DAV UNIVERSITY JALANDHAR

Course Scheme & Syllabus

For

Master of Technology (Mechanical Engineering)

1st TO 4th SEMESTER
Examinations 2013–2014 Session

Syllabi Applicable For Admissions in 2013 onwards

DAV UNIVERSITY, JALANDHAR

Scheme of Courses

Master of Technology (Mechanical Engineering)

Semester 1

S.No	Paper Code	Course Title	L	T	P	Cr	A	B	C	D	E
1	MGT551	Research Methodology	3	1	0	4	25	25	25	25	**100**
2	MTH551	Numerical Analysis	4	0	0	4	25	25	25	25	**100**
3	MEC501	CAD/CAM	4	0	0	4	25	25	25	25	**100**
4	MEC502	Advance Design	4	0	0	4	25	25	25	25	**100**
5	MEC503	Metal Cutting	4	0	0	4	25	25	25	25	**100**
6	MEC511	CAD/CAM Lab	0	0	4	2	20			80	**50**
7	MEC513	Metal Cutting Lab	0	0	4	2	20			80	**50**
			19	**1**	**8**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type & Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type & Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks

L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses

Master of Technology (Mechanical Engineering)

Semester 2

S.No	Paper Code	Course Title	L	T	P	Cr	A	B	C	D	E
1	MEC551	Production Planning & Control	4	0	0	4	25	25	25	25	**100**
2	MEC552	Advance Heat Transfer	4	0	0	4	25	25	25	25	**100**
3	MEC553	Advance Operation Research	4	0	0	4	25	25	25	25	**100**
4	MEC554	Advance Materials	4	0	0	4	25	25	25	25	**100**
5	MEC555	Mechatronics	4	0	0	4	25	25	25	25	**100**
7	MEC550	Seminar	0	0	0	4	100				**100**
			20	**0**	**4**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type & Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type & Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses

Master of Technology (Mechanical Engineering)

Semester 3

S.No	Paper Code	Course Title	L	T	P	Cr	A	B	C	D	E
1		Elective -I	4	0	0	4	25	25	25	25	**100**
2		Elective -II	4	0	0	4	25	25	25	25	**100**
3		Elective -III	4	0	0	4	25	25	25	25	**100**
4	MEC600	Project	0	0	10	12	100				**300**
			20	**0**	**8**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type & Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type & Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
L: Lectures T: Tutorial P: Practical Cr: Credits

List of subjects for Elective

Group I

MEC601 Welding Technology
MEC602 Simulation of Industrial Systems
MEC603 Ergonomics
MEC604 Material Technology
MEC605 Metal Casting and Forming
MEC606 Industrial Tribology
MEC607 Quality Control and Reliability
MEC608 Non-Destructive Testing

Group II

MEC621 Renewable Energy Sources
MEC622 Advance Fluid Mechanics
MEC623 IC Engines
MEC624 Gas Turbines and Compressors
MEC625 Hydro Dynamic Machine
MEC626 Computational Fluid Dynamics
MEC627 Air Conditioning and Ventilation
MEC628 Power Plant Engineering

Scheme of Courses

Master of Technology (Mechanical Engineering)

Semester 4

S.No	Paper Code	Course Title	L	T	P	Cr	A	B	C	D	E
1	MEC700	Dissertation	0	0	0	24	100				**600**
			20	**0**	**8**	**24**					**600**

Detailed Syllabus

Course Title: Research Methodology
Course Code: MGT551

L	T	P	Credits	Marks
4	-	-	4	100

Course Objective: The course is designed to introduce the students to research methodology and application of research techniques and procedures. The primary goal of this course is to develop a sound understanding of research methods.
Learning Outcomes: The students will be able to apply the various research methods by using computerized data analysis softwares to solve the real life problems.

Unit – A

- **Introduction to Research**: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. — 2 hour
- **Defining the Research Problem**: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem — 1 hour
- **Research Design**: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, factors affecting RDs, Relation among RDs, Developing a Research Plan. — 2 hour

Unit – B

- **Sampling design and Procedures**: Sample or Census, The Sampling Design Process, A Classification of Sampling Techniques, Choosing Nonprobability Versus Probability Sampling, Uses of Non probability Versus Probability Sampling. — 2 hours
- **Measurement and Scaling**: Non-comparative Scaling Techniques, Continuous Rating Scale, Itemized Rating Scale, Non-comparative Itemized Rating Scale Decisions, Multi-item Scales, Scale Evaluation, Choosing a Scaling Technique. — 3 hours
- **Methods of Data Collection:** Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection. — 3 hours
- **Questionnaire & form design**: questionnaire & observation forms, questionnaire design process. — 2 hours

Unit – C

- **Data preparation:** editing, coding, transcribing — 1 Hours
- **Data analysis**: tests of significance based on t, f and z distribution and — 3 hours

chi-square test; cross tabulation

- **Multiple Regressio**n: Overview of Multiple Regression, Statistics Associated with Multiple Regression, Conducting Multiple Regression, Stepwise Regression, Multicollinearity — 3 hours
- **Discriminant Analysis**: Discriminant Analysis Model, Statistics Associated with Discriminant Analysis, Conducting Discriminant Analysis — 4 hours
- **Conjoint Analysis**: Basic Concepts in Conjoint Analysis, Statistics Associated with Conjoint Analysis, Conducting Conjoint Analysis, Assumptions & Limitations of Conjoint Analysis, Hybrid Conjoint Analysis — 4 hours

Unit – D

- **Multi Dimensional Scaling**: Basic Concepts in Multidimensional Scaling (MDS), Statistics Associated with MDS, Conducting Multidimensional Scaling, Selecting an MDS Procedure, Deciding on the Number of Dimensions, Labeling the Dimensions & Interpreting the Configuration, Assessing Reliability and Validity, Assumptions & Limitations of MDS, Scaling Preference Data — 3 hours
- **Correspondence Analysis**: Relationship between MDS, FA, & DA — 2 hours
- **Factor Analysis:** Factor Analysis Model, Statistics Associated with Factor Analysis, Conducting Factor Analysis, Applications of Common Factor Analysis — 3 hour
- **Cluster Analysis**: Statistics Associated with Cluster Analysis, Conducting Cluster Analysis, Applications of Non-hierarchical Clustering, Clustering Variables. — 5 hours
- **Research Report Writing**: Contents of Report, Executive Summary, Bibliography format. Presentation of Report. — 2 hour

Total 45 hours

Reference Books:

1. Bajpai Naval, *Business Research Methods*, Pearson Publications.
2. Malhotra, Naresh K. (2007), *Marketing Research: An Applied Orientation*, 5th Edition. Pearson/Prentice-Hall.
3. Proctor Tony, *Essentials of Marketing Research*, Prentice Hall, 4th Edition
4. Beri G. C., *Marketing research*, Mcgrawhill, 4th Edition
5. C.R Kothari, *Research Methodology*, New Age Publishers

Course Title: Numerical Analysis
Paper Code: MTH 551

L	T	P	Credits	Marks
4	-	-	4	100

Objective:
The aim of this course is to teach the applications of various numerical techniques for a variety of problems occurring in daily life. At the end of the course, the students will be able to do programming in MATLAB and understand the basic concepts in Numerical Analysis of differential equations.

NOTE:

- The question paperforend-semesterexamination will have a weightage of 25%. It will be of objective type. Allquestionswill becompulsory.
- Two pre-announced test will be conducted having a weightage of 25% each. Each pre-announced test will consistof 20 objective type, 5short questions/problemson the UGC-NET (objective type) pattern as well as one long answer type question. The student is expected toprovide reasoning/solution/workingfortheanswer. Thecandidateswill attemptall question. Choice will be given only in long answer type.Thequestionpaperis expected tocontainproblemstotheextent of40%of totalmarks.
- Four objective/MCQ type surprise test will be taken. Two best out of four objective/MCQ/subjective type surprise test will be considered towards final each of 12.5% weightage to the final.
- The books indicated as text-book(s) are suggestive however, any other book may be followed.

UNIT-A **15 Hours**

Approximate numbers, Significant figures, rounding off numbers. Error Absolute, Relative and percentage.

Algebraic and transcendental equations: Review of some concepts, Solution of algebraic and transcendental equations: Bisection method, RegulaFalsi, Newton Raphson, Lin Barstow's, convergence.

Systems of simultaneous Equations: Crammer's rule, Gauss elimination, Gauss Jordon method, Matrix inversion method, Iterative methods: Jacobi method and Gauss-Seidel method, partition method, Eigenvalues and Eigen vectors: Cayley Hamilton theorem, Power method for finding largest Eigen value.

UNIT –B **13 Hours**

Finite Difference Methods: Forward, Backward, Central differences, Newton's forward, backward and divided difference formulae, Gauss, Stirling, Bessel central difference formulae.

UNIT –C **14 Hours**

Numerical Differentiation and Numerical Integration: Numerical Differentiation, Trapezoidal and Simpson's one third, Simpson's three eight rule for numerical integration, adaptive integration, Taylor's series method, Euler, modified Euler method, Runge-Kutta methods, Boole, weddle rule, Double integration.

UNIT –D **14 Hours**

Ordinary and Partial Differential Equations: Solution of second and higher order differential equations, boundary value problems, Solution of partial differential equations: Laplace, Heat, Wave equation.

References:

1. K.E. Atkinson, An Introduction to Numerical Analysis, Wiley, 1989.
2. K. Eriksson, D. Estep, P. Hansbo and C. Johnson, Computational Differential Equations, Cambridge Univ. Press, Cambridge, 1996.
3. G.H. Golub and J.M. Ortega, Scientific Computing and Differential Equations: An Introduction to Numerical Methods, Academic Press, 1992.
4. S.D. Conte and Carl De Boor, Elementary Numerical Analysis, An Algorithmic Approach**,** Tata McGraw Hill, New Delhi, 1981.
5. M.K. Jain, Numerical Analysis for Scientists and Engineers, S.B.W. Publishers, Delhi, 1971.

Course Title: Computer Aided Design/ Computer Aided Manufacturing
Course Code: MEC-501
Total Lectures: 52

L	T	P	CREDITS	Marks
4	-	-	4	100

Course Objectives: Students will learn about the applications and benefits of CAD, about geometric transformation, about various curves and surfaces, about various modeling techniques and about automation & group technology.

Part –A

Introduction (4)

Introduction to CAD, Design Process, Introduction to CAM/ CIMS, Importance and Necessity of CAD, Applications of CAD. Coordinate System (WCS, UCS, SCS)

2-D Transformations (6)

Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates.

Part –B

3-D Transformations (6)

3-D scaling, shearing, rotation, reflection and translation, concatenations, concepts of hidden-line removal, shading and rendering

Wireframe Modeling (10)

Geometric Construction Models, Curve representation methods, Parametric representation of cubic splines, Bezier and B-spline curves, blending functions, trimming and segmentation of curve

Part –C

Surfaces Modeling (8)

Surface entities, Plane surface, ruled surface, polygon and quadric surface, surface of revolution, Bi-Cubic, Bezier Surface and B-Spline surfaces.

Solids Modeling (6)

Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation

Part –D

Automation and Numerical Control (6)

Introduction, fixed, programmable and flexible automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems, CAPP

Group Technology (GT) (6)

Part families, part classification and coding, methods of grouping, Machine cell design, Advantages of GT

Reference:

1. C. R. Alavala, **"CAD/CAM Concepts and Applications"**, PHI Learning , New Delhi
2. Groover and Zimmer, **"CAD/ CAM"**, Prantice Hall.
3. Zeid I., **"CAD/ CAM Theory and Practice",** McGraw Hill

4. ChirsMc Mohan & Jimmie Browne, **"CAD/CAM (Principles, Practice & Manufacturing Management)"**, Published by Addison- Wesley.

Course Title: Advance Design
Course Code: MEC-502
Total Lectures: 52

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: Students will learn about machine design, about stresses, about fracture and creep also about the use of computer in machine design.

Part - A

Design against Static Load

Modes of failure, theories of elastic failure, selection and use of failure theories, fracture mechanism, thermal stresses, and residual stresses

Design against Fluctuating Load

Stress concentration factor, reduction in stress concentration, fatigue failure, low and high cycle fatigue, cumulative damage theories.

Part - B

Contact Stresses

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

Statistical Consideration in Design

Probability distribution, design and natural tolerances, reliability, probabilistic approach to design.

Part - C

Fracture and

Fracture Mechanics approach to design. Causes and interpretation of failures;

Creep

Creep behaviour; rupture theory; creep in high temperature low cycle fatigue; designing against creep

Part - D

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

References:

1. **"Machine Design"** by V.B.Bhandari, Tata-McGraw Hill, New Delhi
2. **"Machine Design"** by Pandya &Sha Tata-McGraw Hill, New Delhi
3. **"Machine Design"** by Shigle,Tata-McGraw Hill, New Delhi

Course Title: Metal Cutting
Course Code: MEC503
Total Lectures: 52

L	T	P	Cr	Marks
4	0	0	4	100

Course Objectives: Students will learn about tool, about oblique cutting, about cutting fluids and tool failure analysis.

PART – A

Introduction (6Hours)
System of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram, Factors affecting cutting temperature, Tool wear and Tool Life.

Oblique Cutting (12 Hours)
Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co- efficent, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

PART – B

Dynamometry (6 Hours)
Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental Factors Effect Tool Forces (7 Hours)
Correlation of standard mechanized test (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

PART- C

Cutting Tool Materials (8 Hrs)
Introduction, Cutting tool materials: Plain Carbon Tool Steels, Alloy Tool Steels, HSS, Non Ferrous cast alloys (Stelities), Cemented Carbide, Ceramics and Oxides, Diamonds, CBN, UCON, Sialon.

Cutting Fluids (8 Hrs)
Cutting Fluids, Properties of Cutting Fluids, Types of Cutting Fluids, Requirement of good cutting fluid, Selection of a cutting fluid, Effect of fluids on cutting variables.

PART – D

Cutting Tool Failure Analysis (13 Hours)
Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool

life, tool life equations, (Taylor's woxen etc.) Tool life test, Machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, theory of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of Metal machining.

References:

1. Sen and Bhattacharya**, "Principles of Machine tools",** New Central Book Agency**.**
2. Brown, **"Machining of Metals";** Prentice hall.
3. Shaw**, "Principles of Metal cutting", Oxford I.B.H.**
4. Arshimov & Alekree, **"Metal cutting theory & Cutting tool design",** MIR Publications

Course Title: Computer Aided Design/ Computer Aided Manufacturing Lab
Course Code: MEC-511

L	T	P	Cr	Marks
-	-	4	2	50

The students will be required to carry out the following exercises using educational software (I-DEAS, Pro-Engineer, Solid Work etc).

1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
2. Layout drawing of a building using different layer and line colors indicating all Building details. Name the details using text commands, Make a title Block.
3. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.
4. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.
5. Draw quarter sectional isometric view of a cotter joint.
6. Draw different types of bolts and nuts with internal and external threading in Acme threading standards. Save the bolts and nuts as blocks suitable for insertion.
7. Draw 3D models by extruding simple 2D objects, dimension and name the objects.
8. Draw a spiral by extruding a circle.

Course Title: Metal Cutting Lab
Course Code: MEC-513

L	T	P	Cr	Marks
-	-	4	2	50

List of Experiments:

1. Practice on Lathe: 05 Jobs (Jobs should cover various lathe operations like centering, facing, turning, stepped turning, parting, threading, taper turning, chamfering and knurling)
2. Practice on Shaper: 01 Job (Slot cutting)
3. Practice on milling machine: 01 Job (Slot cutting)
4. Practice on Surface grinder: 01 Job (Creating Flat surface)
5. Practice on Drilling Machine: 01 Job (Marking and drilling operations)

Course Title: Production Planning and Control
Paper Code: MEC551
Total Lectures: 52

L	T	P	Cr	Marks
4	-	-	4	100

Course Objective:

1. Measure the effectiveness, identify likely areas for improvement, develop and implement improved planning and control methods for production systems.
2. Identify different strategies employed in manufacturing and service industries to plan production and control inventory.

Part-A

Introduction **(5)**

Types and characteristics of production systems,
Objective and functions of Production, Planning & Control
Place of production, planning in Engineering and manufactures organization.

Part -B

Preplanning **(7)**

Forecasting & Market Analysis. Factory Location & Layout, Equipment policy and replacement. Preplanning production Capacity planning.

Production Planning **(7)**

Aggregate Planning, MPS, Material Resource Planning, Selection of material methods, machines & manpower. Routing, Scheduling and Dispatching and its sheets & charts,
Production Line Balancing.

Part -C

Production and Inventory Control **(12)**

Progress control through records and charts. Types of inventories, Inventory Classification. Inventory Control under constraints Economic lot (batch) size. Trends in purchasing and store keeping, JIT production MRP II, Comparison of Push & Pull systems, ERP

Part -D (11)

Productivity **(6)**

Importance, Productivity patterns, Productivity measurements & ratios, Improvement-maintenance process.

Human Factors & Ergonomics **(6)**

Human abilities, Training & motivation safety programs, Workplace design & Working conditions

Reference books

1. Chunawala, Production and Operation Management, Himalaya Publication.
2. Martand Telsang, Industrial Engineering and Production Management, S Chand &

Company.
3. Eilon, Elements of Production Planning & Control.
4. Jain and Agarwal, Production Planning & Control
5. Buffa, Operations Management
6. S. Dalela, Mansoor Ali, Industrial Engineering and Management Systems, Standard Publishing Distributors.
7. Philip E Hicks, Industrial Engineering & Management –A new perspective, Mcgraw Hill

Course Title: Advanced Heat Transfer
Course Code: MEC-552
Total Lecture: 45

L	T	P	Cr	Marks
4	-	-	4	100

Objective of Course

It provides the knowledge of advanced techniques for analysis of heat transfer processes in thermal systems.

Part A

Introduction (8)

Brief Introduction to different Modes of heat transfer- Conduction- General heat conduction equation – Boundary conditions – Steady simplified heat transfer in Cartesian coordinates – Finned surfaces- 1-D Heat transfer with internal heat generation.

Part B

Transient heat conduction (10)

Lumped system analysis – Heisler charts – Semi infinite solid -Product solution- 2D – steady state heat conduction – Use of conduction shape factors-Transient heat conduction – Analytical solution- Finite Difference methods for Heat Conduction Problems- 1 D & 2 D steady state and Unsteady heat conduction – Implicit and Explicit methods.

Part C

Forced Convection (7)

Concept of boundary layer-Hydrodynamic and Thermal boundary layer concepts-Equations of Motion and Energy-Methods to determine heat transfer coefficient- Dimensional Analysis–Importance of Non–Dimensional numbers–Analogies between Heat and Momentum Transfer-External flows and integral methods for flow over a flat plate-Application of empirical relations to various geometrics.

Free convection (7)

Dimensionless parameters of free convection-An Approximate Analysis of Laminar Free Convection on Vertical Plate-Free convection on a Horizontal Plate, Cylinder and Sphere-Combined free and forced convection

Part D

Boiling and condensation (6)

Boiling curve – Correlations – Nusselt's theory of film condensation on a vertical plate Assumptions & correlations of film condensation for different geometrics

Radiation (7)

Concept of View factor- Methods of Determining View factors-Radiant heat exchange in Grey, Non- Grey bodies with Transmitting, Reflecting and Absorbing media- Specular surface, gas radiation –Radiation from flames.

References

1. Heat Transfer – Necati Ozisik ,TMH
2. Heat Transfer a basic approach – Yunus Cengel (MH)
3. Heat Transfer – Holman ,TMH
4. Heat Transfer by P.S. Ghoshdastidar (Oxford Press)
5. Heat & Mass Transfer P. K Nag(TMH)
6. Principle of Heat & Mass Transfer – Frank Kreith & Mark. Bohn

Course Title: Advance Operation Research
Paper Code: MEC553

L	T	P	Cr	Marks
4	-	-	4	100

Part-A

Linear Programming **(9)**

The Theory of simplex solution, alternative optimal solution, unbounded solutions, infeasible solutions, formulation of LP models for Production scheduling, network planning, inventory Maintenance and capital budgeting and similar industrial problems. Two phase method, revised simpler method and dual simplex method sensitivity analysis. The dual problem and its role for post optimality analysis. The transportation and assignment models. Travelling salesman model, and their industrial applications.

Part-B

Dynamic Optimisation Models **(6)**

Formulation of dynamic optimisation models for common Industrial problems. Optimisation of non-linear objective function by dynamic programming.

Non-linear Optimisation Models **(5)**

Non-linear objective queuing function of unconstrained variables, quadratic programming.

Part-C

Queues Models **(5)**

Queing with single and parallel channels with limited and unlimited service. Bulk input, bulk service, priority queue discipline.

Simulation Models **(5)**

Generation of Random number. Use of Coeff. random numbers for system simulation. Use of computers for system simulation.

Part-D

Heuristic Models **(5)**

Need for heuristic programming, examples of heuristic models for travelling salesman problems, facilities design and assembly line balancing.

Optimisation Techniques **(5)**

Introduction, theory and algorithms; classical method; non-linear optimisation, unconstrained optimisation, constrained optimisation; langrangian multiplier method.

Recommended Books:

1. Fundamental of Operation research by Ackoff & Sasieni : wiley Eastern.
2. Principles of OR with applications to managerial decisions by Wagner; Prentice Hall
3. Introduction to OR by Hillier & Lieberman Holder day.
4. Operation Research by PK Gupta & DS Hira.

Course Title: Advance Material
Course Code: MEC554
Total Lecture: 45

L	T	P	Credits	Marks
4	-	-	4	100

Course Objectives: To introduce the students with the advance material like composites, Nanomaterials and plastics and to make them familiar with recent innovation in design of these materials

Part A

Nanomaterials (10)

Carbon nanotubes, structure and properties, chemistry of carbon nanotubes, graphite whiskers, cones and polyhedral crystals, nanocrystaline diamond, carbide derived carbon nanotubes in multifunctional polymer nano composites, nanostructred materials for field emission devices, nanotextured carbons for electrochemical energy storage.

Part B

Composites (9)

Introduction, reinforcements, matrix materials, processing, interface, micromechanics, monotonic behaviour, cyclic fatigue, creep, wear, applications, shape memory alloys (SMAs), metallic foam, recemat metal foam etc.

Part C

Plastics (12)

Introduction to plastics, polymeric materials (molecular viewpoint),microstructures in polymers, mechanical properties (macro view point) chemical and physical properties (macro view point), designing with plastics, thermoplastic materials (commodity plastics), thermoplastic materials(engineering plastics), thermo set materials, elastomeric (rubber) materials, extrusion, injection moulding, blow moulding, thermoforming, rotational moulding, casting, foaming, compression moulding, transfer moulding, and related processes, radiation, finishing, adhesion and assembly operations and management, Environmental aspects of plastics.

Part D

Development of Advanced Composite Materials (7)

Micromechanical behavior of a lamina, Mechanics of materials and elasticity approach to stiffness, Comparison of approaches, Mechanics of materials approach to strength. Fatigue behavior in composites, Effect of holes in laminates, Fracture mechanics with reference to composites, transverse shear effects, Post curing shapes of un symmetric laminates, Environmental effects.

Design of Composite Materials (7)

Introduction to design of composite structures, structural design, material selection, configuration selection, laminate joints, Design requirements and design failures criteria, optimization concepts, design analysis philosophy for composite structures.

References

1. Sukh Dev Sehgal, Lindberg R.A., 'Materials, their Nature, Properties and Fabrication', S Chand
2. Polmear I. J. 'Light alloys: Metallurgy of Light Metals', 3rd Edition, Arnold,1995
3. Mechanics of Composite Materials. By Robert M Jones

Course Title: Mechatronics
Paper Code: MEC555
Total Lecture: 45

L	T	P	Credits	Marks
4	-	-	4	100

Course Objectives: To introduce the students with the sensor technology, signal conditioning, digital electronics and control systems.

Part-A

Introduction **(5)**

Definitions, trends, control systems, microprocessor / micro controller based controllers, PC based controllers, applications: SPM, robot, CNC machine, FMS, CIM.

Sensor Technology **(6)**

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.

Part-B

Signal Conditioning **(6)**

Introduction, the operational amplifier, protection, filtering, Wheatstone bridge, digital signals, multiplexers, data acquisition, digital signal processing, pulse-modulation.

Precision Mechanical Actuation **(7)**

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.

Part-C

Electromechanical Drives **(6)**

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.

Digital Electronics **(6)**

Digital logic, number systems, logic gates, Boolean algebra, Karnaugh maps, sequential logic.

Part-D

Control System **(10)**

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.

Recommended Books:

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.

Course Title: Welding Technology
Paper Code: MEC601
Total Lecture: 45

L	T	P	Credits	Marks
4	-	-	4	100

Course Objective:

1. To make familiar with different welding processes.
2. To get the knowledge of metal transfer and melting rate.

Part-A

Introduction (10)

Basic classification of welding processes, weldability, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and microstructural products in weld metal, epitaxial, cellular and dendritic solidification, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of microstructures and properties of weld metal. Heat affected zone, re-crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals.

Part -B

Welding Arc (6)

Arc efficiency, temperature distribution in the arc; arc forces, arc blow, electrical characteristics of an arc, mechanism of arc initiation and maintenance, role of electrode polarity on arc behavior and arc stability, analysis of the arc.

Coated Electrodes (6)

Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires

Part -C

Fusion Welding (6)

Manual metal arc welding (MMAW) GTAW, GMAW, FCAW and CO welding processes, plasma arc, submerged arc welding, electro gas and electro slag welding, analysis of the process.

Welding Power Sources (6)

Arc welding power sources basic charters tics of power sources for various arc welding processes, duty cycles, AC, DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems. Arc length regulation in mechanized welding processes

Part -D

Metal Transfer and Melting Rate (4)

Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

Solid State Welding **(4)**

Theory and mechanism of solid state welding. Techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding. High energy rate welding.

Welding Techniques using Radiation Energy **(4)**

Technique, scope and application of the electron beam and laser welding processes.

Reference books

2. Dr. R.S.Parmar, Welding processes & technology by Khanna Publishers.
3. Dr. R.S.Parmar, Welding Engineering & Technology by Khanna Publishers
4. S.V. Nandkarni, Modern Arc Welding Technology by Oxford & IDH publishing Co.
5. L.M. Gourd ELBS/ Edward Arnold, Principles of Welding Technology
6. Welding handbook, Vol. 1 & 2, seventh edition; American welding society.
7. Richard L. Little, Welding & Welding Technology, McGraw Hill.
8. Welding Technology by Rossi; McGraw Hill.
9. Welding Technology by Koenigsberger and Adaer; Macmillan.

Course Title: Simulation of Industrial Systems
Course Code: MEC-602
Total Lecture: 46

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: Students will learn about the basic concepts of system simulation, about the simulation of continuous, discrete and inventory systems, about the design of simulation experiments, about the PERT simulation and about the simulation languages.

Part – A

Introduction to System Simulation (6)

Introduction and overview, concept of system, system environment, elements of system, system rnodeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of Continuous Systems (5)

Characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

Part – B

Simulation of Discrete System (6)

Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variants for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models

Simulation of Queuing Systems (6)

Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance, Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi server queues, queues involving complex arrivals and service times with blanking and reneging

Part – C

Simulation of Inventory Systems (6)

Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variants, simulation of complex inventory situations.

Design of Simulation Experiments (6)

Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, regenerative technique

Part – D

Simulation of PERT **(5)**

Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages **(6)**

Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages

References:

1. Loffick, **"Simulation and Modelling",** Tata McGraw Hill
2. DeoNarsingh, **"System Simulation with Digital Computer",** Prentice Hall
3. Meelamkavil, **"Computer Simulation and Modelling",** John Willey
4. Gerden, **"System Simulation"**, Prentice Hall

Course Title: Ergonomics
Paper Code: MEC603
Total Lecture: 46

L	T	P	Cr	Marks
4	-	-	4	100

Course Objective:

- To impart the valuable skills to plan and understand work place design.
- To conduct time and motion study to improve the methods/system.
- To impart the knowledge on ergonomics to enhance productivity of the organization.

Part-A

Work Study **(2)**

Definition, objective and scope of work study. Human factor in work study. Work study and supervision, work study and worker.

Introduction to Method Study **(5)**

Definition, objective and scope of method study, activity recording and exam aids. Charts to record movements in shop operation – process charts, flow diagram, flow process charts, travel chart and multiple activity charts. (With simple problems)

Micro and Memo Motion Study **(5)**

Charts to record movements at work place – principles of motion economy, Therbligs and classification of movements, Two Handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method, brief concept about synthetic motion studies.

Part -B

Introduction to Work Measurement **(2)**

Definition, objective and benefit of work measurement.

Work Measurement Techniques **(10)**

Work sampling, need, confidence levels, sample size determinations, random observation, and conducting study with the simple problems.

Stop Watch Time Study: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors affecting rate of working, allowances and standard time determination.

Predetermined Motion Time Study (PMTS)
Method Time Measurement (MTM)

Part -C

Ergonomics **(4)**

Introduction, Areas of study under Ergonomics, System approach to Ergonomics model, Man-Machine System. Components of Man Machine System and Their functions – Work capabilities of Industrial Worker, Design of work space, chair table.

Controls **(4)**

Hand controls and foot controls, location of controls and work place envelope. Recommendation about hand and foot push buttons, rotary selector switches, hand wheels, crank levers etc. Instruments and displays.

Work Load **(4)**

Static and dynamic muscular work. Human motor activity, metabolism, physical work load, measurement of physical work load, mental work load, measurement of mental work load, repetitive and inspection work, work duration and rest pauses, principles of motion economy

Part-D

Climat **(2)**

Heat Humidity: Body heat balance, effective temperature scales, zones of discomfort, effect of heat on body and work performance.

Vibration **(5)**

Terminology, Response of body to low frequency (LF) vibration, vibrations and discomfort, effect on health of worker, high frequency vibration, effect of H.F. vibrations, methods of reducing vibrations, analysis.

Noise **(5)**

Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent thresh hold shift, effect of noise on performance, reduction of noise, personal noise protection. Analysis.

Reference books

1. S. Dalela, Mansoor Ali, Industrial Engineering and Management Systems, Standard Publishing Distributors.
2. Introduction to Work Study : International Labour Organization Geneva
3. Ralph M Barnes, Motion and Time study, John Wiley - 8th Edition, 1985.
4. S Sanders and E J McCormick, Human Factors in Engineering Design, McGraw Hill - 6thEdition.
5. Industrial Engineering Hand book - Maynard.
6. Engineered work Measurement– Wledon - ELBS - 1991.
7. Shah, H.S., Work study and Ergonomics, Dhanpat Rai & Sons-1992.
8. Bridger, Introduction of Ergonomics, Tata McGraw Hill-1995.
9. Lyle, F. Yerges, Sound, Noise and Vibration Control, Van Nostrand-1978.

Course Title: Material Technology
Paper Code: MEC604
Total Lecture: 46

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: To introduce the students with the material properties, about modern metallic and non-metallic materials and material selection

Part-A

Material Properties

Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material

Part-B

Fracture

Griffth's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson–Miller parameter, Deformation and Fracture mechanism maps.

Fatigue Analysis

Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

Part-C

Material Selection

Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto , Marine, Machinery and Nuclear Applications.

Part-D

Modern Metallic Materials

Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

Nonmetallic Materials

Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, A12 O3, SiC, Si3 N4, CBN and Diamond–properties, Processing and applications.

References

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2nd Edition/2000

2. Mechanical Metallurgy/George E. Dicter/McGraw Hill, 1998.
3. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
4. Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson
5. Material Science and Engineering/William D Callister/John Wiley and Sons

Course Title: Metal Casting and Forming
Course Code: MEC- 605
Total Lecture: 45

L	T	P	Cr	Marks
4	-	-	4	100

Part – A

Introduction (3)

General, Classification of manufacturing processes, various kinds of Production System, Computers in manufacturing, Selection of manufacturing process.

Casting and Moulding Methods (7)

Introduction, advantages, limitations and applications of casting process, Classification of casting process, Steps involved in casting, Pattern types, Allowances for pattern, pattern, materials, color coding and storing of patterns. Molding methods and Processes, Moulding materials, Molding sands and its ingredients, Properties of moulding sand, Cores, Sand casting defects, Design of castings.

Part – B

Sand Castings Processes and their Inspection (6)

Pressure die casting, Permanent mould casting, Centrifugal casting, Precision investment casting and its types, Cleaning and finishing of casting, Inspection and testing of casting, Defects in castings.

Foundry Melting Furnaces (4)

Selection of furnace-crucibles oil fired furnaces, electric furnacescupola, calculation of cupola charges, hot blast, cupola-Degasifications, inoculation-pouring equipment, Inspection of castings. Need-Areas for mechanization-Typical layout-sand reclamation techniques-material handling, pollution control in Foundry, Computers in casting process.

Part – C

Forming (7)

Metallurgical aspects of metal forming slip, twining mechanics of plastic deformation effects of temperature, strain rate-microstructure and friction in metal forming, yield criteria and their significance-classification of metal forming processes. Principle classification equipment, tooling processes, parameters and calculation of forces during forging and rolling processes, Ring compression tests, Post forming heat treatment, Defects (cause and remedy) applications. Classification of extrusion processes, tool, equipment and principle of these processes, influence of friction, Extrusion force calculation, Defects and analysis: Rod/wire drawing-tool, equipment and principle of processes defects, Tube drawing and sinking processes-Mannessmann processes of seamless pipe manufacturing.

Part-D

Classification of forming process (4)

Classification conventional and HERF processes Presses types and selection of presses, formability of sheet metals, Principle, process parameters, equipment and application of the following processes. Deep drawing, spinning, stretch forming, plate bending, press brake

forming, Explosive forming, electro hydraulic forming, magnetic pulse forming. Super plastic forming, electro forming-fine blanking, P/M forging-Isothermal forging-high speed, hot forging high velocity extrusion.

References:

1. Raghuwanshi B.S., **"A Course in Workshop Technology",** Vol. 1, Dhanpat Rai, 10th Edition 2009.
2. Taylor H.F., M.C &Wulff J., **"Foundry Engineering"**, Wiley Eastern Limited, 1993.
3. Lindberg R.A, **"Processes and Materials of Manufacture"**, Prentice Hall of India (P) Ltd.,1996
4. Serope Kalpak jain, **"Manufacturing engineering and Technology"**, Edition III - Addision Wesley Publishing Co., 1995.
5. William F. Hosford and Robert M. Caddel, **"Metal forming"**, PrenticeHall Publishing Co., 1990.

Course Title: Industrial Tribology
Course Code: MEC-606
Total Lecture: 45

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: the interest of students in the related topics like friction, wear and lubrication is observed to be very old. Our ancestors invented "the wheel" which can be considered as great achievement to reduce the friction and wear.

Part – A

Introduction:
Friction, wear and lubrication, types of engineering contacts: conforming and non-conforming, Types of motion: rubbing, sliding, oscillating, rolling, surface of interaction, elastic and plastic deformations, properties of materials, surface energy and flash temperature theory.

Friction:
Laws of sliding friction, concept of adhesion, Tabor's model of elastic thermo friction, rolling friction, measurement of friction

Part -B

Wear:
Laws of wear. types of wear such as adhesive, declamation, abrasive, corrosive, fretting, erosive and oxidative. Measurement of wear and friction in atmosphere and different environments, Prevention and control of wear and friction in machines, wear of cutting tools and dies, study of abrasion in grading, lapping/ honing

Lubrication:
Mechanism of lubrication, Boundary, squeeze film hydrodynamic and elasto hydrodynamic and hydrostatic lubrication, plasto hydrodynamic lubrication, solution of Reynolds's equation in two and three dimensional flow, pressure distribution load carrying capacity friction forces in oil film and coefficient of friction in journal bearing, Solid, Liquid and Gas lubricants types and their applications

Part -C

Bearing Design:
Design of bearing clearance in journal bearing, minimum film thickness, sommar field number. oil grooves and flow of oil in axial and circumferential grooves cavitation's and turbulence in oil bearings, Heat generation and cooling or bearing hydrostatic and dynamic and their applications in machine tools, Design of air bearings and other gas bearings.

Rolling Friction:
Reynold slip, Heathe cote concept selection of roller bearings and their methods of lubrication design aspects and modes of bearing failures and elasto hydrodynamic lubrication

Part -D

Tests and Instrumentation in Tribology:

Sliding friction and wear abrasion test, rolling contact and fatigue test, solid particle and erosion test, Corrosion test Special instruments for lubricant analysis such as optical and infrared spectroscopy and infra-red spectroscopy, atomic absorption and emission spectroscopy, mass spectroscopy, NMR spectroscopy, X ray diffraction and chromatographic techniques, Use of transducers and instruments in Tribology- film thickness measurement using modern techniques – Development of test rigs for Tribology research.

Recommended Books

1. Friction, Wear, Lubrication: A text book in Tribology
2. Gwidon W Stachowiah and Gwidon W Engineering Tribology.
3. Bharat Bhusan Principles and Application of Tribology
4. Khonsari and Booser Applied Tribology: Bearing Design and Lubrication.
5. SushilkumarSrivastva Tribology in Industries.
6. BC Majumdar Introduction to Tribology of Bearing.

Course Title: Quality Control and Reliability
Course Code: MEC-607
Total Lecture: 46

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: Students will learn about the concepts of quality control, about the various control charts used for quality control, about the concepts of acceptance sampling, about the reliability and its management.

Part – A

Introduction (6)

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.

Statistical Concepts and Control Charts (8)

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.

Part – B

Acceptance Sampling (10)

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.

Part – C

Total Quality Management (10)

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

Part – D

Reliability (12)

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

References:

1. Harrism; M. Wadsworth, **"Modern Methods for Quality Control and Improvement",** .
2. E.L. Grant, **"Statistical Quality control"**, .
3. B.L. AmsTadter, **"Reliability Mathematics"**, .
4. AmitavaMitra**, "Fundamental of Quality Control and Improvement"**, .
5. Ebling, **"Reliability Engineering"**, Tata McGraw Hill, New Delhi.
6. DD Sharma, **"Total Quality Control",** Tata McGraw Hill, New Delhi

Course Title: Non Destructive Testing
Course Code: MEC-608
Total Lecture: 45

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: Non-destructive testing (NDT) relates to the examination of materials for flaws without harming the object being tested. As an industrial test method, NDT provides a cost effective means of testing while protecting the object's usability for its designed purpose.

Part – A

Introduction

Classification of techniques of material testing, Need and Significance of Non Destructive Testing methods, type of Non Destructive testing methods.

Radiographic Examination

Radiant energy and radiography, practical applications, X-ray and Gamma –ray equipment, effect of variables on radiographs, requirement of a good radiograph, interpretation of radiograph, safety precautions, Xeroradiography.

Part – B

Magnaflux methods

Basic principles, scope and applications, magnetic analysis of steel bars and tubing magnetization methods, equipment, inspection medium, preparation of surfaces Fluorescent Penetration inspection, Demagnetization.

Part – C

Electrical and ultrasonic Methods:

Basic principles, flaw detection in rails and tubes (Sperry Detector), Ultrasonic testing surface roughness, moisture in wood, Detection of defects in ferrous and nonferrous metals, plastics, ceramics, measurement of thickness, hardness, stiffness, sonic material analyzer, proof tests, concrete test hammer.

Part – D

Photo elasticity

Concept and applications of Plane and circular polarization, Photo stress, models.

References:

1. H.E. Davies, G.E Troxell and GFW Hauck, The testing of Engg materials, McGraw Hill.
2. W.H Armstrong, Mechanical Inspection, McGraw Hill.

Course Title: Renewable Energy Sources
Course Code: MEC621
Total Lecture: 45

L	T	P	Cr	Marks
4	-	-	4	100

Course Objectives: Technological development depends primarily on Energy. The depletion of the conventional energy sources and the environmental problems associated with them, necessitate mankind to look for renewable energy systems. This course will expose the students and society to the renewable energy systems and thus will help in sustaining the development of the society.

Part A

Introduction **(4)**

Energy Scenario – Survey of Energy Resources – Classification – Need for Non-Conventional Energy Resources.

Solar Energy **(4)**

The Sun-Earth Relationship–Solar radiation – Attention –Radiation measuring Instruments.

Solar Energy Applications **(5)**

Solar water Heating, Space heating – Active and Passive heating – Energy storage – selective surface – solar stills and ponds – solar refrigeration – photovoltaic generation.

Part B

Wind Energy **(6)**

Wind – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coefficient – Lift machines and drag machines – matching – electricity generation..

Geothermal Energy **(6)**

Structure of Earth – Geothermal Regions – Hot springs – Hot Rocks – Hot Aquifers – Analytical Methods to estimate Thermal Potential – Harnessing Techniques – Electricity Generation Systems.

Part C

Energy from Oceans **(2)**

Tidal Energy; Tides – Diurnal and Semi – Diurnal Nature – Power from Tides

Wave Energy **(4)**

Waves – Theoretical Energy Available – Calculation of period and phase, velocity of waves wave power systems – submerged devices.

Ocean Thermal Energy **(4)**

Principles – Heat Exchangers – Pumping requirements – Practical Considerations.

Part D

Bio – Energy **(5)**

Biomass Energy Sources – Plant Productivity, Biomass Wastes – Aerobic and Anaerobic bio-conversion processes – Raw Materials and properties of Bio-gas- Bio-gas plant Technology and Status – The Energetic and Economics of Biomass systems – Biomass gasification

Direct Energy Conversion Systems **(5)**

Fuel Cells and Solar Cells–Thermionic and Thermoelectric Generation – MHD Generator-Open and Closed Systems

References:

1. Renewable Energy Resources -John Twidell&Tony Weir,Routledge Publishers
2. Biological Energy Resources - Malcolm Flesher &ChrrisLawis
3. Renewable Energy Resources – Basic Principles and Applications – G.N.Tiwari and M.K.Ghosal, Narosa Publication Ltd.,
4. Non-Conventional Energy Sources, G.D Rai, (4th ed.), Khanna Publishers, New Delhi, India (2000).
5. Non-Conventional Energy-Ashok V Desai-Wiley Eastern

Course Title: Advance Fluid Mechanics
Course Code: MEC622
Total Lecture: 45

L	T	P	CREDITS	Marks
4	-	-	4	100

Course Objectives: This course is designed to provide advanced analytical tools for analysis of fluid flow and design of flow systems.

Part A

Basic Equations **(11)**

Deformation and the rate of strain; the deformation tensor; skew-symmetry of the deformation tensor; symmetry of the stress tensor; polar and non-polar fluids; stokesian and Newtonian fluids Derivation of the general differential equations of continuity, momentum and energy in vector form; Euler and Navier-Stokes equations, integration of the momentum equation; the generalized Bernoulli's equation

Part B

Two-Dimensional Irrotational Flow **(12)**

Two dimensional flow in rectangular and polar coordinates; continuity equation and the stream function; irrotationality and the velocity potential function; vorticity and circulation; plane potential flow and the complex potential function. Sources, sinks, doublets and vortices; superposition of uniform stream with above; flow around corners; Rankine ovals; flow around circular cylinders with the without circulation; pressure distribution on the surface of these bodies. Elements of two-dimensional aerofoils theory; Joukowski transformation; circular arc, symmetrical aerofoil theory; Joukowski aerofoils; Joukowski hypothesis; lift and moment.

Part C

Three-Dimensional Irrotational Flow **(5)**

Irrotationality and the velocity potential function; symmetric flows and the Stokes stream function; sources, sinks.

Vortex Motion **(6)**

Definitions; vortex lines, surfaces and tubes; vorticity, circulation; Kelvin's circulation theorem; Helmholtz's vorticity theorems; the convection and diffusion of vorticity

Part D

Viscous Flow **(11)**

Exact solution; plane Poiselle and Couette flows; Hagen-Poiselle flow through pipes. Flows with very small Reynolds number; Flows with very large Reynolds number; elements of two dimensional boundary layer theory; displacement thickness and momentum thickness, skin friction; Blassius solution for boundary layer on a flat plate without pressure gradient; the Karman-Polhausen integral method for obtaining approximate solutions. Drag on bodies; form drag and skin friction drag profile drag and its measurement.

Refrences:

1. The Phenomena of Fluid Brodkey Addition Wesley Motion.

2. Foundation of Fluid Yuan Prentice Hall Mechanics.
3. Advanced Fluid Mechanics Raudkiri & Callander Edward Ronald.
4. Fundamentals of Mechanics Currie McGraw Hill of Fluids.
5. Fluid Mechanics Landau &Lifshitz Addition Wesley.
6. Fluid Mechanics &Som& Biswas Tata McGraw Hyde antic Machinery.

Course Title: I.C. Engines
Course Code: MEC623
Total Lecture: 45

L	T	P	CREDITS	Marks
4	-	-	4	100

Course Objectives: To make understanding of internal combustion engines with their components, and also to make students familiar with the impact of I.C. engines on environment so that they can think significant innovations in I.C. engines.

Part A

Thermodynamic Analysis of IC Engines Cycle (5)
Properties of working fluid, thermodynamic charts, unburned mixture charts, burned mixture, fuel air cycle analysis, real cycles, availability analysis of engine processes.

Gas Exchange Processes (6)
Inlet and exhaust processes in the four stroke cycle, volumetric efficiency, quasistatic and dynamic effects, flow through valves. Scavenging in the two-stroke cycle engines, scavenging parameters and models, actual scavenging processes, flow through ports. Supercharging and turbocharging, basic relationships, compressors, turbines characteristics, matching of compressor, turbines and engine characteristics.

Part B

Combustion in I.C. Engines (6)
S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.

Combustion in SI Engines (6)
Essential features of the process, thermodynamic analysis of SI engine combustion, combustion process characterization, cyclic variations in combustion

Part C

Air pollution from I.C. Engine and Its remedies (5)
Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

Pollutant formation and Control (6)
Nature and extent of problem, Nitrogen oxides. Kinetics of NO formation, NO_x formation in spark-ignition engines, NO_x formation in CI engines. Carbon monoxide, unburned hydrocarbon emissions. Particulate emissions exhaust gas treatment, catalytic

Part D

Alternate-Fuels (5)
Alcohols, Vegetable oils and bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability, Engine Modifications, Performance, Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

Recent-Trends **(6)**

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines

References

1. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
2. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India
3. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York
4. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York
5. Fundamentals of Internal Combustion Engines-H.N. Gupta, PHI, New Delhi

Course Title: Gas Turbine and Compressor
Course Code: MEC624
Total Lecture: 45

L	T	P	CREDITS	Marks
4	-	-	4	100

Course Objectives: It is intended to give a thorough understanding of gas turbines, compressors, gas turbine cycles, energy and fluid flow dynamics and power plants based on gas turbines.

Part A

Introduction **(5)**

Development, classification and field of application of gas turbines

Gas Turbine Cycle **(6)**

Ideal and actual cycles; multi-stage compression; reheating, regeneration, combined and cogeneration

Part B

Energy Transfer and Fluid Flow Characteristics **(4)**

Energy transfer between fluid and rotor; axi-symmetric flow in compressors and gas turbines

Centrifugal Compressors **(5)**

Principles of operation; compressor losses; adiabatic efficiency; slip factor; pressure coefficient; power unit; design consideration for impeller and diffuser systems; performance characteristics.

Axial Flow Compressors **(6)**

Elementary theory; vortex theory; degree of reaction; simple design; elementary air-foil theory; isolated airfoil and cascade theory; three dimensional flow; stages; stage efficiency and overall efficiency; performance characteristics.

Part C

Turbines **(10)**

Axial flow and radial flow turbines; impulse and reaction turbines; fundamental relations and velocity triangles; elementary vortex theory; limiting factors in turbine design; application of airfoil theory to the study of flow through turbine blades; aerodynamic and thermodynamic design considerations; blade materials; blade attachments and blade cooling.

Part D

Gas Turbine Power Plants **(9)**

Fuel and fuel feed systems; combustion systems-design considerations and flame stabilization; regenerator types and design; gas turbine power; plant performance and matching; applications.

References

1. “Gas Turbine Theory”, Cohen & Rogers, Longman
2. “Theory & Design of Gas Turbine and Jet Engines”, Vincent, McGraw Hill.
3. “Gas Turbine Principles and Practice”, Cox, Newnes.
4. “Jet Propulsion and Gas Turbine”, Zucrow, John Wiley.

Course Title: Hydro Dynamic Machine
Course Code: MEC625
Total Lecture: 45

L	T	P	CREDITS	Marks
4	-	-	4	100

Course Objectives: To expose students to various strategic issues related to hydro dynamic machines such as turbines, pumps etc. Being a Post graduate Course the design of these has been included.

Part A

Introduction: **(10)**

Basic fluid mechanics of turbomachiery; Eulers equation for energy conversion through rotor one-dimensional theory and its limitations; two – dimensional theory of flow through axial and radial – flow machines.

Part B

Hydrodynamic Machines-Turbines **(8)**

Classification of turbines and various forms of turbine runners. Impulse turbines; general theory of impulse machines; performance characteristics; design of runner; bucket shape and size; design of nozzles; regulation mechanisms; penstock design. Reaction turbines; general theory of reaction machines; performance characteristics;
types; Francis and Kaplan turbines;

Design Process: **(5)**

Runner design; blade design; design of the spiral casing; guide vanes and draft tube design; theory of cavitation flows in hydrodynamic runners

Part C

Hydrodynamic pumps **(7)**

Classification of pumps and various forms of pump impellers; general theory of centrifugal pumps; performance characteristics;

Design Process **(5)**

Design of casings and diffusers; cavitation effects in impellers

Part D

Hydrodynamic Transmissions **(10)**

General features; primary and secondary units of the systems; fluid couplings and torque converters; general theory; performance characteristics; basic design considerations

References:

1. Fluid Mechanics of Turbomachinery, Vol. I Wislicenus Dover.
2. Principles of Turbomachinery Shepherd Macmillan.
3. Hydraulic Turbines NechlebaArtia (Prague).
4. Centrifugal & Axial Flow pumps Stepanoff John Wiley.
5. Theory & Design of Automatic Transmission Weston Butterworths Components.

Course Title: Computational Fluid Dynamics
Course Code: MEC626
Total Lecture: 45

L	T	P	Credits	Marks
4	-	-	4	100

Course Objectives: It is intended to provide the basic tools needed for numerically solving fluid flow and heat transfer processes using computer.

Part A

Introduction: (5)

Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics

Governing Equations of Fluid Dynamics: (6)

Introduction, Control Volume, Substantial Derivative, Divergence of Velocity, Continuity Equation, Momentum Equation and Energy Equation.

Part B

Mathematical Behavior of Partial Differential Equations: (6)

Introduction, Classification of Quasi-Linear Partial Differential Equations, Eigen Value Method, Hyperbolic Equations, Parabolic Equations, Elliptic Equations.

Finite element methods:(5)

Rayleigh- Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications.

Part C

Basics Aspects of Discretization: (6)

Introduction, Introduction of Finite Differences, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, Grid Generation.

Incompressible Fluid Flow: (6)

Introduction, Implicit Crank-Nicholson Technique, Pressure Correction Method, Computation of Boundary Layer Flow.

Part D

Heat Transfer: (11)

Finite Difference Applications in Heat conduction and Convention – Heat conduction, steady heat conduction, in a rectangular geometry, transient heat conduction, Finite difference application in convective heat transfer.

REFERENCES

1. Computational fluid dynamics - Basics with applications - John. D. Anderson / McGraw Hill.
2. Computational Fluid Mechanics and Heat Transfer, Anderson, D.A.,Tannehill, I.I., and Pletcher, R.H.,Taylor and Francis
3. Numerical heat transfer and fluid flow / Suhas V. Patankar- Butter-worth Publishers
4. Fundamentals of Computational Fluid Dynamics, T. K Sengupta, University Press

Course Title: Air Conditioning and Ventilation
Course Code: MEC627
Total Lecture: 45

L	T	P	Credits	Marks
4	0	-	4	100

Course Objectives: To introduce the students the basic physiological principles, comfort charts, air conditioning systems and the design of piping and ducts.

Part A

Psychrol (6)

Goff and gratach method of calculation of moist air properties; mass transfer and evaporation of water into moist air; theory of psychrometer; correlation of w.b.t. with temperature of adiabatic saturation; Lewis number; construction of h.w. psychrometric chart

Physiological Principles (6)

Comfort; thermal interchanges with environment; physiological body regulatory processes against heat or cold; high and low temperature harards; extreme environmental conditions; heat stress index; ASHRAE comfort standards.

Part B

Simultaneous Heat and Mass Transfer (10)

Direct contact transfer equipment; simple air washer and indirect evaporative cooling contact mixture principle; enthalpy potential; basic equation for direct contact transfer equipment; graphical and analytical methods for heat and mass transfer analysis of air washers with heated and chilled water sprays; cooling towers.

Part C

Extended Surface Heat Transfer Apparatus (4)

Cooling and Dehumidifying coils, Design of finned surfaces, Adsorption cooling systems.

Ventilation (7)

Necessity; ventilation standards; natural and mechanical ventilation; forces for natural ventilation; general ventilation rules; advantages of mechanical ventilation; various methods; ejector systems; determining ventilation requirement; use of decay equation.

Part D

Air Cleaning (6)

Physical and chemical vitiation of air; permissible concentration of air contaminants; mechanical and electronic air cleaners; dry and wet filters; air sterilization; odour control

Steam Heating Systems (6)

Elements of steam, water and warm-air heating systems; radiators and convectors Design of a year-round air conditioning system. Piping and Ducts Pressure drops in piping and fittings; design of water and refrigerant piping; Air conditioning duct design methods.

References

1. Thermal Environmental Threlkeld Prentice Hall Engineering

2. ASHRAE Handbook – ASHRAE (Fundamentals)
3. Refrigeration StoeckerMcGraw Hill and Air-conditioning & Jones
4. Air-conditioning Engg Jones Arnold
5. Fundamentals of Industrial BaturinPergamon Ventilation
6. Refrigeration & Arora Tata-McGraw Hill Air conditioning

Course Title: Power Plant Engineering
Course Code: MEC628
Total Lecture: 45

L	T	P	Credits	Marks
4	0	-	4	100

Course Objectives: To introduce the students the basic physiological principles, comfort charts, air conditioning systems and the design of piping and ducts

Part-A

Introduction **(5)**

Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Hydro Electric Power Plants **(6)**

Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

Part-B

Steam Power Plants **(6)**

Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Combined Cycles **(6)**

Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

Part-C

Nuclear Power Plants **(6)**

Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

Power Plant Economics **(6)**

Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing, Problems.

Part-D

Non-Conventional Power Generation **(5)**

Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

Direct Energy Conversion Systems **(4)**

Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

Reference Books:

1. Power Plant Engg. : M.M. El-Wakil McGraw Hill 1985
2. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill Publishing Campany Ltd., New Delhi
3. Power Plant Engineering : P.K. Nag Tata McGraw Hill second Edition 2001.