PUNJAB TECHNICAL UNIVERSITY, JALANDHAR
Study Scheme
M.Tech.(Mechanical Engg)

1st Semester

Subject Code	Title of the Subject	Teaching Load/Week			Marks		
		L	T	P/D	Theory	Sessional	Total
MME-501	Optimization Techniques	4	-	-	100	50	150
MME-503	Advance Heat & Mass Transfer	4	-	-	100	50	150
MME-505	Advance Machine Design	4	-	-	100	50	150
MME-507	Advance Manufacturing Processes	4	-	-	100	50	150
MME-509	Quality Assurance & Reliability Engg.	4	-	-	100	50	150
Total		20	-	-	500	250	750

2nd Semester

Subject Code	Title of the Subject	Teaching Load/Week			Marks		
		L	T	P/D	Theory	Sessional	Total
MME-502	Research Methodology	4	-	-	100	50	150
MME-504	Computational Fluid Dynamics	4	-	-	100	50	150
MME-506	Computer Aided Design	4	-	-	100	50	150
MME-508	Operations Management	4	-	-	100	50	150
MME-510	Mechatronics	4	-	-	100	50	150
MME-512	Project-I	1	-	4	50	50	100
Total		21	-	4	550	300	850

Study Scheme of M.Tech.(Mechanical Engg); 3rd Semester

3rd Semester

Sr. No.	Subject Code	Title of the Subject	Teaching Load/Week			Total Hrs/ week
			L	T	P/D	
1.	MME-	Elective-I	4	-	-	4
2.	MME-	Elective-II	4	-	-	4
3.	MME-511	Project-II (leading to Dissertation)	8	-	-	8
4.	MME-513	Seminar	-	-	-	-
			16			16

List of Elective Subjects

Production	Design	Thermal
MME-515 Total Quality Management	MME-539 Advanced Mechanics of Solids	MME-559 Advanced Internal Combustion Engines
MME-517 Industrial Automation	MME-541 Mechanical Vibrations	MME-561 Turbo-machinery
MME-519 Computer Aided Manufacturing	MME-543 Experimental Stress Analysis	MME-563 Refrigeration Engineering
MME-521 Machining Science	MME-545 Advanced Kinematics & Dynamics of Machines	MME-565 Air Conditioning
MME-523 Production Planning & Control	MME-547 Instrumentation	MME-567 Direct Energy Copversion
MME-527 Maintenance Engg. & Factory Planning	MME-549 Tribology	MME-569 Fluid Engineering
MME-529 Advanced Manufacturing Techniques	MME-551 Industrial Robotics	MME-571 Gas Dynamics
MME-533 Strategic Entrepreneurship	MME-553 Finite Element Methods	MME-573 Nuclear Engineering
MME-535 Computer Integrated manufacturing Systems	MME-557 Machine Vision	MME-575 Rocket & Jet Propulsion
MME-537 Supply Chain Management		MME-577 Solar Energy

MME-501 Optimization Techniques

L	T	P
4	0	0

Definition of Optimization: Meaning of Operations Research, Modeling in operation research, principles of modeling, Introduction to linear and non-linear programming problems and formulation of problems.

Linear Programming: Characteristics, Assumptions and Applications, Graphical solutions of two variables LP Problem, Linear programming in standard form, Solution of LP by Simplex (including Big M and Two phase methods) and revised Simplex methods, Special cases of LP, Duality and dual Simple method, Sensitivity analysis of LP problems.

Network Models: Transportation problem, Transshipment problem, Assignment problem, Traveling-salesman problem, Shortest route problem, Minimal spanning tree problem, Maximum flow problem.

CPM & PERT: Characteristics & uses, drawing of network, removal of redundancy in network. Computation of EOT, LOT, free slack, total slack in CPM and PERT, crashing, resource allocation

Dynamic Programming: Deterministic and Probabilistic Dynamic programming

Game theory: Two-person, Zero-sum games, Games with mixed strategies, Graphical solution, Solution by linear programming.

Non-linear Programming: Characteristics, Concepts of convexity, maxima and minima of functions of n variables using Lagrange multipliers and Kuhn-Tukker conditions, Quadratic programming , One dimensional search methods, Fibonacci and golden section method, Optimization using gradient methods for unconstrained problems.

Books Recommended:

1. Engineering Optimization Theory and Practice by S.S. Rao, New Age International
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI
3. Optimization Techniques by J.S Arora, John Wiley

MME-503 Advance Heat and Mass Transfer

L	T	P
4	0	0

Review
Review of the basic laws of conductions, radiation and convection.

Conduction
One dimensional steady state conduction with variable thermal conductivity and with internal distributed heat source, local heat source in non-adiabatic plate.
Extended surfaces-review, fins of non-uniform cross section, performance of fins (fin efficiency, thermal resistance of a fin, total surface efficiency), design consideration.
Two dimensional steady and unsteady state conduction, semi-infinite and finite flat plates; temperature field in finite cylinders and infinite semi-cylinders, numerical method, graphical method.
Unsteady state conduction; sudden changes in the surface temperatures of infinite plate, cylinders and spheres; solutions using Groeber's and Heisler's charts for plates, cylinders and spheres suddenly immersed in fluids.

Radiation
Introduction, properties and definitions, review of radiation principles (Planck's law, Kirchoff's law, Stefan Boltzman law, Lambert's cosine law).

Radiation through non-absorbing media; Hottel's method of successive reflections; Radiation through absorbing media; logarithmic decrement of radiation; apparent abosrptivity of simple shaped gas bodies; net heat exchange between surfaces separated by absorbing medium; radiation of luminous gas flames.

Convection
Heat transfer in laminar flow; free convection between parallel plates; forced internal flow through circular tubes; fully developed flow; velocity and thermal entry lengths; solutions with constant wall temperature and with constant heat flux; forced external flow over a flat plate; the two dimensional velocity and temperature boundary layer equations; Karman Pohlhousen approximate integral method.

Heat transfer in turbulent flow; eddy heat diffusivity; Reynold's analogy between skin friction and heat transfer; Von Karman integral equations, analogy between momentum and heat transfer, flow across cylinders, spheres and other bluff shapes and packed beds.

Mass Transfer
Introduction, concentration, velocities and fluxes, Fick's law of diffusion, steady state diffusion in common geometries, equimolal counter-diffusion in gases, steady state diffusion in liquids, transient mass diffusion in common geometries, mass transfer coefficient, convective mass transfer

Recommended Books:

1.	Analysis of Heat and Mass Transfer	Eckert and Drake	McGraw Hill
2.	Fundamentals of Heat Transfer	Grober, Erk and Grigul	McGraw Hill
3.	Heat Transfer	Holman J.P.	McGraw Hill
4.	Conduction Heat Transfer	Schneider	Addison Wesley
5.	Thermal Radiation	Siegel and Howel	McGraw Hill
6.	Heat, Mass and Momentum	Rohsenhow and Choi	Prentice Hall

MME-505 Advance Machine Design

L	T	P
4	0	0

Machine Design Review

Review of failure theories; designing against fatigue; cumulative damage theories; design of machine members (bolts, shafts, springs) under fatigue loading.

Contact Stresses

Hertzian contact stresses (cylindrical and spherical surfaces) and their effect on design; theory of limit design; Machinery construction principles.

Fracture and Creep

Fracture Mechanics approach to design. Causes and interpretation of failures; Creep behaviour; rupture theory; creep in high temperature low cycle fatigue; designing against creep.

Reliability

Probabilistic approach to design; reliability prediction; design for reliability.

Computer Aided Machine Design

Philosophy of Computer Aided Machine Design, Interactive design software, Basic advantages of analysis Software, Design of machine components (springs, gears, temporary fasteners, permanent fasteners, belts and ropes) through interactive programming, Introduction to FEM.

Books Recommended:

1. Machine Design by S harm a & Aggarwal
2. Machine. Design by B'ack.
3. Machine Design by Shigley
4. Machine Design by Pandya & Shah
5. Strength of Materials by Sadhu Singh

MME-507 Advance Manufacturing Processes

L	T	P
4	0	0

Introduction: Overview of general trends in Manufacturing, concept and significance of important properties related to manufacturing processes; Machinability index, Formability, weldabilty, Fluidity, dimensional accuracy, surface integrity, residual stresses, limitations of conventional manufacturing processes need and evolution of advanced manufacturing, selection and economics of manufacturing processes. (5hours)

Advanced Machining Processes: Classification, Review of conventional machining processes (2 hours), Principles, process parameters, capabilities and mechanism of material removal of Electro discharge machining, Electrochemical Machining, Laser Beam Machining, and Abrasive Flow machining, concept and need of Hybrid machining Processes (10 hours)

Advanced Welding Processes: Classification, Review of conventional welding processes (2 hours), Principles, process parameters, capabilities and theoretical considerations for Ultrasonic Welding, friction Welding, Explosion Welding, Underwater Welding, Adhesive Bonding (10 hours)

Advanced Forming Processes: Classification, Review of conventional Forming processes (2hours), concept of High Energy Rate Forming, Principles, process parameters, capabilities and theoretical considerations for Explosive Forming, Electro hydraulic Forming, Electromagnetic Forming, Super plastic forming (10 hours)

Advanced Casting processes: Classification, Review of conventional casting processes (2 hours), brief review regarding Casting of Ferrous and Non ferrous metals, Principles, process parameters, capabilities and theoretical considerations for Shell Mould Casting, Vacuum Casting, Lost Foam Casting, Investment Casting, Centrifugal Casting, concept of rapid solidification (10 hours)

Recommended books

1. Shan and Pandey Modern Machining Processes Tata Mc Hill N. Delhi
2. ASTME High Velocity Forming pf Metals PHI N. Delhi
3. Serope Kalpakjian and Steven R. Schmid Manufacturing Processes for Engg. Materials, Pearson Education
4. G.F Benedict Non Traditional manufacturing, Marcel Dekker
5. P.K Mishra, Non Conventional Machining Narosa Publishing House N. Delhi

MME-509 Quality Assurance & Reliability Engineering

L	T	P
4	0	0

1. Introduction:

Concept of quality, Need, Factor influencing quality, Types of quality, Quality control, Cost of quality control, Quality assurance, Benefits, Modern concept, Inspection and quality control, Quality characteristics, Quality circles with case study. **(6 hrs)**

2. Statistical Concepts and Control Charts:

Review of fundamental statistical concept, Frequency distribution, Central tendency, measures of dispersion, Probability distributions, statistical quality control, Theory of control charts, Control charts for variables and attributes ($\bar{x}$, R, P, np and C chart), their advantages and disadvantages, Applications. **(8 hrs)**

3. Acceptance Sampling:

Introduction, Advantages and Disadvantages, Operating Characteristics curve, Producer's and consumer's risk, Quality indices for acceptance sampling plans, Types of sampling Plans-single double sequential sampling plan, Sampling plan for variables, continuous sampling plans, Skip lot sampling plans, Chain sampling plan. **(8 hrs)**

4. Total Quality Management:

Introduction, Concept of Total quality, Quality function deployment tools for continuous quality improvement with case study, ISO 9000:2000 family of standards, Six sigma: DMAIC and its comparison with ISO system. **(8 hrs)**

5. Reliability:

Introduction, Factors effecting Reliability, Failure and its types, Failure curve, reliability and its management, MTBF, MTTF, Relationship b/w reliability failure rate and MTBF, and its characteristics, reliability predictions and analysis, System reliability analysis, Reliability test and life testing plans, Types of test, Maintainability and Availability. (**10 hrs)**

Books Recommended:

1. Statistical Quality control by R.C. Gupta.
2. Modern Methods for Quality Control and Improvement by Harrism; M. Wadsworth.
3. Statistical Quality control by E.L. Grant.
4. Reliability Mathematics by B.L. Ams Tadter.
5. Fundamental of Quality Control and Improvement by Amitava Mitra.
6. Reliability Engineering and Tero technology by A.K. Gupta.

MME: 502 RESEARCH METHODOLOGY

L	T	P
4	0	0

Nature and objectives of research Methods of Research: historical, descriptive and experimental Alternative approaches to the study of the research problem and problem formulation. Formulation of hypotheses, Feasibility, preparation and presentation of research proposal.

Introduction to statistical analysis : Probability and probability distributions; binomial, Poisson, exponential and normal distributions and their applications.

Sampling: Primary and secondary data, their collection and validation, methods of sampling: Simple random sampling, stratified random sampling and systematic sampling.

Regression and correlation analysis. Tests of significance based on normal, t and chi-square distributions. Analysis of variance.

Basic Principles of design of experiments, completely randomized and randomized block designs

Edition, tabulation & testing of hypotheses, Interpolation of results, presentation, styles for figures, tables, text, quoting of reference and bibliography. Use of software for statistical analysis like SPSS, Mini Tab or MAT Lab, Report writing, preparation of thesis, use of software like MS Office.

The course will include extensive use of software, report writing and seminars in the tutorial class.

Recommended Books

1. C.R. Kothari, Research Methodology, Wishwa Prakashan

2. P.G. Tripathi, Research Methodology, Sultan Chand & Sons, N. Delhi

3. Fisher, Design of Experiments, Hafner

4. Sadhu Singh, Research Methodology in Social Sciences, Himalya Publishers

5. Stoufferetal, Measurement & Prediction, Wiley, N. York

6. J.W. Barnes, Statistical Analysis for Engineers & Scientists, McGraw Hill, N. York

7. Donald Cooper. Business Research Methods, Tata McGraw Hill, N. Delhi

MME: 504 COMPUTATIONAL FLUID DYNAMICS

L	T	P
4	0	0

1. Introduction

History of CFD; Comparison of the three basic approaches in engineering problem solving – Analytical, Experimental and Computational Methods. Recent Advances in Computational Techniques. **(5 hrs)**

2. Problem Formulation:

The standard procedure for formulating a problem Physical and Mathematical classification of problems; Types of governing Differential equations and Boundary conditions. **(7 hrs)**

3. Methods of Discretisation:

Basics of Finite Difference Method; Finite Element Method, Finite volume Method and Spectral Method. Treatment of Boundary Condition. **(5 hrs)**

4. Numerical Solution to Heat Conduction Problems:

Steady-state Problems: (i) One-dimensional Heat Conduction Transfer through a Pin-fin (ii) Two-dimensional Conduction through a plate Unsteady-state Problem: One-dimensional Transient Heat Conduction. Explicit and Implicit Methods, Stability of numerical Methods. **(10 hrs)**

5. Numerical Solution to Fluid Flow Problems

Types of fluid flow and their governing equations; Viscous Incompressible flows Calculation of flow field using the stream function-vorticity method; Calculation of boundary layer flow over a flat plate; Numerical algorithms for solving complete Navier-Stokes equations- MAC method; SIMPLE algorithm; Project problem. **(13 hrs)**

Books Recommended:

1. Numerical Heat Transfer and Fluid Flow by Suhas V. Patankar, Taylor & Francis.
2. Computational Fluid Dynamics by J. Anderson

MME: 506 COMPUTER AIDED DESIGN

L	T	P
4	0	0

1. **Introduction:**
   Design process in general and using computers, hardware and software in CAD applications 4hrs

2. **Two Dimensional Transformations:**
   Two dimensional geometric transformations-basic transformations, concatenation, reflection, shear and transformations between coordinate systems. 4hrs

3. **Two** and **Three Dimensional Object representations:**
   Parametric representation of synthetic curves, spline representations, cubic spline interpolation methods, Bezier curves and surfaces, B spline curves and surfaces,conversion between spline representations 8hrs

4. **Representation of Solids:**
   Half spaces, boundry representation (B-rep), sweep representation, constructive solid geometry (CGS), solid manipulations. 6hrs

5. **Three Dimensional Geometric Transformations:**
   Tranformations-translation, rotation, scaling, reflections, shears, concatenation transformations 6hrs

6. **Visual Realisation:**
   Basic concepts of visual realization, hidden line removal, hidden surface removal, shading surfaces and solids 4hrs

7. **CAD Standards:** 2hrs

8. **CAD and CAM integration:** 2hrs

9. **Introduction to reverse engineering and rapid prototyping:** 3hrs

10. Practice on available CAD packages, computer programming for geometric modelling of curves, surfaces & solids, projects involving assembly and kinematics analysis of mechanisms, surface modeling in any available CAD package.
    8-12hrs

Books Recommended:

1. CAD/CAM by Groover and Zimmer, Prentice Hall
2. CAD/CAM: Theory and Practice by I. Zeid, McGraw Hill
3. Geometric Modeling by M.E. Mortenson

MME: 508 OPERATIONS MANAGEMENT

L	T	P
4	0	0

Introduction to Operation Management: Today's Global business condition, Operations strategy, forming operations strategy.

Forecasting: Demand forecasting, Qualitative forecasting methods and quantitative methods, selection of forecasting methods.

Designing and Developing Products and Services: Process Planning and Design, Major Factors affecting Process Design Decision, Types of Process Designs, Interrelationships among Product Design, Process Design and Inventory Policy, Process Design in Services.

Facility capacity and location: Facility Planning Long-Range Capacity Planning, Facility Location, Facility layout in Product & service.

Production Planning: Production – Planning Hierarchy, Aggregate Planning, Master Production Scheduling, Types of Production-Planning and control systems, Planning and control of Projects.

Maintenance: Maintenance Management, Preventive maintenance and TPM.

Quality: Managing Quality and SQC and SPC, Quality assurance, acceptance plans.

Inventory Management: Purchase system and purchase principles, stores Management, Standardization, codification and variety, MRP, Supply Chain Management.

Reference Books:

1. Production and Operation Management Chunawala & Patel Himalaya Publishers
2. Production and Materials Management Bhagde, S.D U.S.G Publishers 1995
3. Production and Inventory Control Plossl, G.W & Prentice Hall 1967 Wight, O.We
4. Operations management by heizer and render, Prentice hall 2001 6E.
5. Operations management by Norman Gaither and Greg Fraizer

MME: 510 MECHATRONICS

L	T	P
4	0	0

1. Introduction:
Definitions, trends, control systems, microprocessor / micro controller based controllers, PC based controllers, applications: SPM, robot, CNC machine, FMS, CIM. **(3 hrs)**

2. Sensor Technology:
Sensor and transducers, terminology, displacement, position, proximity - encoders, velocity - tachogenerators, force - strain gauges, pressure, temperature-thermocouples, RTDs, thermistors, light sensors - photoelectric sensors, IR sensors, sensor selection. **(4 hrs)**

3. Signal Conditioning:
Introduction, the operational amplifier, protection, filtering, Wheatstone bridge, digital signals, multiplexers, data acquisition, digital signal processing, pulse-modulation. **(3 hrs)**

4. Precision Mechanical Actuation:
Pneumatic actuation systems, electro-pneumatic actuation systems, hydraulic actuation systems, electro-hydraulic actuation systems, mechanical systems, types of motion, kinematics, inverse kinematics, timing belts, ball screw and nut, linearmotion guides, linear bearings, harmonic transmission, bearings, motor / drive selection. **(6 hrs)**

5. Electronic Devices and Circuits:
Semiconductor devices, diodes and LEDS, zener diodes and voltage regulator, inductive kick, bandwidth, frequency %& response of a measurement system, bipolar transistor circuits, amplifiers. **(4 Hrs)**

6. Electromechanical Drives:
Relays and solenoids, stepper motors, DC brushed and brushless motors, DC servo motors, AC / DC motors for non-servo motion drives, braking methods, pulse width modulated, Bipolar driver, Mosfet drives, SCR drives, variable frequency drives. **(4 hrs)**

7. Digital Electronics:
Digital logic, number systems, logic gates, Boolean algebra, Karnaugh rnaps, sequential logic. **(3 hrs)**

8. Microprocessors:
Control, microcomputerstructure, microcontrollers, digital interfacing, analog interfacing, DAC, ADC, applications. **(4 hrs)**

9. Input / Output Systems:
Interfacing, input / output ports, interface requirements, peripheral interface adapters, serial communication interface, direct memory access. **(3 hrs)**

10. Control System:
System transfer function, Laplace transformation and its applications, continuous and discrete processes, proportional control, integral control, differential control, PID control, digital controllers, control system performance, controller tuning, adaptive control, frequency response, PLC, PMC, introduction to fuzzy logic and neural networks. **(6 hrs)**

Books Recommended:

1. Understanding Electro-Mechanical Engineering - An Introduction to Mechatronics by Kamm, Prentice-Hall of India**.**
2. Computer Control of Manufacturing system by, Koren, McGraw Hill.
3. Production Systems and CIM, Groover, PHI.
4. Flexible Manufacturing systems, by Maleki, Prentice Hall.
5. Feedback Control Systems, BC. Kuo, PHI.