical systems - active and passive elements - resistance inductance and capacitance - dynamic equations using Kirchhoff's current and voltage laws - RL, RC and RLC circuits and their dynamic equations - block diagrams and signal flow graphs - masons gain formula

Module II: Modelling of non-electrical systems (11 hours)

Module III: Transfer function and time domain analysis (15 hours)
Use of laplace transforms - concept of transfer function - impulse response - convolution integral - response to arbitrary inputs - transfer function of typical systems discussed in Module I - time domain analysis - test inputs - step - velocity and ramp inputs - transient and steady state response - first and second order - under damped and over damped responses - maximum overshoot - settling time - rise time and time constant - higher order systems - steady state error - error constants and error different types of inputs - Fourier series expansion of periodic functions - symmetry conditions - exponential form of Fourier series - Fourier integrals and Fourier transform - spectral properties of signals - analysis by Fourier methods

Module IV: State space analysis and stability of systems (15 hours)
Concept of state - state space and state variables - advantage over transfer function approach - state equations for typical electrical and mechanical and electromechanical systems - representation for linear time varying and time invariant systems - solution of state equation for typical test inputs - zero state and zero input response - concept of stability - bounded input bounded output stability - Lyapunov’s definition of stability - a sympathetic stability - stability in the sense of Lyapunov-Routh Hurwitz criterion of stability for single input single output linear systems described by transfer function model

Reference books
2. Tripathi J.N., Linear Systems Analysis, New Age International

Sessional work assessment
Assignments 2x10 = 20
2 tests 2x15 = 30
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 506A : NUMERICAL ANALYSIS
(common for A12K/CE2K/CH2K/EC2K/EE2K/IC2K/ME2K 506A)

3 hours lecture and 1 hour tutorial per week

**Module I: Errors in numerical calculations (13 hours)**
Sources of errors, significant digits and numerical instability - numerical solution of polynomial and transcendental equations - bisection method - method of false position - Newton-Raphson method - fixed-point iteration - rate of convergence of these methods - iteration based on second degree equation - the Muller’s method - Chebyshev method - Graeffe’s root squaring method for polynomial equations - Bairstow’s method for quadratic factors in the case of polynomial equations

**Module II: Solutions of system of linear algebraic equations (13 hours)**
Direct methods - gauss and gauss - Jordan methods - Crout’s reduction method - error analysis - iterative methods - Jacobi’s iteration - Gauss-seidel iteration - the relaxation method - convergence analysis - solution of system of nonlinear equations by Newton-Raphson method - power method for the determination of Eigen values - convergence of power method

**Module III: Polynomial interpolation (13 hours)**
Lagrange’s interpolation polynomial - divided differences Newton’s divided difference interpolation polynomial - error of interpolation - finite difference operators - Gregory-Newton forward and backward interpolations - Stirling’s interpolation formula - interpolation with a cubic spline - numerical differentiation - differential formulas in the case of equally spaced points - numerical integration - trapezoidal and Simpson’s rules - Gaussian integration - errors of integration formulas

**Module IV: Numerical solution of ordinary differential equations (13 hours)**
The Taylor series method - Euler and modified Euler methods - Runge-Kutta methods (2\textsuperscript{nd} order and 4\textsuperscript{th} order only) - multistep methods - Milne’s predictor - corrector formulas - Adam-Bashforth & Adam-Moulton formulas - solution of boundary value problems in ordinary differential equations - finite difference methods for solving two dimensional Laplace’s equation for a rectangular region - finite difference method of solving heat equation and wave equation with given initial and boundary conditions

**Reference books**

**Sessional work assessment**
Assignments 2x10=20
2 tests 2x15=30
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 506B : COMPOSITE MATERIALS
(common with ME2K/PE2K 506B)

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)
Introduction - classification and characteristics of polymer matrix and metal matrix composites - mechanical behaviour of UD composites - longitudinal strength and stiffness - transverse strength and stiffness - failure modes - short fiber composites

Module II (15 hours)

Module III (13 hours)
Analysis of orthotropic lamina - Hook’s law for orthotropic materials - stress-strain relations and engineering constants - specially orthotropic lamina - relation between engineering constants and elements of stiffness and compliance matrices - restrictions on elastic constants - stress-strain relationships for generally orthotropic lamina - transformation of engineering constants - strengths of orthotropic lamina - typical design application examples

Module IV (13 hours)
Analysis of laminated composites - strain and stress variation in a laminate - synthesis of stiffness matrix construction and properties of special laminates - symmetric laminates - unidirectional, cross-ply and angle-ply laminates - quasi-isotropic laminates - determination of laminae stresses and strains - laminate analysis through computers - typical design application examples

Reference books
5. Tsai S.W., Introduction to Composite Materials, Technomic Publishing Company
6. Chawla K.K., Ceramic Matrix Composites, Chapman & Hall

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 506C : MULTI-PHASE FLOW  
(common with ME2K/PE2K 506C)

3 hrs lecture & 1 hour tutorial per week

Module I (13 hours)
Basic equations and empirical correlation's for multi-phase flow - flow patterns - identification and classification - flow pattern maps and transition - momentum and energy balance - homogeneous and separated flow models - correlation's for use with homogeneous and separated flow models - two phase flow through inclined pipes and singularities - void fraction and slip ratio correlation's - influence of pressure gradient - empirical treatment of two phase flow - drift flux model - correlation's for bubble - slug and annular flows - pressure losses through enlargements - contractions - orifices - bends and values

Module II (13 hours)
Boiling and multiphase heat transfer - vapour-liquid equilibrium - mechanisms - pool boiling convective boiling - heat transfer in partial and fully developed sub cooled boiling - void fraction and pressure drop in sub cooled boiling - saturated boiling heat transfer - two phase forced convection laminar and turbulent flow solutions for film heat transfer - empirical equations for film boiling and transition boiling - burnout mechanism and correlation's - critical coefficient in nucleate and convective boiling

Module III (13 hours)
Condensation - basic processes of condensation - mechanism of evaporation and condensation - film condensation on a planar surface - dropwise condensation - pressure gradient in condensing systems - methods of improving heat transfer coefficient in condensation

Module IV (13 hours)
Critical multiphase flows - mathematical models - critical flow criterion - compatibility conditions and their physical interpretation - experimental observations - propagation of small disturbances - pressure drop limitation effect - graphical representation of critical flow conditions

Text books
Collier J.G., Convective Boiling and Condensation, McGraw Hill

Reference books
1. Hsu Y.Y. & Graham R.W., Transport Processes in Boiling and Two Phase Systems, Hemisphere
3. Tong L.S., Boiling Heat Transfer and Two Phase Flow, Wiley

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 506D : FINITE ELEMENT METHODS
(common with ME2K/PE2K 506D)

3 hours lecture and 1 hour practical per week

Module I (13 hours)

Module II (11 hours)
Finite element analysis of one dimensional problems - procedure - one dimensional elements and interpolation functions - analysis of one dimensional second and fourth order equations - approximation errors in the finite element method - computer implementation

Module III (15 hours)
Finite element analysis of two dimensional problems - two dimensional elements and interpolation functions - second order equations involving a scalar valued function - comments on mesh generation and composition of boundary conditions - analysis of plane elasticity and incompressible fluid flow problems - time dependent problems (transient heat transfer) - isoparametric elements and numerical integration

Module IV (13 hours)
Alternative formulations - the least square formulation - the mixed formulation - Eigen value problems - non linear problems - three dimensional elements and interpolation functions - formulation of three dimensional problems (two and three dimensional Navier-Stoke's equations - three dimensional heat transfer equations)

Text books

Reference books

Sessional work assessment
3 Tests 2 x 15 = 30
2 Assignments 2 x 10 = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 506E : OBJECT ORIENTED PROGRAMMING  
(common for all programmes)

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)  
OOPS and Java basics - Java virtual machine - Java platform API - extended security model - applet classes - exceptions and abstract classes - Java applet writing basics - GUI building with canvas - applet security - creating window applications - writing console applications - utility and math packages

Module II (10 hours)  
Swing programming - working with swing components - using the clipboard - input/output streams - printing - working with 2D and 3D Graphics - using audio and video - creating animations

Module III (10 hours)  
Java beans development kit - developing beans - notable beans - network programming - client and server Programs - naming and directory services - working with Java management APIs

Module IV (20 hours)  
Distributed application architecture - CORBA - RMI and distributed applications - working with remote objects - object serialization and Javaspaces - Java IDL and ORBs, connecting to database - using JDBC - integrating database - support into web applications - Java servlets - JSDK - JAR files - Java native interface

Text books  

References books  
1. Holzner S., Java 2, Swings, Servlets, JDBC & Java Beans Programming, IDG Books

Sessional work assessment  
Assignments 2x10 = 20
Tests 2x15 = 30
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
PM2K 506F : MARKETING MANAGEMENT  
(common with ME2K 506F)

3 hours lecture & 1 hour tutorial per week

**Module I (14 hours)**
Introduction to marketing - concept of market and marketing - marketing environment - controllable factors - factors directed by top management - factors directed by marketing - uncontrollable factors - demography, economic conditions, competition, social and cultural forces, political and legal forces, and technology

**Module II (14 hours)**
Marketing planning - marketing planning process - Boston consultancy group model - marketing mix - marketing mix variables - market segmentation and market targeting - introduction to segmentation - targeting and product positioning

**Module III (12 hours)**
Marketing research - need and scope - marketing research process - research objectives, developing research plan, collecting information, analysis, and findings - consumer behaviour - factors influencing consumer behaviour - perceived risks - product life cycle - marketing strategies for different stages of product life cycle

**Module IV (12 hours)**
Marketing communication - marketing mix variables - steps in developing effective communication - identification of target audience - determination of communication objectives - designing the message - selecting the communication channels - promotion mix evaluation - advertising and sales promotion - factors in advertising - sales promotion tools

**Text books**

**Reference books**

**Sessional work assessment**
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (8 hours)
History of England - cultural, social and political - origin of the English language - vocabulary - grammar - syntax - English language vis-a-vis other European and Asian languages - Indo European languages - Language families of the world - Language, literature, history and culture of a nation - English as a global language

Module II (14 hours)
Introduction to English usage and composition - essentials of English grammar - style and technique of effective English communication - techniques of persuasive speech and writing - Rhetoric - Common errors in English usage (spoken and written) - Different varieties of English (British, American and Indian)
Basics of English pronunciation - Phonetics - Stress, Accent, Rhythm (Appreciation of English speech patterns, conversations, great orators etc. through audio cassettes and CDs) - Practical Speaking Listening sessions in the Language Laboratory - Different forms of communication in English - Business English, English for professionals and literary English

Module III (15 hours)
English literature - Survey, Scope and History
English prose - Great essayists - Addison, Steele, Lamb, Russell, Chesterton, Bacon
English Poetry - Ancient (Chaucer, Milton, Spencer)
Medieval and Modern English poetry - Shakespeare, Wordsworth, Keats, Shelley, Byron, Browning, Tennyson, T.S. Eliot (Core reading)
Novels: Classics of English fiction - critical appreciation with a view for improving style and expressions (Charles Dickens, Aldous Huxley, Jane Austen, George Eliot, Jonathan Swift)
The great short story writers - O. Henry, Saki, James Joyce (Dubliners)

Module IV (15 hours)
English Drama and theatre - Shakespeare - The Great Tragedies - Othello, Hamlet, Macbeth, King Lear
Comedies - As you like it (Others in Recommended Reading) - George Bernard Shaw - Man and Superman, Pygmalion
Modern Drama - Harold Pinter, Edward Bond
Others - Plato, Longinus, Rasa theory and Indian poetics (In this module students will be expected to have read the primary works and develop a critical appreciation of them)

Text books
1. Barber C.L., History of the English Language
2. Trevelyan G.M., Social History of England, Longmans
5. Krishna Mohan & Meera Banerji, Developing Communication Skills
6. Krishna Mohan & Meera Banerji, Effective English Communication
7. The Harp & the Lyre - An Anthology of English Poems
8. Elements of Style Strunk

Sessional work assessment
Assignments 2x10 = 20
Tests 2x15 = 30
Total marks = 50
<table>
<thead>
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<th>University examination pattern</th>
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<td>Q V  - 2 questions of 15 marks each from module IV with choice to answer any one</td>
</tr>
</tbody>
</table>
PM2K 507(P) : HEAT TRANSFER LABORATORY
[common with ME2K 507(P)]

3 hours practicals per week

Introduction to fundamentals of heat transfer - condensation and buoy-heat exchanges experimental techniques in thermal sciences

**Exercise**
1. Performance studies on a shell and tube heat exchanger
2. Performance studies on parallel and count a flow arrangements in a concentric pipe heat exchanger
3. Emissivity measurement of a radiating surface
4. Measurement of solar radiation
5. Thermal conductivity of a metal road
6. Measurement of unsteady state conduction heat transfer
7. Experimental study on forced convection heat transfer
8. Experimental study of dropwise and filmwise condensation
9. Experiments on boiling heat transfer
10. Measurement of critical heat flux

**Reference books**

**Sessional work assessment**
Laboratory practicals and record = 30
Test/s = 20
Total marks = 50

National Institute of Technology Calicut 19 Mechanical Engineering (Production & Management)
PM2K 508(P) : PRODUCTION ENGINEERING LAB II
[common with ME2K 508(P)]

3 hours practicals per week


**Exercises**:
1. Multi start thread
2. Square thread
3. Eccentric turning
4. Exercise on limits and fits
5. Internal thread
6. Spur gear and
7. Helical gear- by simple, differential indexing
8. Surface, slot and keyway milling
9. Shaper exercise on cube with v groove, slot and guide ways
10. Exercise on grinding
11. Tool grinding

**Reference books**
2. ASTM, *Tool Engineer's Handbook*

**Sessional work assessment**

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
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<td>Laboratory practicals and record</td>
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<tr>
<td>Test/s</td>
<td>20</td>
</tr>
<tr>
<td>Total marks</td>
<td>50</td>
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</tbody>
</table>
Module I (11 hours)
Characteristics of instruments - generalised measurement systems - input-output configurations - static characteristics - errors in measurement - drift - noise - accuracy - precision - static sensitivity - resolution - traceability - loading effects on instruments - dynamic response of measuring instruments - zero, first and second order instruments - response of instruments to step, ramp, impulse and periodic inputs - experimental determination of measurement system parameters

Module II (13 hours)
Metrology - tolerances - interchangeability - ISO system of limits and fits - design of limit gauges - tolerance analysis - linear measurements - slip gauges - micrometers - variable inductive transducers - comparators - mechanical, electrical, pneumatic and optical comparators - optical methods of dimensional measurement - measuring microscope - profile projector - autocollimator - interferometer - metallurgical microscope, etc. - thread measurements - measurement of pitch - effective and root diameter - gear measurements - measurement of gear tooth thickness - tooth spacing and pitch circle diameter

Module III (15 hours)
Measuring devices - transducer elements and types - bonded strain gauges - differential transformers - piezoelectric transducers - synchros, etc. measurement of strain - various types of strain gauges - application of strain gauges for measurement of load - torque - measurement of force and torque - hydraulic and electrical dynamometers - cutting tool dynamometers for measurement of force and torque during turning - milling - drilling etc - measurement of temperature - thermo couples - resistance thermometers - resistance temperature detectors - radiation thermometers - thermists, etc. - typical applications in metal cutting - metal casting processes and automobile engineering - pressure and sound measurement - low and high pressure measurement - sound meter - various types of microphones - sensitivity - air pollution measurement - orsat apparatus - principle of gas chromatography - measurement of vibration - principles of accelerometer and seismometer

Module IV (13 hours)
Data acquisition and processing - analog and digital sensor processing - filters - A/D and D/A converters - microprocessor applications
Modern measuring instruments/machines - coordinate measuring machine-hard probes - touch trigger probes - non-contact sensors - probe calibration - drive systems - performance evaluations - geometric and scanning softwares - effect of environments - surface finish measurements - stylus instruments - skid, skidless and non-contact types - measurement of roughness parameters - Ra, Rq, Rt, Rk, Rmax, tp, etc. - machine vision - image formation - image analysis and image interpretation - charge coupled device and charge injected devices - typical application examples

Reference books

Sessional work assessment
3 Tests  2 x 15  = 30
2 Assignments  2 x 10  = 20
Total marks  = 50
<table>
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<td>Q V</td>
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</tr>
</tbody>
</table>
PM2K 602 : OPERATIONS RESEARCH
(common with ME2K 602)

3 hours lecture and 1 hour tutorial per week

Module I: Linear algebra (13 hours)
Vectors - vector space and Euclidean space - vector operations - matrix operations - unit vector - sum vector - linear dependence - bases - spanning set - rank - simultaneous equations - basic solutions - point sets - lines and hyper planes - linear inequalities - convex sets - extreme points - fundamental theorem of linear programming

Module II: Linear programming (13 hours)
Statement of the LP problem - slack and surplus variables - basic feasible solutions - reduction of a feasible solution to basic feasible solution - artificial variables - optimality conditions - unbounded solutions - Charnes’ M method - two phase method - degeneracy - duality

Module III: Transportation, assignment & game problems (13 hours)
The transportation problem - the coefficient matrix and its properties - basic set of column vectors - linear combination of basic vectors - the tableau format - stepping stone algorithm - UV method - inequality constraints - degeneracy in transportation problems - the assignment problem as a maximally degenerate transportation problem - Köening’s method - rectangular zero sum games - Von Neuman’s theorem - saddle points - pure and mixed strategies - formulation of the primal and dual LP problem for fixed strategies - dominance - graphical solutions

Module IV: Queueing theory (13 hours)
Basic structure of queueing models - exponential and Poisson’s distributions - the birth and death process - queueing models based on Poisson inputs and exponential service times - the basic model with constant arrival rate and service rate - finite queue - limited source queue models involving non-exponential distributions - single service model with Poisson arrival and any service time distribution - Poisson arrival with constant service time - Poisson arrival and Erlang service times - priority disciplines - dynamic programming - Bellman’s principle of optimality - formulation and solution of simple problems

Text books
1. Hadley G., Linear Programming, Addison Wesley

Reference books
2. Wagner, Principles of Operations Research, Prentice Hall of India

Sessional work assessment
3 Tests  2 x 15 = 30
2 Assignments  2 x 10 = 20
Total marks  = 50

University examination pattern
Q I    - 8 short type questions of 5 marks each, 2 from each module
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Q IV   - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V    - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (10 hours)
Introduction - solidification of metals - mechanism of solidification - solidification with predominant interface resistance - solidification with constant surface temperature - solidification with predominant resistance in mould and solidified metal - flow of molten metal in moulds - furnaces and melting practices - patterns - pattern allowance - design considerations - shrinkage and machining allowance - foundries

Module II (14 hours)
Casting processes - comparison - sand casting - shell moulding - silicate bonded sand process (CO2 process) - expended polystyrene process - plaster mould casting - ceramic mould casting - investment casting - permanent mould casting - slush casting - pressure casting - die casting - centrifugal casting - squeeze casting - semisolid casting (thesocasting, thixoforming) - casting techniques for single crystal components - rapid solidification - residual stress - defects - inspection of castings - casting design - gating system design - risering - casting alloys - economics of casting - design rules for castings - case studies with specific examples of sand cast and permanent mould cast parts

Module III (16 hours)

Module IV (12 hours)
The metallurgy of welding - metallurgy of weld metal and HAZ for carbon steels, ferritic and high alloy steels, austenitic and high alloy steels non-ferrous metals (Aluminium and its alloys, Copper and its alloys, Magnesium and its alloys) - weld quality - weldability - testing welded joints - welding design and process selection - brazing, soldering, adhesive bonding and mechanical joining processes - joining plastics - surface energy and contact angle - capillary action in brazing and soldering - residual stress and stress concentration factors in adhesive bonding

Reference books
2. Serope Kalpakjian, Manufacturing Engineering & Technology, Addison Wesley
5. Doyle L.E., Manufacturing Processes and Materials for Engineers, Prentice Hall of India
6. Metals HandBook- Vol.5., Welding Institute of Metals

Sessional work assessment
2 tests 2x15 = 30
2 assignments 2x10 = 20
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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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
PM2K 604 : PRODUCTION THERMAL ENGINEERING

Module I (13 hours)
Internal combustion engines - classification - spark ignition and compression ignition engines - 2-stroke and 4-stroke engines - value timing diagrams - theoretical and actual cycles - deviation of an actual cycle from ideal cycle - loss due to dissociation and specific heat variation - different system of IC engines - combustion process in CI and SI engines - excess air calculations - performance of IC engines - frictional losses - mechanical efficiency - thermal efficiency - volumetric efficiency - morse test - heat balance sheet for IC engines - governing of IC engines

Module II (13 hours)
Nozzles - isentropic flow of fluids through variable area passage - expression for velocity and discharge - throat pressures and areas for maximum discharge - effect of friction - supersaturated flow - Wilson line - effect of variation of back pressure
Steam turbines - impulse and reaction turbines - compounding - velocity diagrams for single stage and several blade rings - work done and blade efficiency - conditions for maximum efficiency - application of energy equation to turbine blades - effect of blade friction - condition line - reheat factor

Module III (13 hours)
Gas turbine cycles - joule brayton cycle - open and closed cycles - effect of various parameters on performance - regeneration - intercooling and reheating
Reciprocating compressors - single stage and multi stage compressors - condition for maximum efficiency - effect of cylinder clearance - volumetric efficiency
Rotary compressors: types - fans - rotary displacement blowers - turbo blowers - turbo compressors - work done and efficiency in centrifugal compressor

Module IV (13 hours)
Refrigeration - working, performance and application of air refrigerator - vapour compression refrigeration - vapour absorption refrigeration - co-efficient of performance - pressure-enthalpy diagram
Air conditioning - psychrometry - psychrometric processes - human comfort - effective temp - cooling and dehumidification - heating and humidification - summer and winter air conditioning system - cooling load and simple air conditioning calculations

Reference books
2. Kearton W.J., Steam Turbines; Theory & Practice, ELBS
3. Lewitt E.H., Thermodynamics Applied to Heat Engines, Sir Isaac Pitman & Sons
4. Cohen & Rogers, Refrigeration and Air Conditioning
5. Rajput R.K., Thermal Engineering

Sessional work assessment
2 test 2 x 15 = 30
2 Assignment = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 605 : MACHINE DESIGN

Module I (13 hours)
Introduction to design - steps in design process - design factors - tolerances & fits - principles of standardization - selection of materials - strength of mechanical elements - stress concentration - theories of failure - impact load - fatigue loading - consideration of creep and thermal stresses in design
Threaded fasteners: Thread standards - stresses in screw threads - preloading of bolts - bolted joints - eccentric loading - gasketed joints

Module II (13 hours)
Keys : Types of keys and pins - stresses in keys and pins - design of keys - design of cotter and pin joints
Welded joints : Types of welded joints - stresses in butt and fillet welds - torsion and bending in welded joints - welds subjected to fluctuating loads - design of welded machine parts and structural joints
Springs : Stresses in helical springs - deflection of helical springs - extension, compression and torsion springs - design of helical springs for static and fatigue loading - critical frequency of helical springs - stress analysis and design of leaf springs

Module III (14 hours)
Power shafting: Stresses in shafts - design for static loads - reversed bending and steady torsion - design for strength and deflection - design for fatigue loading - critical speed of shafts
Design of gears: Spur, helical, bevel and worm gears - tooth loads - gear materials - design stresses - basic tooth stresses - stress concentration - service factor - velocity factor - bending strength of gear teeth - Buckingham’s equation for dynamic load - surface strength and durability - heat dissipation - design for strength and wear

Module IV (12 hours)
Lubrication & journal bearing design: Types of lubrication and lubricants - viscosity - journal bearing with perfect lubrication - hydrodynamic theory - design considerations - heat balance - journal bearing design
Rolling contact bearings: Bearing types - bearing life - static and dynamic capacity - selection of bearings with axial and radial loads - lubrication - seals, shaft, housing and mounting details

Text book
Shigley J.E., Mechanical Engineering Design, McGraw Hill Book Company

Reference books
1. Siegel, Maleev & Hartman, Mechanical Design of Machines, International Book Company

Data hand books (allowed for reference during examinations)

Sessional work assessment
2 tests (best 2 out of 3 tests conducted) 2x15 = 30
2 assignments 2x10 = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V  - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 606A : OPTIMIZATION TECHNIQUES
(common with AI2K/CE2K/EC2K/EE2K/IC2K/ME2K 606A)

3 hours lecture and 1 hour tutorial per week

Module I: Linear programming I (13 hours)
Systems of linear equations and inequalities - convex sets - convex functions - formulation of linear
programming problems - theory of simplex method - simplex algorithm - Charne’s M method - two phase
method - duality in linear programming - dual simplex method

Module II: Linear programming II (13 hours)
Sensitivity analysis - parametric programming - bounded variable problems - transportation problem -
development of the method - integrality property - degeneracy - unbalanced problems - assignment
problem - development of the Hungarian method - routing problems

Module III: Nonlinear programming (13 hours)
Mathematical preliminaries of non-linear programming - gradient and hessian - unimodal functions -
convex and concave functions - role of convexity - unconstrained optimization - fibonacci search - golden
section search - optimal gradient method - classical optimization - Lagrange multiplier method - Kuhn-
tucker conditions - quadratic programming - separable convex programming - frank and wolfe method

Module IV: Dynamic programming & game theory (13 hours)
Nature of dynamic programming problem - Bellman’s optimality principle - cargo loading problem -
replacement problems - multistage production planning and allocation problems - rectangular games - two
person zero sum games - pure and mixed strategies - 2×m and m×2 games - relation between theory of
games and linear programming

Reference books
   Wiley
3. Hadley G., ‘Linear Programming’, Addison Wesley

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

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one
PM2K 606B : MECHATRONICS
(common with ME2K/PE2K 606B)

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)
Introduction to mechatronics - sensors and transducers - signal conditioning - pneumatic and hydraulic systems - mechanical and electrical systems

Module II (11 hours)
System modeling - mathematical models - mechanical, electrical, fluid and thermal system building blocks - system models - dynamic response of systems - first and second order systems - modeling dynamic systems - system transfer functions - frequency response - stability

Module III (15 hours)
Closed loop controllers - continuous and discrete processes - proportional, derivative and integral controls - PID controller - digital controllers - controller tuning - adaptive control

Module V (15 hours)
Micro controllers and microprocessors - digital logic circuits - micro controller architecture and programming - programmable logic controllers

Text book

Reference books
2. Krishna Kant, *Computer Based Industrial Control*, Prentice Hall of Indian Private Limited

Sessional work assessment
Test 2x15 = 30
Assignment 2x10 = 20
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 15 marks each from module I with choice to answer any one
Q III  - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV   - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V    - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 606C : FRACTURE MECHANICS
(common with ME2K/PE2K 606C)

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)
Linear elastic fracture mechanics (LEFM): elastic stress field approach - mode I elastic stress field equations - expressions for stresses and strains in the crack tip region - finite specimen width - superposition of stress intensity factors (SIF) - SIF solutions for well known problems such as centre cracked plate - single edge notched plate - embedded elliptical cracks etc.

Module II (13 hours)
Crack tip plasticity: Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behaviour
Energy balance approach: Griffith energy balance approach - relations for practical use - determination of SIF from compliance - slow stable crack growth and R-curve concept - description of crack resistance
LEFM testing: plane strain and plane stress fracture toughness testing - determination of R-curves - effects of yield strength and specimen thickness on fracture toughness - practical use of fracture toughness and R-curve data

Module III (13 hours)
Elastic plastic fracture mechanics (EPFM): development of EPFM - J-integral - crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard J\textsubscript{lc} test and COD test
Fatigue crack growth: description of fatigue crack growth using stress intensity factor - effects of stress ratio and crack tip plasticity - crack closure - prediction of fatigue crack growth under constant amplitude and variable amplitude loading - fatigue crack growth from notches - the short crack problem

Module IV (13 hours)
Sustained load fracture: time-to-failure (TTF) tests - crack growth rate testing - experimental problems - method of predicting failure of a structural component - practical significance of sustained load fracture testing
Practical problems: through cracks emanating from holes - corner cracks at holes - cracks approaching holes - fracture toughness of weldments - service failure analysis - applications in pressure vessels - pipelines and stiffened sheet structures

Text book

Reference books
3. Prashant Kumar, Elements of Fracture Mechanics, Wheeler Publishing

Sessional work assessment
2 tests (best 2 out of 3 tests conducted) 2x15 = 30
2 assignments 2x10 = 20
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 606D: INSTRUMENTATION THEORY & CONTROL
(common with ME2K 606D)

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)
Applications of measuring instruments - functional elements of an instrument - instrument as a transducer -
generalised measuring instrument- generalised mathematical model of measuring systems - zero order -
first order - second order instruments - classification of instruments- input/output configurations - methods
of correction for spurious inputs - inherent insensitivity - high-gain feed-back - signal - filtering and
opposing inputs - static calibration and determination of bias (systematic error) and random error
(imprecision) of an instrument - assumption of Gaussian distribution for experimental data - “chi-square
goodness-of-fit” test - method of least squares for curve fitting - static characteristics - accuracy
(inaccuracy = systematic error ± random error) loading effect - backlash - friction - hysteresis - threshold -
dead space - resolution - static sensitivity and linearity - problems on friction - loading effect - sensitivity
etc. and calibration

Module II (13 hours)
Uncertainty in “computed quantities” from measured values - estimation of permissible uncertainties of
instruments for specific purposes - potentiometer transducer as a zero order instrument - analysis of its
loading error - mercury-in-glass thermometer as a first order instrument - step, ramp and frequency
response of first order instruments - problems - seismic instrument as a second order instrument - step -
terminated ramp - ramp and frequency response of second order instruments - slip gages - assembling the
blocks - temperature problems - LVDT- comparators: principle of working of mechanical, electrical,
pneumatic comparators - measurement of strain: strain gauge classification - unbounded and bonded strain
gauges - gage factor - strain gauge rosettes - selection and installation of bonded gauges - ballast, DC
bridges and constant current circuits - temperature compensation - calibration

Module III (13 hours)
Measurement of force: multiple lever system for weighing - strain gauge load cells - temperature sensitivity
- calibration - ballistic weighing - potentiometer transducer - hydraulic and pneumatic load cells - measurement of torque: water brake
Heenan and Froude hydraulic dynamometer - general purpose electric dynamometer - beam and strain
gauge transmission dynamometer - measurement of temperature: pressure thermometers - RTDs -
compensation for lead resistance - thermistors - thermocouples - five laws of thermocouples and there
application - series in parallel connected thermocouples - materials used and there ranges - pyrometry -
total radiation pyrometers - optical pyrometer - infrared pyrometry - air pollution measurement: gas
chromatography - Orsat’s apparatus - nuclear instrumentation: Gieger Muller counter - ionisation chamber -
sцинтирование counters

Module IV (13 hours)
Acoustical measurements: characterisation of sound (noise) - basic acoustical parameters - sound pressure -
sound pressure level, power, intensity & power level - combination of sound pressure levels - attenuation
with distance - psychoacoustic relationships - micro phones - sound level meter - principles of automatic
control: open and closed loop systems - servo mechanism - process control and regulators - transfer
function - block diagram representation and signal flow graphs - mathematical modelling of mechanical
and electrical systems - transfer function of simple systems - time domain analysis of control system:
steady state response - steady state error - error coefficients - stability of control systems: concept of
stability - method of determining stability of linear control systems - Ruth Hurwitz criterion

Reference books
### Sessional work assessment

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5. **Q V** - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 606E : RANDOM VIBRATIONS
(common with ME2K 606E)

Module I (13 hours)
Basic probability concepts - events and probability - elements of set theory - simple events and combination of events - Venn diagram - mutually exclusive events and collectively exhaustive events - De Morgan’s rule - basic axioms of probability - conditional probability - statistical independence - theorem of total probability - Bayes’ theorem - definition of a random variable - probability distribution and probability distribution and probability density of discrete and continuous random variables - main descriptors of a random variable (mean, mode, median, variance, standard deviation, coefficient of variation, skewness and kurtosis) - absolute moments and central moments - moment generating functions, characteristics functions and log characteristic functions

Module II (13 hours)
Useful probability distributions - the normal distribution - the standard normal distribution - lognormal distribution - binomial distribution - geometric distribution - negative binomial distribution - poisson process and poisson distribution - hypergeometric distribution - beta distribution - gamma distribution - extreme value distributions - joint and conditional probability distributions - covariance and correlation mean and variance - functions of single random variable - single function of multiple random variables - multiple functions of multiple random variables - moments of functions of random variables

Module III (13 hours)
Random processes - introduction - ensemble averages and correlation functions - time averages and correlation functions - weakly stationary and strongly stationary random processes - ergodic random processes - probability density and distribution functions - properties of autocorrelation functions - fourier transforms - power spectral density functions - wiener khintchine equations - properties of spectral density functions - spectral classification of random processes (narrow band, wide band, white noise) - level crossing - expected frequency and amplitude of narrow band Gaussian processes - Rayleigh distribution

Module IV (13 hours)
Response to random excitations - introduction - impulse response and frequency response function as fourier transform pair - response of a linear system function to stationary random excitation - response of a single - degree - of freedom system to random excitation - contour integration - joint probability distribution of two random variables - joint properties of stationary random processes - joint properties of ergodic random processes - cross - correlation functions for linear systems - response of multi-degree of freedom system to random excitations - response of one - dimensional continuous systems to random excitations

Text books

Reference books
2. Bendat & Piersol, “Random Data Analysis And Measurement Procedure”, Wiley Inter Science, John Wiley
### Sessional work assessment

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Tests</td>
<td>$2 \times 15 = 30$</td>
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<tr>
<td>2 Assignments</td>
<td>$2 \times 10 = 20$</td>
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<td><strong>Total marks</strong></td>
<td><strong>50</strong></td>
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### University examination pattern

<table>
<thead>
<tr>
<th>Question</th>
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<tr>
<td>Q I</td>
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</tr>
<tr>
<td>Q V</td>
<td>- 2 questions A and B of 15 marks each from module IV with choice to answer any one</td>
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</table>
PM2K 606F : INTRODUCTION TO SOCIAL SCIENCES
(common with AI2K/EC2K/IC2K/ME2K/PE2K 606F)

Module I (8 hours)

Module II (14 hours)
Philosophy and history - Philosophy as the mother of all sciences - history of Philosophy - issues in ancient, medieval and modern philosophy - Aristotle and Plato - renaissance thinkers - the Political System & socio-cultural environment of Renaissance - different thinkers - Plato, Scopenhauer, Kant, Sartre
History - historiography, classical history - readings from classics of historical writing - current debates in history (India World) - Modern Indian history

Module III (15 hours)
Sociology and psychology - the evolution of ‘Sociology’ - society - terms in Sociology - Society, individual, caste, race, religion, class, tribe
Social thinkers - Auguste Comte, Emile Durkheim, Karl Marx, Max Weber, Mahatma Gandhi
Sociologists - M.N. Srinivas, Y. Singh
Social evils and concerns - Dowry system, Indian caste system, Communalism, Globalisation

Module IV (15 hours)
Polity and international affairs - concept of State, Government and Polity - various forms of government - relation of technology to politics
Indian polity - constitution - systems of governance - post independence policies - political and economic - rights and duties of citizens - secularism and national integration
International affairs - global politics, geography and geo-politics - Power zones - alliances and treaties UNO - international law - India’s role in the next millenium

Text books
1. Will Durrant, The Story of Philosophy, Washington Square
3. Nehru, Glimpses of World History, OUP
4. Bibin Chandra, India’s Struggle for Independence
5. Basu D.D., Introduction to the Constitution of India, Prentice Hall of India
7. Srinivas M.N., Caste in Modern India
8. Singh Y., Modernisation of Indian Tradition

Reading List
1. Baron, Psychology, Prentice Hall of India
2. Baron & Byrne, Social Psychology, Prentice Hall of India
3. Dikshit, Geographical Thought - A Contextual History of Ideas, Prentice Hall of India
4. Lipson, The Great Issues of Politics - An Introduction to Political Science
5. Mukharjee & Ramaswamy, A History of Political Thought - Plato to Marx
6. Dahl, Modern Political Analysis
7. Linguistics - An Introduction to Language and Communication
8. Inkeles, What is Sociology? - An Introduction to the Discipline and Profession
9. Nanda Baudev, Indian Political Tradition
10. Nanda Baudev, Political Theory
11. Vadrevu Sivaji, Essentials of Indian Government and Politics
### Sessional work assessment

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Assignments</td>
<td>2x10 = 20</td>
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<tr>
<td>Tests</td>
<td>2x15 = 30</td>
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<td>Total marks</td>
<td>= 50</td>
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### 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 any one
- **Q III** - 2 questions of 15 marks each from module II with choice to answer any one
- **Q IV** - 2 questions of 15 marks each from module III with choice to answer any one
- **Q V** - 2 questions of 15 marks each from module IV with choice to answer any one
PM2K 606G : FLEXIBLE MANUFACTURING SYSTEMS
(common with ME2K/PE2K 606G)

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)
Computer technology - introduction - CPU - types of memory - input/output devices - computer programming - operating the computer system - mini/micro computers and programmable controllers - computer aided design - fundamentals of CAD - the design process - application of computers for design - manufacturing data base - computer graphics - software configuration - constructing the geometry - transformations - data base structure and content - wire frame and solid models

Module II (13 hours)
Numerical control - basic components of NC systems - NC coordinate systems - motion control system - application of numerical control - NC part programming - punched tape - tape coding and format - manual part programming - computer assisted part programming - APT language - NC programming with interactive graphics

Module III (13 hours)
Manufacturing systems - development of manufacturing system - components of FMS - FMS work station - Job coding and classification - group technology - benefits of FMS - tools and tooling - machining centres - head indexers - pallets - fixtures - work handling equipments - system storage - automated guided vehicles - industrial robots - programming of robots - assembly & inspection

Module IV (13 hours)
Flexible manufacturing system management - FMS control software - manning of FMS - tool management - controlling precision - simulation and analysis of FMS - approaches to modelling for FMS - network simulation - simulation procedure - FMS design - economics of FMS - artificial intelligence

References books

Sessional work assessment
Two assignments = 20
Two tests = 30
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
1. Study of systems and components of petrol and diesel engines
2. Study of automotive parts
3. Study of air compressors, blower and fan
4. Determination of viscosity, flash and fire points and calorific value of oils
5. Tests on internal combustion engines:
   a) Determination of value timing diagram of engines
   b) Determination of various efficiencies - brake thermal efficiency, indicated thermal efficiency, mechanical efficiency and volumetric efficiency
   c) Determination of friction power - retardation test and Morse test
   d) Study of effect of cooling water and speed on engine performance
   e) Heat balance test
   f) Analysis of exhaust gas of internal combustion engines
6. Performance tests on air compressor and blower
7. Performance test on refrigeration plant

List of experiments in thermal engineering lab
(Based on test rigs available in Calicut REC)
1. Determination of viscosity of oils and its variation with temperature
2. Determination of flash and fire points of fuels
3. Determination of calorific value of fuels
4. Value timing diagram on Ruston engine and kirloskar engine
5. Constant speed performance characteristics of ambassador engine
6. Constant speed performance characteristics of comet engine
7. Constant speed performance characteristics of Jawahar engine
8. Constant speed performance characteristics of Kirloskar (5hp) engine
9. Variable speed performance characteristics of Kirloskar (10hp) engine
10. Variable speed performance characteristics of ambassador engine
11. Variable speed performance characteristics of Honda engine
12. Morse test on ambassador engine
13. Retardation test on Jawahar engine
14. Retardation test on Anil engine
15. Cooling curve on Jawahar engine
16. Cooling curve on Comet engine
17. Cooling curve on Kirloskar (10hp) engine
18. Heat balance test on Jawahar engine
19. Heat balance test on Comet engine
20. Heat balance test on Kirloskar (10hp) engine
21. Exhaust gas analysis of Fiat engine
22. Performance test on Reciprocating Air Compressor
23. Performance test on Rotary Air Compressor
24. Performance test on Air Blower
25. Performance test on vapour compression refrigeration plant
### Sessional work assessment

<table>
<thead>
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<th>Component</th>
<th>Marks</th>
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<tr>
<td>Laboratory practicals and record</td>
<td>30</td>
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<tr>
<td>Test/s</td>
<td>20</td>
</tr>
<tr>
<td>Total marks</td>
<td>50</td>
</tr>
</tbody>
</table>
The project work can be a design project, experimental fabrication project or software development project on any of the topics of mechanical engineering (production & management) interest - it can be allotted as a group project with groups consisting of three or four students.

The assessment of all the mini projects should be done by a committee consisting of three or four faculty members specialised in the various fields of mechanical engineering (production & management) - the students will present their project work before the committee - the relative gradings and group average marks for the various projects will be fixed by the committee - the guides will award the marks for the individual students in the project maintaining the group average - each group will prepare the project report and submit to the department through the guide - the head of the department will certify the copies and keep them in the departmental library.

<table>
<thead>
<tr>
<th>Sessional work assessment</th>
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<tbody>
<tr>
<td>Presentation</td>
<td>30</td>
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<tr>
<td>Report</td>
<td>20</td>
</tr>
<tr>
<td>Total marks</td>
<td>50</td>
</tr>
</tbody>
</table>
PM2K 701 : ECONOMICS
(common with CE2K/ME2K/PE2K 701)

3 hours lecture & 1 hour tutorial per week

Module I (13 hours)
Definition of economics - nature and scope of economic science - nature and scope of managerial economics - basic terms and concepts - goods - utility - value - wealth - factors of production - land - its peculiarities - labour - its peculiarities and division of labour - capital and capital formation - organisation or enterprise - economies of large and small scale - consumption - wants - its characteristics and classification - law of diminishing marginal utility - relation between economic decision and technical decision - economic efficiency and technical efficiency

Module II (13 hours)
Demand - demand schedule - demand curve - law of demand - elasticity of demand - types of elasticity - factors determining elasticity - measurement - its significance - supply - supply schedule - supply curve - law of supply - elasticity of supply - time element in the determination of value - market price and normal price - perfect competition - monopoly - monopolistic competition

Module III (13 hours)
Forms of business - proprietorship - partnership - joint stock company - cooperative organisation - state enterprise - mixed economy - money and banking - nature and functions of money - theory of money - inflation and deflation - banking - kinds - commercial banks - central banking functions - control of credit - monetary policy - credit instrument

Module IV (13 hours)
International trade - distinction between internal and international trade - theory of international trade - free trade v/s protection - balance of trade and balance of payments - exchange control - trade policy of the Government of India - national income - concepts - measurement - difficulties in the measurement its significant - features of underdeveloped economy with special reference to India - taxation - canons of taxation - direct and indirect tax - impact and incidence of the tax - working capital - factors affecting - sources

Reference books
5. Adhikary M., *Managerial Economics*

Sessional work assessment
2 Tests 2 x 15 = 30
2 Assignments 2 x 10 = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 702 : MACHINE TOOLS

3 hours lecture & 1 hour tutorial per week

Module I (13 hours)
Machine tool - (machine tool - fixture - job - cutting tool) system - kinematics of machine tools - job - tool relative motions - types of drives - kinematics of gear boxes - realisation of various machine tools like lathe - milling machines - grinding machines - drilling machines - shaping machines - planning machines - boring machines

Module II (13 hours)
Hydraulic circuits - components - valves - motors accumulators - characteristics of the above - operation of typical machine tools - programmed operations of hydraulically operated machine tools - control circuits and their characteristics

Module III (13 hours)
Machining operations - thread cutting - turning - facing - taper turning - form cutting with form tools - gear forming - gear shaping - gear hobbing - kinematics of gear shapes and gear hobbers - boring - boring tools - boring bars - drilling - fluted drills - deep hole drilling - grinding wheels - specification and selection of grinding wheels - types of grinding wheels suited to the types of grinding machines

Module IV (13 hours)
Special purpose machine tools - jig boring machine - superfinishing - honing - automated machines - copying operations in turning - principle of NC machining - programming numerical control machines

Reference books
1. Acherkan, Principle of Machine Tools, Vol. 1, 2, 3 & 4, Mir publishers
4. Ernst, Oil Hydraulics Power - Industrial Applications, McGraw Hill Book Company
6. Bhattacharya A., Machining Systems
7. Groover, CAD/CAM, Prentice Hall of India

Sessional work assessment
2 test  \[ 2 \times 15 = 30 \]
2 Assignment  = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 703 : INDUSTRIAL MANAGEMENT
(common with ME2K 703)

3 hours lecture & 1 hour tutorial per week

Module I (14 hours)
Management concepts - system concepts of management - management functions - planning - principles of planning - management by objectives - organizing - organization structures - principles of organizing - span of control - delegation - leadership - directing - controlling

Module II (14 hours)

Module III (12 hours)
Marketing management - concept of market and marketing - importance of marketing - marketing environment - marketing mix - marketing research - advertising and sales promotion - product life cycle

Module IV (12 hours)
Human resources management - job design - job enrichment - job enlargement - job evaluation - merit rating - wages and incentives - work study - method study - time study - work sampling - human behaviour and work environment interface

Text books
5. Bhattacharya A.K., Principles and Practice of Cost Accounting, Wheeler Publishing

Reference books

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (13 hours)

Module II (13 hours)
Processes - drawing and extrusion - process classification - lubrication - temperature effects - analysis of the processes of drawing and extrusion of wire and strip through friction less dies and dies with friction - production of seamless pipe and tubes - analysis - residual stresses in rods - wires - tubes, deep drawing

Module III (13 hours)
Classification of rolling processes - hot rolling - cold rolling - rolling of bars and shapes - analysis of rolling process in conditions of plane strain - classification of forging process - open die forging - closed die forging - analysis of forging process in conditions of plane strain - forging allowances and tolerances - sheet metal forming, shearing, blanking, bending and stretch forming

Module V (13 hours)
Slip line field theory - incompressible two-dimensional flow - slip lines - equilibrium equations referred to slip lines - Henkey's theorem - hodographs - simple slip line field analysis in extrusion - compression of block between parallel plates - strip load on semi-infinite body - lower and upper bound theorems with proofs and applications

Text books

Reference books
2. Chen W.F. & Han D.J., *Plasticity for Structural Engineers*, Springer Verlag

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
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Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 705A : COMPUTATIONAL FLUID MECHANICS
(common with ME2K 705A)

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)
Classification of partial differential equations - system of first and second-order partial differential equations - initial and boundary conditions - finite difference formulations - finite difference equations - finite difference approximation of mixed partial derivatives

Module II (12 hours)
Parabolic partial differential equations - explicit methods - implicit methods - parabolic equations in two-space dimensions - consistency, stability, and error analysis of finite difference equations - artificial viscosity

Module III (12 hours)
Elliptic equations - finite difference formulations - solution algorithms - hyperbolic equations - finite difference formulations -splitting methods - multiple-step method

Module IV (16 hours)
Scalar representation of the navier - stokes equations - model equations - numerical algorithms - incompressible navier - stokes equations - primitive variable and vorticity - stream function formulations - poisson equation for pressure - numerical algorithms - boundary conditions - staggered grid

Text book
Hoffmann Klaus A., "Computational Fluid Dynamics for Engineers - Volume I", Engineering Education System, Wichita, Kansas, USA

Reference books

Sessional work assessment
Computer run assignments = 20
Two tests = 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
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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
PM2K 705B: INDUSTRIAL PSYCHOLOGY
(common for all programmes)

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)
Introduction - psychology as a science - areas of applications - study of individual - individual differences -
study of behavior - stimulus - response behavior - heredity and environment - human mind - cognition -
character - thinking - attention - memory - emotion - traits - attitude - personality

Module II (13 hours)
Organizational behavior - definition - development - fundamental concept - nature of people - nature of
organization - an organizational behavior 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

Reference books
5. Blum M.L. & Naylor J.C., "Industrial Psychology", CBS Publisher, Horper & Row

Sessional work assessment
2 Tests 2 x 15 = 30
2 Assignments 2 x 10 = 20
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
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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
Module I (16 hours)
Definition - history and applications - propositional calculus - predicate calculus - inference rules - structures and strategies for state space search - heuristic search algorithms - heuristics in games - complexity issues - control and implementation of state space search - production systems - planning - the blackboard architecture

Module II (14 hours)
Knowledge intensive problem solving - expert system technology - rule-based expert systems - model based reasoning - case based reasoning - knowledge representation problem - reasoning with uncertain or incomplete information - statistical approach - non-monotonic systems - fuzzy sets - knowledge representation - languages - issues - network representation - conceptual graphs - structured representation

Module III (12 hours)
Languages and programming techniques for AI - overview of LISP - search - higher order functions and procedural abstractions - search strategies - pattern matching - recursion - interpreters - logic programming in LISP - streams and delayed evaluation - expert system shell in LISP - network representations and inheritance - CLOS

Module IV (10 hours)
Introduction to understanding natural language - introduction to automated reasoning - introduction to machine learning

Text book
Luger G.F. & Stubblefield W.A., Artificial Intelligence, Addison Wesley

Reference books
2. Elain Rich & Kevin Knight, Artificial Intelligence, Tata McGraw Hill
3. Tanimoto S.L., The Elements of Artificial Intelligence, Computer Science Press
4. Winston P.H., LISP, Addison Wesley

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

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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Q V - 2 questions of 15 marks each from module IV with choice to answer any one
**Module I: Ceramics - structure and properties (13 hours)**

**Module II: Ceramics - applications and processing (12 hours)**

**Module III: Polymers - structure and properties (14 hours)**

**Module IV: Polymers - applications and processing (13 hours)**

**Text book**
Callister Jr., William D., “*Materials Science and Engineering - An Introduction*”, John Wiley

**Reference books**

**Sessional work assessment**
- Two Tests = 30
- Two Assignments = 20
- Total marks = 50

**University examination pattern**
- Q I - 8 short type questions of 5 marks each, 2 from each module
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- Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
- Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
- Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 705E : INVENTORY & SUPPLY CHAIN MANAGEMENT
(common with ME2K/PE2K 705E)

3 hours lecture & 1 hour tutorial per week

Module I (12 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 (12 hours)
Sourcing and procurement - sourcing - factors in source selection - vendor rating - qualitative and quantitative methods - purchasing - objectives and procedure - purchasing systems - tender method - computer based systems/EDI - inventory concept - functions of inventory - selective inventory control techniques - structure of inventory problem - costs associated with materials management - relevant costs

Module III (14 hours)
Independent demand items - probabilistic - single order quantities - payoff matrix - incremental analysis - mathematical formulation of discrete and continuous cases - independent demand items - deterministic and dynamic - deterministic inventory models without and with backordering - sensitivity analysis - quantity discount - all units and incremental discounts

Module IV (14 hours)
Independent demand items - probabilistic and dynamic inventory models - Q and P system models - dependent demand items - deterministic models - lot sizing models - lot by lot - EOQ - part period balancing - wagner-whitin method - concept of just-in-time - kanban - introduction to distribution requirement planning

Text books

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

Sessional work assessment
2 test
2 x 15 = 30
2 Assignment
= 20
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (20 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 (10 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 (12 hours)
Process and strategies for starting a 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 (10 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

Reference books
5. Dr Patel V.G., Seven Business Crisis, Tata McGraw Hill

Sessional work assessment
Assignments  
Tests
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 any one
Q III - 2 questions of 15 marks each from module II with choice to answer any one
Q IV - 2 questions of 15 marks each from module III with choice to answer any one
Q V - 2 questions of 15 marks each from module IV with choice to answer any one
Module I (13 hours)
Introduction to dynamical systems: discrete time systems - continuous time systems - autonomous and nonautonomous systems - phase space and flows - attracting sets - concepts of stability
Equilibrium solutions: fixed points and stability of continuous - time systems - classification and stability of equilibrium solutions - fixed points of maps and their stability - local and global bifurcation of continuous systems - static and dynamic bifurcations - bifurcation of maps

Module II (13 hours)
Periodic solutions - periodic solutions of continuous - time dynamical systems - autonomous and nonautonomous systems - limit cycle - floquet theory - poincare' maps - bifurcation - symmetry breaking - cyclic fold - period doubling - transcritical and Hopf bifurcations
Quasiperiodic solutions: Poincare' maps - circle map - construction of quasiperiodic solutions

Module III (13 hours)
Chaotic solutions of maps: dynamics of logistic equation - bifurcation diagram of one-dimensional maps - feigenbaum number - Henon map
Chaotic solutions of continuous systems: Duffing's equation - Rossler equations - period doubling and intermittency mechanisms
Experimental methods in chaotic vibrations: experimental system to measure the Poincare' map of a chaotic physical system

Module IV (13 hours)
Fractals and dynamical systems: Koch curve - cantor set - fractal dimension - measures of fractal dimension - capacity dimension - correlation dimension and Information dimension - fractal dimension of strange attractors
Tools to identify and analyze motions: time history - state-space and pseudo state space - embedding dimension and time delay - Fourier spectra, Poincare' sections and maps - lyapunov exponents

Text books
3. Moon F.C., Chaotic and Fractal Dynamics, John Wiley

Reference books
1. Wiggins S., Introduction To Applied Nonlinear Dynamical Systems And Chaos, Springer Verlag
3. Peitgens, Jurgens & Saupe, Chaos and Fractals, Springer Verlag

Sessional work assessment
3 Tests 2x15 = 30
4 Assignments = 20
Total marks = 50
Note: Computer based assignments are to be included.

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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 705H : NUCLEAR ENGINEERING
(common with ME2K/PE2K 705H)

| 3 hours lecture & 1 hour tutorial per week |

Module I (13 hours)
Review of radioactive decay - binding energy and fission - nuclear cross sections - reaction rates - neutron moderation - elastic and inelastic scatterings - logarithmic energy decrement - moderating ratio and slowing down power - neutron multiplication - thermal neutron cycle - four-factor formula - criticality

Module II (13 hours)
Neutron diffusion - steady state in homogeneous reactors - boundary conditions - diffusion length - albedo concept - diffusion equation solutions with and without external sources - criticality equation - migration length - buckling - reflected reactors - heterogeneous reactors - criticality in heterogeneous reactors - multigroup diffusion theory - two group and multi group equations - iteration procedures

Module III (13 hours)
Time dependent reactor behaviour - in - hour equation - burn up and build up - temperature coefficient of reactivity - poison effects - design considerations of control requirements - control rod worth - heat transfer in reactors - thermohydraulic design - heat removal from the fuel - heat transfer coefficient - pressure calculations - core thermohydraulics

Module IV (13 hours)
Radiation shielding - dose units and calculations - safety limits - design of simple shields - safety - engineered safety features (ESF) - design basis accidents - risk analysis - fault and event trees - comparison of conventional and non-conventional power risks - nuclear energy and environment - fuel production - reactor operation - fuel reprocessing - waste disposal

Text book

Reference books

Sessional work assessment
| Two Tests | = 30 |
| Two Assignments | = 20 |
| 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 15 marks each from module I with choice to answer any one |
| Q III | 2 questions A and B of 15 marks each from module II with choice to answer any one |
| Q IV | 2 questions A and B of 15 marks each from module III with choice to answer any one |
| Q V | 2 questions A and B of 15 marks each from module IV with choice to answer any one |
I. (a) Determination of uncertainties in computed quantities such as the following
   (i) Volume of a rectangular block or cylinder computed from measurements of length, width, height and diameter
   (ii) Water power computed from measurements of density, local acceleration due to gravity, volumetric flow rate and head
   (iii) Shaft power computed from measurements of speed and torque
   (iv) Electrical power computed from measurements of “number of rotations of energymeter disk”, time taken and “energymeter constant”

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

II. Determination of bias and random error of the following instruments by calibrating them using proper standards
   (a) Load cells such as strain-gauge-load cells, strain-gauge-beam transducer etc.
   (b) Rotameter
   (c) Bourdon-tube pressure gauge
   (d) LVDT
   (e) Thermocouples
   (f) Tachometers
   (g) Constant area flow meters

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

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

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

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<tr>
<th>Sessional work assessment</th>
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<tr>
<td>Laboratory practicals and record</td>
<td>30</td>
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<tr>
<td>Test/s</td>
<td>20</td>
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<td>50</td>
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PM2K 707(P) : SEMINAR

3 hours per week

Individual students should be asked to choose a topic in any field of mechanical engineering (production & management), preferably from outside the B.Tech syllabus and give a seminar on that topic for about thirty minutes - a committee consisting of at least three faculty members (preferably specialised in different fields of mechanical engineering (production & management)) should assess the presentation of the seminars and award the marks to the students - each student should be asked to submit two copies of a write up of his seminar talk - one copy should be returned to the student after duly certifying it by the chairman of the assessment committee and the other kept in the departmental library

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The project work can be a design project - experimental project - computer oriented software project on any of the topics of mechanical engineering (production & management) interest - it can be allotted as a group project consisting of a maximum number of five students - the topic of the project for any student should be different from his/her mini project.

The assessment of all the projects should be done at the end of the seventh semester by a committee consisting of three or four faculty members specialised in the various fields of mechanical engineering (production & management) - the students will present their project work before the committee - the complete project report is not expected at the end of the seventh semester - however a three-four page typed report based on the work done should be submitted by the students to the assessment committee - the project guides will award the marks for the individual students in a project maintaining the group average fixed by the assessment committee.

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PM2K 801 : OPERATIONS MANAGEMENT  
(common with ME2K 801)

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)
Decision making - strategic and tactical decisions - strategy formulation - models of decision making -
single stage decisions under risk - incremental analysis - multi stage decision making - decision trees -
decision making under uncertainty - Baye’s decision theory - equally likely - minimax - maximum
likelihood - maximin criterion - network techniques - basic concepts - network construction - CPM and
PERT networks - algorithm for critical path - slacks and their significance - crashing - network flow
problems - the shortest route problem - minimal spanning tree problem - maximal flow in capacitated
network

Module II (12 hours)
Inventory control - functions of inventories - structure of inventory problems - relevant costs - opposing
costs - opportunity cost - selective control techniques - dynamic inventory models under certainty -
sensitivity analysis - quantity discounts - introduction to dynamic inventory models under risk - Q and P
system design

Module III (14 hours)
Production planning and control - scope and objectives - functions of PPC - product consumption cycle -
product design and development - production planning - process planning - material requirement planning -
forecasting - methods of forecasting - moving average method - single exponential smoothing - linear
regression - linear forecaster - scheduling - objectives - performance measures - priority rules - single
machine scheduling - job shop scheduling - 2 jobs N machines - flow shop scheduling - N jobs 2 machines -
N jobs 3 machines scheduling

Module IV (12 hours)
Facilities planning and design - factors influencing location - plant layout - layout design procedures -
systematic layout planning - computerised layout planning - construction algorithm ALDEP - improvement
algorithm - greedy switch and steepest descent methods - CRAFT - introduction to line balancing methods -
risk positional weight method

Text books
   Students Edition
2. Weist & Levy, A Management Guide to PERT & CPM, Prentice Hall of India
3. Starr & Miller, Inventory Control - Theory & Practice, Prentice Hall of India
4. Samuel Eilon, Production Planning & Control, Universal Book Corporation
5. Francis & White, Facility Layout & Location, Prentice Hall Inc.

Reference books
2. Biegel, Production Control, Prentice Hall of India

Sessional work assessment
Two Tests = 30
Two Assignments = 20
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (14 hours)
System concepts - systems and system environment - components of a system - discrete and continuous systems - types of system study - system analysis - system design and system postulation - system modelling - types of models - system simulation - steps in a simulation study - comparison of simulation and analytical models - Monte Carlo simulation - examples of simulation of single server, single queue systems and simple inventory systems - concepts in discrete event system simulation - event scheduling/time advance algorithm - modelling world views

Module II (12 hours)
Random number generation - techniques for generating random numbers - linear congruential method - tests for random numbers - frequency tests - the Kolmogorov-Smirnov test and the Chi-square test - random variate generation - inverse transformation method - exponential, uniform and empirical discrete and empirical continuous distributions - input modelling for simulation - data collection - identifying the distribution using histograms - parameter estimation - Chi-square goodness of fit test

Module III (13 hours)
Verification and validation of simulation models - verification of simulation models - calibration and validation of models - face validity - validation of model assumptions and validating input-output transformations - output analysis for a single model - types of simulations with respect to output analysis - measures of performance and their estimation - output analysis for terminating simulations - confidence interval estimation for a fixed number of replication - confidence intervals with specified precision - output analysis for steady-state simulations - initialization bias - replication method - sample size determination for a specified precision - batch means method

Module IV (13 hours)
Simulation modelling and analysis of manufacturing systems - objectives - performance measures - issues in simulation of manufacturing systems - simulation of simple job shop manufacturing systems - Introduction to simulation software for manufacturing applications - salient features of simulation languages such as general purpose simulation system (GPSS) and simulation language for alternative modelling (SLAM) - salient features of simulators such as WITNESS and arena

Text book

Reference books

Sessional work assessment
Two tests = 30
Two assignments = 20
Total marks = 50
University examination pattern

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Q II -  2 questions A and B of 15 marks each from module I with choice to answer any one
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Q V  - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 803 : TOOL ENGINEERING & DESIGN  
(common with ME2K 805E)

3 hours of lecture and 1 hour of tutorial per week

Module I: Design of chips forming tools (13 hours)
Single point tools - tool geometry - tool materials - milling cutters - drills & reamers - grinding wheels -
tipped tools - design of tool holders & boring bars - vibration damping of boring bars - form tools -
influence of cutting parameters on cutting force and power - cutting power estimation in turning, milling &
drilling

Module II: Press working tools (13 hours)
Power presses - die cutting operations - centre of pressure - punch & die size and press tonnage calculations -
scrap - strip layout - compound and progressive dies - die design for simple components - drawing dies -
blank development - press tonnage estimation - blank holding pressure - multiple draws - draw dies for
simple shells

Module III: Design of fixture (13 hours)
Elements of fixture - standard work holding devices - principles of location & clamping - plain &
concentric location - clamping elements - quick acting clamps - design & sketching of fixtures for milling
of simple components

Module IV: Design of jigs (13 hours)
Jigs for drilling & reaming - types of jigs - guide bushings - indexing jigs - design & sketching of Jigs for
simple jobs

Reference books
1. Bhattacharyya A., "Metal Cutting Theory & Practice", Central Book Publishers
2. ASTME, "Fundamentals of Tools Design", Prentice Hall
5. Rodin P., "Design & Production of Metal Cutting Tools", MIR Publishers
6. HMT, "Production Technology", Tata McGraw Hill

Sessional work assessment
Two tests = 30
Two assignments = 20
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one
PM2K 804 : QUALITY ENGINEERING & MANAGEMENT
(common with ME2K 805D)

3 hours lecture and 1 hour of tutorial per week

Module I (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

Module II (10 hours)

Module III (10 hours)
Customer needs and product quality - market research - product design - quality function deployment - reliability - reliability goals - failure mode, effect, and criticality analysis - design for safety - error proofing design for manufacturability - manufacturing planning for quality - quality responsibilities on the factory floor - total employee involvement and empowerment - benchmarking - continuos improvement strategies - kaizen approach

Module IV (11 hours)
Statistical tools in quality - making predictions using the normal, poisson and binomial probability distributions - statistical process control - control charts for variables - control charts for attributes - P, np, c and u charts

Module V (11 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 - dodge - romig sampling tables - ATI and AFI - introduction to life testing and reliability

Text books
4. Logothetis N., “Managing for Total Quality”, Prentice Hall of India Private Limited

Sessional work assessment
Two tests = 30
Two assignments = 20
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 15 marks each from module I with choice to answer any one
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Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Module I (13 hours)
Introduction - purpose of work holding devices - principles of jig and fixture design - construction methods and materials used - process planning and typical operation layout product considerations - pre-design analysis - product analysis - operation analysis - machine analysis - operator analysis and cost analysis - examples of pre-design analysis - principles of locating and positioning - definition of location - basic principles - methods of location - pin and button locators - plane, concentric, spherical, radial and V-locators - redundant locators

Module II (13 hours)
Design and mechanics of clamping devices - principles of clamping - standard fixture components - types of clamps - strap, swing, hinge and two-way (multiple) clamps - wedge, pinch and magnetic clamps - latch and self locking clamps - pneumatic, hydraulic and pneumo-hydraulic clamps - design considerations in work holder design and selection - design calculations of lever type clamp - hook type clamp - wedge type clamp - screw clamps - mandrels and collet - chucks - worked examples

Module III (13 hours)
Fixtures - milling fixtures - slot and key-way milling fixtures - fixture for milling flanges - straddle milling fixtures - indexing fixture - face milling fixture with equalizers - profile milling fixtures - universal fixture for profile milling - boring and lather fixtures - fixture design - examples of design and drawing of milling fixtures for machining of simple components - fixtures for inspection testing and assembly - welding fixtures - economics

Module IV (13 hours)
Drill Jigs -definition - drill guide bushings - jig feet and legs - types of drill jigs -template -vise - leaf box and tumble jigs - indexing jigs - jaw chucks - drive chucks - magnetic chucking devices -mandrels - machine vices - indexing tables and worktables - examples of design and drawing of drill jig for machining of simple components

Reference books
1. Kempster M.H.A., "An Introduction to Jig and Tool Design", ELBS
2. ASTME, Fundamentals of Tool Design, Prentice Hall
7. Cole B., "Tool Design", Taraporevala

Sessional work assessment
2 tests
2 Design and drawing assignments (one for Jig design and other for fixture design)
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
PM2K 805B : INTERNET TECHNOLOGIES
(common with AI2K/CE2K/CH2K/EC2K/EE2K/IC2K/ME2K/PE2K 805B)

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)
Computer networks and the internet - principles of application-layer protocols - HTTP - FTP - e-mail - DNS - socket programming with TCP/UDP - web servers - web pages design using HTML and XML

Module II (13 hours)
Multimedia networking - applications - streaming stored audio and video - internet telephony - RTP - scheduling and policing mechanisms - integrated services - RSVP - differentiated services - network management - the internet network management framework

Module III (14 hours)
Network security - E-mail security - privacy - S/MIME - IP security - overview - architecture - authentication - header and payload - combining security associations - key management - web security - SSL and transport layer security - SET - systems security - intruders and viruses - firewalls - design - trusted systems

Module IV (13 hours)

Text books
2. Stallings W., Cryptography and Network Security Principles and practice, Pearson Education Asia, Module III
3. Schiller J., Mobile Communications, Addison Wesley, Module IV

Reference books

Sessional work assessment
Assignments 2x10 = 20
Tests 2x15 = 30
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 any one
Q III - 2 questions of 15 marks each from module II with choice to answer any one
Q IV - 2 questions of 15 marks each from module III with choice to answer any one
Q V - 2 questions of 15 marks each from module IV with choice to answer any one
Module I (13 hours)
Introduction to artificial neural networks - biological neurons - Mc Culloch and Pitts models of neuron - types of activation function - network architectures - knowledge representation - learning process - error-correction learning - supervised learning - unsupervised learning - single unit mappings and the perceptron - perceptron convergence theorem (with out proof) - method of steepest descent - least mean square algorithms - adaline/medaline units - multilayer perceptrons - derivation of the back-propagation algorithm

Module II (13 hours)

Module III (13 hours)
Fuzzy logic - fuzzy sets - properties - operations on fuzzy sets - fuzzy relations - operations on fuzzy relations - the extension principle - fuzzy measures - membership functions - fuzzification and defuzzification methods - fuzzy controllers - Mamdani and Sugeno types - design parameters - choice of membership functions - fuzzification and defuzzification methods - applications

Module IV (13 hours)
Introduction to genetic algorithm and hybrid systems - genetic algorithms - natural evolution - properties - classification - GA features - coding - selection - reproduction - cross over and mutation operators basic GA and structure
Introduction to Hybrid systems - concept of neuro-fuzzy and neuro-genetic systems

Reference books
7. Suran Goonatilake & Sukhdev Khebbal (Eds.), “Intelligent Hybrid Systems”, John Wiley

Sessional work assessment
Test 2 x 15 = 30
Assignment 2 x 10 = 20
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
PM2K 805D : ROBOTICS
(common with PE2K 805D)

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)
Introduction to robotics - advantages and applications of robots - basic structure of robots - resolution, accuracy and repeatability - classification and basic structure of robotic system - drives, feed back devices and control systems of robots

Module II (13 hours)
Kinematic analysis and coordinate transformations - direct kinematics problem - homogeneous transformations - Denavit-Hartenberg convention - inverse manipulator kinematics - solvability - algebraic Vs geometric - examples of inverse kinematics

Module III (13 hours)
Trajectory planning - pick and place operation - continuous path control - joint interpolated trajectory and task based trajectory - task planning - robot programming methods

Module IV (13 hours)
Sensors, vision and intelligent programming - different types of sensors used in robotic applications - tractile sensors, proximity sensors, etc. - robot vision - image representation - image processing and recognition - intelligent programming - architecture of expert system - knowledge representation - semantics of expert systems

Reference books
3. Craig J.J., Introduction to Robotics, Mechanics and Control, Addison and Wesley

Sessional work assessment
Two tests = 30
Two assignments = 20
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
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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
PM2K 805E : MODERN ENGINEERING MATERIALS
(common with PE2K 805E)

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)

Module II (13 hours)

Module III (15 hours)

Module IV (13 hours)
Material selection and design considerations - materials for cylindrical shafts - automobile valve spring - material for artificial hip joint - thermal protection systems for space applications - material for integrated circuits like lead frame - die bonding and wire bonding - package encapsulation - tape automated bonding

Text & reference books

Sessional work assessment
Two tests = 30
Two assignments = 20
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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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
PM2K 805F : GLIMPSES OF WORLD THOUGHT
(common with ME2K 805F)

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)
Introduction - Ancient Period - The History of ‘ideas’ - the earliest thinkers - East and West - Ancient Indian texts - Vedas, Sutras, Sastras and Upanishads - some early Greek thinkers - Anaxagoras, Ionians - other centres of learning in the ancient world - China, Egypt, South America - Mayars, Incars - Greek and Roman schools of thought

Module II (11 hours)
Medieval ages & Renaissance - The Dark Ages - Renaissance Thinkers - Leonard, Copernicus and Kepler - art and literary movements (school of paintings and other forms of reputation) - The Philosophy of science and the development of the Scientific Method - Arts Vs. Science - the flowering of academic disciplines - the science of ‘knowledge’ - the great intellectual debates - technology and revolutions - industrial and scientific revolution

Module III: Modern period (15 hours)
The major schools of thought - positivism, nihilism, dialectical materialism - Marxism and its social, cultural and economic dimensions - revolutions in human perception - theories of human evolution - theories of human betterment - theories of social analysis (French Revolution, October Revolution) - the great inventors and discoveries and their relation to human thought (Darwin’s theory and growth of imperialism) - determinism, modernism and colonial theories.

Module IV (15 hours)
The modern era - structuralism - definition and implications in the various sciences - post-structuralism, post-modernism, Neo-Marxism and post-colonial theories - new disciplines - cognitive science - language, culture and cognition - current trends and issues - semiotics - the science of signs

Text books
1. Will Durrant, The Story of Philosophy, Washington Square
2. Will Durrant, The Pleasures Philosophy
3. Berntand Russell, History of Western Philosophy

Recommended and suggesting reading - GWT
1. Will & Ariel Durrent, The Story of Civilisation, Volume I to XII
2. Edward Gibbon, The Rise and Fall of the Roman Empire
3. Oswald Spingler, Decline of the West
4. Dr Radhakrishnan S., The Creative Life
5. Dr Radhakrishnan S., The Present Crisis of Faith
6. Dr Radhakrishnan S., Our Heritage
7. Dr Radhakrishnan S., Religion and Culture
8. Dr Radhakrishnan S., Living With A Purpose
9. Dr Radhakrishnan S., True Knowledge
10. Dr Radhakrishnan S., Towards A New World
11. Dr Radhakrishnan S., Recovery of Faith
12. Dialogues of Plato
15. Shaffer, Philosophy of Mind, Prentice Hall

Sessional work assessment
Assignments 2x10 = 20
Tests 2x15 = 30
Total marks = 50
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Module I (12 hours)
Principles of refrigeration - unit of refrigeration - capacity - coefficient of performance (COP) - refrigeration systems - Carnot refrigeration cycle - steam jet refrigeration - thermoelectric refrigeration - air refrigeration cycle - thermodynamic analysis of Bell-Coleman cycle - vapour absorption system - principle of operation of aqua - ammonia and lithium bromide - water systems - electrolux system

Module II (14 hours)
Vapour compression system - theoretical and practical cycles - simple and multipressure systems - thermodynamic analysis - refrigerants - thermodynamic - physical and chemical properties of refrigerants - selection criteria of refrigerants - compressors - reciprocating compressors - single and multistage compressors - rotary compressors - screw type and vane type compressors - hermetic - semihermetic and open compressors - condensers - water cooled and air cooled condensers - evaporative condensers - expansion devices - capillary tube - constant pressure expansion valve - thermostatic expansion valve - float valves - evaporators - natural convection and forced convection coils - flooded evaporators - direct expansion coils

Module III (14 hours)
Psychrometry - psychrometric properties and processes - determination of air entering conditioned space - air conditioning systems - summer, winter and year - central and unitary systems - Human comfort - comfort chart and limitations - effective temperature - factors governing effective temperature - design considerations - cooling load calculation - various heat sources - solar load - equipment load - infiltration air load - duct heat gain - fan load - moisture gain through permeable walls and fresh air load - design of air conditioning systems

Module IV (12 hours)
Heating systems - warm air systems - hot water systems - steam heating systems - panel and central heating systems - heat pump circuit - heat sources for heat pump - duct design - equal friction - static regain and velocity reduction methods - air distribution systems - analysis for heating and cooling systems - control systems for temperature and humidity - noise and noise control

Reference books
1. Stoecker, Refrigeration and Air Conditioning, McGraw Hill
2. Dossat, Refrigeration and Air Conditioning
4. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill
5. Norman Harris, Modern Air conditioning Practice, McGraw Hill
6. Laub, Heating and Air Conditioning of Buildings
7. Kell & Martin, Air Conditioning and Heating of Buildings

Sessional work assessment
Two tests = 30
Two assignments = 20
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
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PM2K 805H : FINANCIAL MANAGEMENT  
(common with ME2K 805H)

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)
Introduction - finance and related disciplines scope of financial management - functions - objectives of financial management - an overview on Indian financial system

Module II (15 hours)
Financial analysis - financial statement analysis - ratio analysis - statement of change in financial position - working capital basis only

Module III (13 hours)
Capital budgeting: nature - evaluation techniques - traditional technique - discounted cash flow techniques (NPV & IRR) - working capital: nature - determinants - computation of working capital

Module IV (13 hours)
Sources of corporate finance - capital market - stock exchanges - equity - debt - other financial instruments - foreign investments and financing sources - Euro currency market, Euro issues, GDR, ADR etc.

Reference books
2. Prasanna Chandra, "Financial Management", TMH
3. Shapiro A.C., "Modern Corporate Finance", Max well Macmillan

Sessional work assessment
Two assignments = 20
Two tests = 30
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 15 marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks each from module IV with choice to answer any one
Objective: At the end of this laboratory course you must be able to
1. Create and Edit solid models and working drawings
2. Perform Static and Dynamic analysis using FEM
3. Program and Simulate CNC machine tool operations
4. Program an industrial robot for simple material handling tasks
5. Demonstrate the capabilities of a CMM for quality control

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

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

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

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

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

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

Sessional work assessment
| Laboratory practical and record | = 30 |
| 2 tests | 2 x 10 = 20 |
| Total marks | = 50 |
PM2K 807(P) : PROJECT

7 hours per week

The project work started in the seventh semester will continue in this semester - the students should complete the project work in this semester and present it before the assessment committee.

The assessment committee as constituted in the seventh semester, will assess the various projects, fix the relative gradings and group average marks - the guides will award the marks for the individual students in a project maintaining the group average - each group will submit the copies of the completed project report signed by the guide (in the format prescribed by the department) to the department - the head of the department will certify the copies and return them to the students - one copy will be kept in the departmental library.

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<thead>
<tr>
<th>Sessional work assessment</th>
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<tbody>
<tr>
<td>Presentation</td>
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<tr>
<td>Report</td>
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<td>Total marks</td>
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PM2K 808(P) : VIVA VOCE

There is only university examination for this - the university will appoint examiners for conducting the viva voce examination - the examiners will ask questions from subjects studied for the B.Tech. course, mini project, project and seminar reports of the student. The relative weightage of questions shall be as follows.

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<th>Sessional work assessment</th>
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<tbody>
<tr>
<td>Subjects</td>
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<tr>
<td>Mini project</td>
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<td>Project</td>
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<td>Seminar</td>
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<td>Total marks</td>
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National Institute of Technology Calicut

Mechanical Engineering (Production & Management)