Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Design/Manuf./Thermal Engineering)	Research Methods and Techniques	ME 501	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit I

An Introduction to Research Methodology: Meaning of Research*;* Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research and Scientific Method; Importance of Knowing How Research is Done; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India**[1].**

Defining the Research Problem: What is a Research Problem?; Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem; An Illustration**[1].** **(07 Hours)**

Unit II

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; Developing a Research Plan**[1].**

Sampling Design: Census and Sample Survey; Implications of a Sample Design; Steps in Sampling Design; Criteria of Selecting a Sampling Procedure; Characteristics of a Good Sample Design; Different Types of Sample Designs; How to Select a Random Sample?; Random Sample from an Infinite Universe; Complex Random Sampling Designs **[1].** **(07 Hours)**

Unit III

Measurement and Scaling Techniques: Measurement in Research; Measurement Scales; Sources of Error in Measurement; Tests of Sound Measurement; Technique of Developing Measurement Tools; Scaling; Meaning of Scaling; Scale Classification Bases; Important Scaling Techniques; Scale Construction Techniques **[1].**

Methods of Data Collection: Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Difference between Questionnaires and Schedules; Some Other Methods of Data Collection; Collection of Secondary Data; Selection of Appropriate Method for Data Collection **[1].** **(08 Hours)**

Unit IV

Processing and Analysis of Data: Processing Operations; Some Problems in Processing; Elements/Types of Analysis; Statistics in Research; Measures of Central Tendency; Measures of Dispersion; Measures of Asymmetry (Skewness); Measures of Relationship; Simple Regression Analysis; Multiple Correlation and

Regression; Partial Correlation; Association in Case of Attributes; Other Measures **[1].**

Sampling Fundamentals: Need for Sampling; Some Fundamental Definitions; Important Sampling Distributions; Central Limit Theorem; Sampling Theory; Sandler's *A*-test; Concept of Standard Error; Estimation; Estimating the Population Mean (u); Estimating Population Proportion; Sample Size and its Determination; Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level; Determination of Sample Size through the Approach Based on Bayesian Statistics **[1]. (08 Hours)**

Unit V

Testing of Hypotheses: What is a Hypothesis?; Basic Concepts Concerning Testing of Hypotheses; Procedure for Hypothesis Testing; Flow Diagram for Hypothesis Testing; Measuring the Power of a Hypothesis Test; Tests of Hypotheses; Important Parametric Tests; Hypothesis Testing of Means; Hypothesis Testing for Differences between Means; Hypothesis Testing for Comparing Two Related Samples; Hypothesis Testing of Proportions; Hypothesis Testing for Difference between Proportions; Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance; Testing the Equality of Variances of Two Normal Populations; Hypothesis Testing of Correlation Coefficients; Limitations of the Tests of Hypotheses **[1].**

Analysis of Variance and Covariance: Analysis of Variance (ANOVA); What is ANOVA?; The Basic Principle of ANOVA; ANOVA Technique; Setting up Analysis of Variance Table; Short-cut Method for One-way ANOVA; Coding Method; Two-way ANOVA; ANOVA in Latin-Square Design; Analysis of Co-variance (ANOCOVA); ANOCOVA Technique; Assumptions in ANOCOVA **[1]. (08 Hours)**

Unit VI

Interpretation and Report Writing: Meaning of Interpretation; Why Interpretation?; Technique of Interpretation; Precaution in Interpretation; Significance of Report Writing; Different Steps in Writing Report; Layout of the Research Report; Types of Reports; Oral Presentation; Mechanics of Writing a Research Report; Precautions for Writing Research Reports **[1].**

Application of results and ethics - Environmental Impacts; Ethical Issues; Ethical Committees, Commercialisation, Copy Right, Royalty; Intellectual Property Rights and Patent Law; Trade Related Aspects of Intellectual Property Rights; Reproduction of Published Material, Plagiarism, Citation and Acknowledgement, Reproducibility and accountability **[2]. (07 Hours)**

Text Books:

[1] C. R. Kothari; Research Methodology: Methods and Techniques; New Age International.

[2] B. L. Garg, R. Karadia, F. Agarwal, F. and U. K. Agarwal; An introduction to Research Methodology, RBSA Publishers.

[3] B. L. Wadehra; Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications; Universal Law Publishing.

Reference Books:

[1] S. C. Sinha and A. K. Dhiman; Research Methodology, Ess Ess Publications, 2 Volumes.

[2] W.M.K. Trochim; Research Methods: the Concise Knowledge Base, Atomic Dog Publishing.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Finite Element Methods	ME 503	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Introduction: Basic Concept; Historical Background; Engineering Applications; General Description. Introduction; Weak Formulations; Weighted Residual Methods; Variational Formulations; Weighted Residual; Collocation; Subdomain; Least Square and Galerkin's Method; Direct Method; Potential Energy Method **[1]**. **(08 Hours)**

Unit - II

One-Dimensional Analysis: Basis Steps; Discretization; Element Equations; Linear and Quadratic Shape Functions; Assembly; Local and Global Stiffness Matrix and its Properties; Boundary Conditions; Applications to Solid Mechanics; Heat and Fluid Mechanics Problems; Axisymmetric Problems **[1] [3]**. **(08 Hours)**

Unit - III

Plane Truss and Beams: Local and Global Coordinate Systems; Stress Calculations; Example Problems. Introduction; Euler-Bernoulli Beam Element; Numerical problems **[1] [2]**. **(08 Hours)**

Unit - IV

Scalar Field Problems in 2-D: Triangular and Rectangular Elements; Constant Strain Triangle; Iso-parametric Formulation; Higher Order Elements; Six Node Triangle; Nine Node Quadrilateral; Master Elements; Numerical Integration; Computer Implementation **[2]**.

(07 Hours)

Unit - V

Bending of Elastic Plates: Review of Classical Plate Theory; Plate Bending Elements; Triangular and Rectangular Elements; Shear Deformation Plate Theory; Numerical Problems **[2]**.

(07 Hours)

Unit - VI

Applications to Heat Transfer Problems: Variational Approach; Galerkin Approach; One Dimensional and Two Dimensional Steady State Problems for Conduction; One and Two Dimensional Formulation of Fin; Transient Problems **[1] [3]**. **(07 Hours)**

Text Books:

[1] An Introduction to the Finite Element Method; J.N. Reddy / Tata McGraw Hill; 3rd Ed.; 2007

[2] The Finite Element Method in Engineering – Singiresu S Rao; Elsevier Butterworth Heinemann; 4th Ed; 2005

[3] Introduction to Finite Elements in Engineering; R. Tirupathi; Chandrupatla; Ashok D. Belagundu; Prentice- Hall India; 3rd Ed; 2002.

Reference Books:

[1] Concepts and Applications of Finite Element Analysis; Robert Cook. et al.; John Wiley & Sons; 4th Ed.; 2003.

[2] Applied Finite Element; G. Ramamurthy; I K International; New Delhi; 2nd Ed; 2010.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Design Engg.)	Product Design & Development	ME 505	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Introduction to Product Design: Introduction to PDD; Applications; Relevance; Scope; Terminology; Design Definitions; The Role and Nature of Design; Old and New Design Methods; Design by Evolution; Product Development Process; Product Development Organizations; Identifying the Customer Needs; Establishing the Product Specifications; Concept Generation; Concept Selection **[1] [2]**. **(08 Hours)**

Unit - II

Product Architecture: Product Architecture; Implication of the Architecture; Establishing the Architecture; Related System Level Design Issues **[1]**.

(06 Hours)

Unit - III

Industrial and Manufacturing Design: Need for Industrial Design; Impact of Industrial Design; Industrial Design Process; Assessing the Quality of Industrial Design; Human Engineering Consideration **[1] [2]**. **(08 Hours)**

Unit - IV

Prototyping and Economic Analysis: Principles of Prototyping; Planning for Prototypes; Elements of Economic Analysis; Base Case Financial Model; Sensitivity Analysis; Influence of the Quantitative Factors **[2]**. **(08 Hours)**

Unit - V

Product Appraisal: Information and Literature Search; Patents; Standards and Codes; Environment and Safety Considerations; Existing Techniques such as Work-Study; SQC etc. which could be used to Improve Method & Quality Of Product; Innovation Versus Invention; Technological Forecasting **[1]**.

(08 Hours)

Unit - VI

Product Development Projects: Sequential; Parallel and Coupled Tasks; Baseline Project Planning; Project Budget; Project Execution; Project Evaluation **[2]**. **(07 Hours)**

Text Books:

[1] Product Design & Manufacturing; A. K. Chitab & R. C. Gupta; PHI (EEE).

[2] The Technology of Creation Thinking; R. P. Crewford – Prentice Hall.

Reference Books:

[1] Product Design and Development; Karal .T. Ulrich; Steven D. Eppinger; McGraw Hill.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Finite Element Methods Lab	ME 523	SM+ET 50+50
Semester	**Credits**	**L-T-P**	**Exam.**
I	3	1-0-3	3 Hours

Perform 10 of the Following-

1. Introduction to Commercial Software, Ansys/ABAQUS and Practice Session on Handling Assembly, Boundary Conditions etc.
2. To Learn Applying Static and Variable Loading and Boundary Conditions in FE Solvers.
3. Study of Types of Elements Used in Finite Elements Analysis and their Applications.
4. To Solve Structural Problems (*e.g.* Trusses, Beams Frames, Pressure Vessels etc.) Using Ansys/ABAQUS, Involving Deformation, Stresses.
5. To Solve Problems involving Plasticity and Fracture Using Ansys/ABAQUS.
6. To Study Buckling Behavior of Columns and Find Out Eigen Values of – Simple Materials and Composites both.
7. To Perform Vibration Analysis and Find out Natural Frequencies and Modes of Vibrations.
8. To Study Heat Transfer Problems.
9. To Perform Thermal-Displacement Coupled Problems.
10. To Study Stresses in Rotating Bodies.
11. To Study Stress Concentration and Crack Propagation Problems.
12. To Study Impact on Structures Problems.
13. To Study Coupled Friction-Heat Generation Problems.
14. Introduction to Developing Code for Finite Element Analysis in MATLAB.
15. To Develop Programs in MATLAB to Solve Typical FEA Problems.
16. To Execute a Medium Size Project.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Advance Mechanical Design	ME 507	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit – I

Design Philosophy: Design Process; Problem Formation; Introduction to Product Design; Various Design Models- Shigley Model; Asimov Model and Norton Model; Need Analysis; Strength Considerations -Standardization. Creativity; Creative Techniques; Material Selections; Notches and Stress Concentration; Design for Safety and Reliability **[2] [3]**. **(06 Hours)**

Unit – II

Economic Factors Influencing Design: Economic Analysis; Break-Even Analysis; Human Engineering Considerations; Ergonomics; Design of Controls; Design of Displays; Value Engineering; Material and Process Selection in Value Engineering; Modern Approaches in Design **[2]**. **(06 Hours)**

Unit – III

Product Design: Product Strategies; Value; Planning and Specification; Concept Generation; Concept Selection; Concept Testing **[3]**. **(05 Hours)**

Unit – IV

Design for Manufacturing: Forging Design; Casting Design; Design Process for Non Metallic Parts; Plastics; Rubber; Ceramic; Wood and Glass Parts Like; Material Selection in Machine Design **[1]**. **(07 Hours)**

Unit – V

Failure Theories: Static Failure Theories; Distortion Energy Theory; Maximum Shear Stress Theory; Coulomb-Mohr's Theory; Modified Mohr's Theory. Fatigue Failure Theory: Fracture; Fatigue Mechanisms; Fatigue Failure Models; Design for Fatigue Strength and Life. Creep: Types of Stress Variation; Design for Fluctuating Stresses; Design for Limited Cycles; Multiple Stress Cycles; Fatigue Failure Theories ;Cumulative Fatigue Damage; Thermal Fatigue and Shock; Harmful and Beneficial Residual Stresses; Yielding and Transformation **[1] [2]**.

Surface Failures: Surface Geometry; Mating Surfaces; Oil Film and Their Effects; Design Values and Procedures; Adhesive Wear; Abrasive Wear; Corrosion Wear; Surface Fatigue; Different Contacts; Dynamic Contact Stresses; Surface Fatigue Failures; Surface Fatigue Strength **[1]**. **(15 Hours)**

Unit – VI

Design of Machine Elements: Advanced Concepts for Design of Spur; Bevel; Worm and Other Types of Gear Drives; Bearings; Rotating Discs **[1] [2]**.

(06 Hours)

Text Books:

[1] Machine Design: An Integrated Approach; Robert L. Norton; Prentice-Hall New Jersey; USA.

[2] Engineering Design; George E Dieter; McGraw Hill; 2008

[3] Mechanical Engineering Design; J. E. Shigley and L.D. Mitchell; McGraw Hill International Book Company; New Delhi.

Reference Books:

[1] Product Design and Development; Karl T. Ulrich and Steven D. Eppinger; 3rd edition; Tata McGraw Hill.

[2] Product Design and Manufacturing; A. K. Chitale and R. C. Gupta; Prentice Hall.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Advance Mechanics of Solids	ME 509	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit – I

Flat Plates: Introduction to Plates as Structure; Types of Plates-Isotropic and Anisotropic; Displacement Theory for Plates; Stress-Strain-Temperature Relationship for Isotropic Elastic Plates; Strain Energy of A Plate; Boundary Conditions for Plates; Determination of Field Variable in Rectangular and Circular Plates **[1]**. **(07 Hours)**

Unit – II

Beams on Elastic Foundation: General Theory; Infinite Beam Subjected to Concentrated Load; Boundary Conditions; Infinite Beam Subjected to A Distributed Load Segment; Semi-Infinite Beam Subjected to Loads of its End; Semi-Infinite Beam with Concentrated Load Near its End; Short Beams; Thin-Wall Circular Cylinders **[1] [2]**. **(06 Hours)**

Unit – III

Torsion: Torsion of Bars Having Different Cross-Section: Circular; Rectangular; Elliptical etc. Torsion of Cylindrical Bar of Circular Cross-Section Saint-Venant's Semi-Inverse Method; Linear Elastic Solution; The Prandtl Elastic; Membrane (Soap-Film) Analogy; Narrow Rectangular Cross-Section; Hollow Thin-Wall Torsion Members: Multiply Connected Cross-Section; Thin-Wall Torsion Members With Restrained Ends; Fully Plastic Torsion **[1]**.

(08 Hours)

Unit – IV

Crack in Structure: Develop Basic Fundamental Understanding of the Effects of Crack-Like Defects on the Performance of Mechanical Engineering Structures; Selection of Appropriate Materials for Engineering Structures to Insure Damage

Tolerance; Numerical Methods to Determine Critical Crack Sizes and Fatigue Crack Propagation Rates in Engineering Structures **[2]**. **(07 Hours)**

Unit – V

Contact Stresses: Type of Contacts; Line and Point; Contact Stresses; Development of Governing Equation for Computation of Contact Stresses; Determination of Elastic Deformation at Line; Point and Rectangular Area Contacts **[1] [2]**. **(09 Hours)**

Unit – VI

Stress Concentration: Introduction to Stress Concentration; Static Stress Concentration; Dynamic Stress Concentration; Determination of Stress Concentration Factors; Measurement of Stress Concentration **[1]**. **(08 Hours)**

Text Books:

[1] Advanced Mechanics of Materials; A. P. Boresi; and O. M. Sidebottm.

[2] Advanced Mechanics of Materials; Seely and Smith.

Reference Books:

[1] Advanced Strength of Materials; S. P. Timoshenko.

[2] Advanced Strength of Materials; Den Hartog.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Design of Pressure Vessels and Piping	ME 511	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit – I

Introduction: Introduction; Stresses in a Circular Ring; Cylinder - Membrane Stress Analysis of Vessel Shell Components; Cylindrical Shells; Spherical Shells; Tori-Spherical Heads; Conical Heads; Thermal Stresses; Discontinuity Stresses in Pressure Vessels **[3]**. **(07 Hours)**

Unit – II

Buckling and Fracture in Vessels: Buckling Phenomenon; Elastic Buckling of Circular Ring and Cylinders Under External Pressure; Collapse of Thick Walled Cylinders or Tubes Under External Pressure; Effect of Supports on Elastic Buckling of Cylinders; Buckling Under Combined External Pressure and Axial Loading; Control and Significance of Fracture Mechanics in Vessels **[1] [2]**. **(06 Hours)**

Unit – III

Design of Vessels: Pressure Vessels Subjected to Internal Pressure & External Pressure; Design of Tall Cylindrical Self Supporting Process Columns; Supports for Short Vertical Vessels; Stress Concentration - at a Variable Thickness Transition Section in a Cylindrical Vessel; about a Circular Hole; Elliptical Openings; Theory Of Reinforcement - Pressure Vessel Design **[2] [3]**.

(08 Hours)

Unit – IV

Pipe Fittings: Introduction to Piping Components; Bends; Tees; Bellows and Valves. Flow Diagram; Piping Layout; General Arrangement Drawings; Preparation of Cross Sectional Drawings; Piping Isometric Drawings; Piping Material; Piping Supports; Types of Supports; Support Selection; Support Location; Support Span Charts **[1]**. **(10 Hours)**

Unit – V

Piping Design: Piping Stress Analysis; Flexibility Factor and Stress Intensification Factor; Design of Piping System as Per Standard Piping Codes **[1]**. **(07 Hours)**

Unit – VI

Maintenance Of Pressure Vessel And Piping: Health Monitoring of Pressure Vessels and Piping From Maintenance Perspective **[2]**. **(07 Hours)**

Text Books:

[1] Pressure Vessels: Design and Practice; Somnath Chattopadhyay; CRC Press.

[2] Pressure Vessel Design; Donatello Annaratone.

[3] Pressure vessel Design; J. F. Harvey; CBS Publication.

Reference Books:

[1] Pressure Vessel Design Hand Book; Henry H Bednar; CBS Publishers and Distributors.

[2] Chemical Process equipment; Selection and Design; Stanley M Wales Butterworths; Series in Chemical Engineering;1988.

[3] Approximate Methods in the Design and Analysis of Pressure Vessels and Piping; William. j.; Bees; ASME Pressure vessels and piping conference;1997.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Environmental Engineering & Pollution Control	ME 513	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 **Hours**

Unit – I

Environment: Environmental Segments; The Natural Cycles of Environment; The Hydrological Cycle; The Oxygen Cycle; The Nitrogen Cycle; The Phosphate Cycle; The Sulphur Cycle; Atmospheric Structure **[1] [2]**. **(07 Hours)**

Unit – II

Introduction To Pollution: Green House Effect; Ozone Hole; Pollution of Air; Water and Soil; Effect of Pollution on Living Systems; Minimum National Standards; Air Pollution; Sources and Classification of Pollutants; Effects of Air Pollution; Pollution From Industries; Chemical Reactions in a Contaminated Atmosphere; Urban Air Pollution; Acid Rain; Photo Chemical Smog; Meteorological Aspects of Air Pollution **[1]**. **(08 Hours)**

Unit – III

Air Pollution Sampling and Measurement: Collection of Gaseous Air Pollutants; Collection of Particulate Pollutants; Analysis of Air Pollutants; Sulphur-Dioxide; Nitrogen Oxides; Carbon Monoxide; Oxidants and Ozone; Hydro Carbons and Particulate Matter; Air Pollution Control Methods and Equipment; Control Methods; Source Correction Method; Cleaning of Gaseous Effluents; Particulate Emission Control; Control of Specific Gaseous Pollutants SO_2; Nox; Hydro Carbons; CO **[2] [3]**. **(09 Hours)**

Unit – IV

Water Pollution and Control: Origin of Waste Water; Types of Water Pollutants and their Effects; Water Pollution Laws and Standards Waste Water Sampling and Analysis; Treatment of Waste Water **[2]**. **(07 Hours)**

Unit – V

Solid Waste Management: Sources and Classification of Solid Waste Management; Public Health Aspects; Methods of Collection; Disposal Methods; Potential Methods of Disposal **[1] [2]**. **(07 Hours)**

Unit – VI

Noise Pollution: Human Acoustics; Perception of Noise; Sound and its General Features; Noise and its Measurement; Noise Pollution Hazards & Controlling Methods **[2]**. **(07 Hours)**

Text Books:

[1] Environmental Pollution Control Engineering; C. S. Rao; 2nd Edition; New age International; 2007.

[2] Air Pollution; M. N. Rao and H. V. N. Rao; 1st Edition; Tata Mc Graw Hill; 1989.

[3] Pollution Control in Process Industries; S. P. Mahajan; 1st Edition; Tata Mc Graw Hill; 1985.

Reference Books:

[1] Energy Technology; S. Rao and B. B. Parulekar; Khanna publishers; 1991.

[2] Noise Pollution; S. K. Agarwal; APH Publishing corporation; 1st Edition; 2009.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Engineering Fracture Mechanics	ME 515	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit – I

Introduction: History and Overview of Fracture Mechanics; Lefm; Griffith Energy Balance; Instability and R Curves; Stress Analysis of a Crack; Crack Tip Plasticity; Plain Strain Fracture Vs Friction; Mixed Mode Fracture ; Interaction of Multiple Crack **[2]**. **(08 Hours)**

Unit – II

Elastic Plastic Fracture Mechanics: Ctod; J Contour Integral; Relationships Between J and Ctod; Crack Growth Resistance Curves; J Controlled Fracture; Crack Tip Constraints Under Large Scale Yielding; Scaling Model for Cleavage Fracture; Limitations of Two Parameter Fracture Mechanics **[2]**. **(08 Hours)**

Unit – III

Dynamic and Time Dependent Fracture: Dynamic Fracture and Crack Arrest; Creep Crack Growth; Viscoelastic Fracture Mechanics; Transition from Linear to Nonlinear Behavior **[1]**. **(07 Hours)**

Unit – IV

Fracture Mechanics in Metals and Nonmetals: Ductile Fracture; Cleavage; Ductile- Brittle Transition; Inter-granular Fracture; Yielding and Fracture in Polymers; Fiber Reinforced Plastic; Ceramic and Ceramic Composites; Fracture Toughness Testing of Metals And Non-Metals **[1] [2]**. **(08 Hours)**

Unit – V

Fatigue Crack Propagation: Similititude in Fatigue; Crack Closure; Fatigue Threshold; Variable Amplitude Loading and Retardation; Growth of Short Crack; Micro Mechanism of Fatigue **[2] [3]**. **(07 Hours)**

Unit – VI

Computational Fracture Mechanics: Fem; Bem; Traditional Methods in Computational Fracture Mechanics; Energy Domain Integral; Mesh Design; Convergence Study **[1]**. **(07 Hours)**

Text Books:

[1] Elementary Engineering Fracture Mechanics; David and Bruck; Norelco; 1982.

[2] Fracture Mechanics Fundamentals and Applications; T. L. Anderson; 3rd edition CRC Press; 2005

[3] Fracture of Structural Materials by AS Tetelman and A. J. Mc Evily; John Wiley and Sons; 1967.

Reference Books:

[1] Elastic Plastic Fracture Mechanics; V. Z. Parton; Taylor and Francis; 1992.

[2] Deformation and Fracture Mechanics of Engineering Materials; R. W. Hertzberg; Willey Publisher; 1989.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Design of Hydraulic and Pneumatic Systems	ME 517	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit – I

Fluid Power Systems and Fundamentals: Introduction to Fluid Power; Advantages of Fluid Power; Applications of Fluid Power System. Types of Fluid Power Systems; Properties of Hydraulic Fluids – General Types of Fluids – Fluid Power Symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar And Turbulent Flow – Reynold's Number – Darcy's Equation – Losses In Pipe; Valves And Fittings **[1]**. **(08 Hours)**

Unit – II

Hydraulic System & Components: Sources of Hydraulic Power: Pumping Theory – Pump Classification – Gear Pump; Vane Pump; Piston Pump; Construction and Working of Pumps – Pump Performance – Variable Displacement Pumps; Fluid Power Actuators; Linear Hydraulic Actuators – Types Of Hydraulic Cylinders – Single Acting; Double Acting Special Cylinders Like Tanden; Rodless; Telescopic; Cushioning Mechanism; Construction of Double Acting Cylinder; Rotary Actuators – Fluid Motors; Gear; Vane and Piston Motors **[2]**. **(09 Hours)**

Unit – III

Design of Hydraulic Circuits: Construction of Control Components; Directional Control Valve – 3/2 Way Valve – 4/2 Way Valve – Shuttle Valve – Check Valve – Pressure Control Valve – Pressure Reducing Valve; Sequence Valve; Flow Control Valve – Fixed And Adjustable; Electrical Control Solenoid Valves; Relays; Ladder Diagram. Accumulators and Intensifiers: Types of Accumulators – Accumulators Circuits; Sizing of Accumulators; Intensifier – Applications of Intensifier – Intensifier Circuit **[2]**. **(08 Hours)**

Unit – IV

Pneumatic Systems and Components: Pneumatic Components: Properties of Air – Compressors – Filter; Regulator; Lubricator Unit – Air Control Valves; Quick Exhaust Valves; Pneumatic Actuators. Fluid Power Circuit Design; Speed Control Circuits; Synchronizing Circuit; Penumo Hydraulic Circuit; Sequential ircuit Design for Simple Applications Using Cascade Method **[2]**.

(07 Hours)

Unit – V

Servo Systems: Servo Systems – Hydro Mechanical Servo Systems; Electro Hydraulic Servo Systems and Proportional Valves. Fluidics – Introduction to Fluidic Devices; Simple Circuits **[1]**. **(06 Hours)**

Unit – VI

Design of Pneumatic Circuits: Introduction to Electro Hydraulic Pneumatic Logic Circuits; Ladder Diagrams; PLC Applications Fluid Power Control. Fluid Power Circuits; Failure and Troubleshooting **[1] [2]**. **(07 Hours)**

Text Books:

[1] Hydraulic and Pneumatic controls; R. Srinivasan; Vijay Nicole; 2006.

[2] Pneumatic systems – Principles and maintenance; S. R. Majumdar; Tata McGraw Hill; 1995

Reference Books:

[1] Practical guide to fluid power; L. Harry and D. B. Stevart; Taraoeala sons and Port Ltd. Broadey; 1976.

[2] Basic Fluid Power; Dudelyt A. Pease and John T. Pippenger; Prentice Hall; 1987.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Design of Automotive Components	ME 519	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit I

Introduction: Engineering Materials and their Physical Properties Applied to Design; Selection of Materials; Factor of Safety; Endurance Limit; Notch Sensitivity; Principles of Design Optimization; Future Trends; Computer Aided Drafting **[2]**. **(07 Hours)**

Unit II

Limits; Fits; Tolerances; Surface Finish; Shafts and Spring: Definitions; Types of Tolerances and Fits; Design Considerations for Interference Fits; Surface Finish; Surface Roughness; Design of Power Transmission Shafts; Design of Helical Springs **[1] [3]**. **(08 Hours)**

Unit III

Design Of Cylinder and Piston: Choice of Material for Cylinder and Piston; Piston Friction; Piston Slap; Design of Cylinder; Piston; Piston Pin; Piston Rings; Piston Failures; Lubrication of Piston Assembly **[2]**. **(07 Hours)**

Unit IV

Design of Connecting Rod; Crankshaft: Material Selection for Connecting Rod; Determining Minimum Length of Connecting Rod; Small End and Big End Design; Shank Design; Design of Big End Cap Bolts; Connecting Rod Failures; Balancing of I.C. Engines; Significance of Firing Order; Material for Crankshaft; Design of Crank Shaft Under Bending and Twisting; Balancing Weight Calculations **[1]**. **(08 Hours)**

Unit V

Design of Valves and Flywheel: Design Aspects of Intake and Exhaust Manifolds; Inlet and Exhaust Valves; Valve Springs; Tappets; Valve Train. Materials and Design of Flywheel **[2]**. **(08 Hours)**

Unit VI

Practical Aspects: Performance Comparison of Advanced Vehicles Based on a Diesels and Petrol Fuels. Environmental Issues and their Impact on Design of Engines **[2]**. **(07 Hours)**

Text Books:

[1] Machine Design; R.K. Jai; Khanna Publishers; New Delhi; 1997.

[2] Design Data Book; PSG College of Technology; Coimbatore; 2000.

[3] High Speed Combustion Engines; P.M.Heldt; Oxford-IBH Publishing Co.; Calcutta; 1965.

Reference Books:

[1] Design of Automotive Engines; A. Kolchin and V. Demidov; MIR Publishers; Moscow; 1984.

[2] Machine Design; T. V. Sundararaja Murthy; Khanna Publishers; New Delhi; 1991.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Design of Material Handling Equipments	ME 521	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Introduction: Importance of Material Handling; Principles of Material Handling System; Classification of Material Handling Equipments; Interrelationships Between Material Handling and Plant Layout; Factors Affecting for Selection; Material Handling Equation; Analysis Procedures; Analytical Techniques; Selection of Suitable Types of Systems for Applications; Activity Cost Data and Economic Analysis for Design of Components of Material Handling Systems; Functions and Parameters Affecting Service; Packing and Storage of Materials **[1]**. **(06 Hours)**

Unit - II

Design of Hoists: Drives for Hoisting; Components and Hoisting Mechanisms; Rail Traveling Components and Mechanisms; Hoisting Gear Operation During Transient Motion; Selecting the Motor Rating and Determining Breaking Torque for Hoisting Mechanisms **[1]**. **(08 Hours)**

Unit - III

Design of Cranes: Hand-Propelled and Electrically Driven E.O.T. Overheat Traveling Cranes; Traveling Mechanisms of Cantilever and Monorail Cranes; Design Considerations for Structures of Rotary Cranes with Fixed Radius ; Fixed Post and Overhead Traveling Cranes; Stability of Stationary Rotary and Traveling Rotary Cranes **[2]**. **(08 Hours)**

Unit - IV

Design of Load Lifting Attachments: Load Chains and Types of Ropes Used in Material Handling System; Forged; Standard and Ramshorn Hooks; Crane Grabs

and Clamps; Grab Buckets; Electromagnet; Design Consideration for Conveyor Belts; Application of Attachments **[1]**. **(08 Hours)**

Unit - V

Study of Systems and Equipments Used for Material Storage: Objectives of Storage; Bulk Material Handling; Gravity Flow of Solids Through Slides and Chutes; Storage in Bins and Hoppers; Belt Conveyors; Bucket-Elevators; Screw conveyors; Vibratory Conveyors; Cabin Conveyors; Mobile Racks etc **[2]**.

(07 Hours)

Unit - VI

Material Handling / Warehouse Automation and Safety Considerations: Storage and Warehouse Planning and Design; Computerized Warehouse Planning; Need; Factors and Indicators for Consideration in Warehouse Automation; Which Function, When and How to Automate; Levels and Means of Mechanizations; Safety and Design; Safety Regulations and Discipline **[1]**.

(08 Hours)

Text Books:

[1] Material Handling System Design; James M. Apple; John-Willy and Sons Publication; New York.

[2] Material Handling; John R. Immer; McGraw Hill Co. Ltd.; New York.

Reference Books:

[1] Bulk Solid Handling; C. R. Cock and J. Mason; Leonard Hill Publication Co. Ltd.; U.S.A.

[2] Material Handling Hand Book; R. A. Kulwiac; 2nd edition; John-Willy Publication; New York.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Advanced Design Lab	ME 516	SM+ET 50+50
Semester	**Credits**	**L-T-P**	**Exam.**
II	2	0-0-3	3 Hours

TESTING

Exp 1: Preparation and Study of the Micro Structure of Ferrous Metals and Alloys.

Exp 2: Preparation and Study of the Microstructure of Nonferrous Metals and Alloys.

Exp 3: Preparation and Study of the Microstructure of Composite Materials.

Exp 4: Determination of Hardness, Tensile and Impact Properties of Metals and Composites.

MODELING

Exp 5: Surface Modeling; Solid Modeling.

Exp 6: Drafting; Assembling.

ANALYSIS OF STRUCTURES USING FEA PACKAGES

Exp 7: Static Analysis; Modal Analysis and Harmonic Analysis of Structures.

Exp 8: Spectrum and Buckling Analysis of Structures.

Exp 9: Study of processing, Characterization and Analysis of Composite Materials.

Exp 10: Study of Failure and Fracture Mechanics of Metals and Composites.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Industrial Tribology	ME 502	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit – I

Introduction: Historical Background; Viscosity, Viscometry; Effect of Temperature on Viscosity; Effect of Pressure in Viscosity; Other Physical Properties of Mineral Oils; The Generalized Reynolds Equation; Flow and Shear Stress; The Energy Equation; The Equation of State; Mechanism of Pressure Development **[1] [3]**. **(04 Hours)**

Unit – II

Surface Engineering: Concept and Scope of Surface Engineering; Mathematical Modeling and Manufacturing Of Surface Layers; Three Dimensional Structures of Surface; Superficial Layer and its Parameters **[1]**.

(08 Hours)

Unit – III

Contact Mechanism: Types of Contact, Conformal and Non-Conformal: Hertizian Stresses and Elastic Deformation **[2]**. **(07 Hours)**

Unit – IV

Friction: Theory of Friction-Sliding and Rolling Friction; Friction Properties of Metallic and Non Metallic Materials; Friction in Extreme Conditions **[2]**.

(08 Hours)

Unit – V

Wear: Mechanism of Wear; Wear Resistant Materials; Mechanism and Types of Corrosion; Measurement and Testing of Friction; Wear and Corrosion; Prevention of Wear and Corrosion **[1]**. **(08 Hours)**

Unit – VI

Lubrication and Tribo-Performance Measurements: Purpose of Lubricants and Their Characteristics; Different Types of Lubricants and Their Constitutive Relations; Lubricants Standards; Lubrication Regimes; Hydrodynamic Lubrication; Reynold's Equation; Thermal, Inertia and Turbulent Effects; Elasto, Plasto and Magneto Hydrodynamic Lubrication, Hydrostatic, Gas Lubrication; Classification of Fluid Film Bearings; Design of Fluid Film Bearings; Design of Air Bearing and Gas Bearing **[3]**.

Surface Topography Measurements; Electron Microscope; Laser Method; Instrumentation; International Standards; Bearing Performance Indicators and Their Measurements; Bearings Vibration Measurement; Need; Failure Mechanism and Causes; Economics of Condition Monitoring; Condition Monitoring Methods; Vibration Monitoring; Oil Analysis; Noise and Acoustic Emission **[2] [3]**.

(10 Hours)

Text Books:

[1] Principles of Tribology; J. Halling, McMillan 1984.

[2] Friction, Wear, Lubrication: A text book in Tribology; Kenneth Ludema, CRC press,1996.

[3] Surface Engineering of Metals: Tadausz Burakowski, 1998

Reference Books:

[1] Tribology for Scientists and Engineers; Pradeep L Menezes, Edited by Michael Nosonovsky, Edited by Sudeep P Ingole, Springer-Verlag New York Inc., 07 January 2014

[2] Applied Tribology; Michael M. Khonsari, E. Richard Booser; 2nd edition, April 2008.

[3] Fundamentals of Fluid Film Lubrication; Bernard J. Hamrock; McGraw Hill, 1994.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Experimental Stress Analysis	ME 504	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam;**
II	4	3-1-0	3 Hours

Unit – I

Basic Purpose of Experimental Analysis: Strain Measurement; an Ideal Strain Gauge; Mechanical; Optical; Acoustical; Pneumatic; Dielectric and Electrical Strain Gauges; Differential Transformer and Piezoelectric Transducers **[1]**. **(06 Hours)**

Unit – II

Strain Gauges: Electrical Wire Resistance Strain Gauges; Bonded Type Gauges; Bonding Agents; Foil Gauges; Gauge Materials; Weld-able Gauges; Strain Gauge Adhesive; Fixing of Gauges; Temperature Effects in Bonded Gauges; Gauge Factor and Gauge Sensitivity; Measurement of Stress and Strain **[1] [2]**. **(08 Hours)**

Unit – III

Strain Gauge Circuits: Measuring Circuits and Strain Gauge Rosette; Potentiometer Circuit; Wheatstone Bridge; Circuit Sensitivity and Output; Temperature Compensation and Signal Addition; Rectangular; Delta and Tee-Delta Rosette; Applications of Strain Gauge in Practical Problems **[2]**.

(07 Hours)

Unit – IV

Photo Elasticity: Whole Field Methods: Photo Elasticity; Stress Loci; Isoclinics; Isostatics and Isochromatics; Stress Optic Law and Strain Optic Law; Photo-elastic Materials; Polarization of Light; Plane Polarized and Elliptically Polarized Light; Brittle Coating; Crack Pattern and Crack Detection in Coating; Moire Fringe Geometry **[3]**. **(09 Hours)**

Unit – V

Polariscope: Analysis of Photo Elasticity Data; Polariscope; Fringes Due to Principal Stress Direction and Difference; Model Making; Interpretation of Isoclinics and Isochromatics and Fractional Fringe Order; Calibration Through Tension; Beam and Disc Models; Reflection Polariscopy **[1]**.

(09 Hours)

Unit – VI

Applications and Case Studies: Applications to Stress Concentration and Stress Intensity Factor; Separation of Stresses; Applications of The Frozen-Stress Method; Scattered-Light Method **[1] [3]**. **(06 Hours)**

Text Books:

[1] Experimental Stress Analysis; J.W. Dally and W.F. Riley; McGraw Hill, 3rd Edition, March 1991.

[2] Experimental Stress Analysis; Abdul Mubeen; Dhanpat Rai and Sons, 2003.

[3] Experimental Stress Analysis and Motion Measurements; R.C. Dove and P. H. Adams; Prentice Hall, 1965.

Reference Books:

[1] Elements of Experimental Stress Analysis; A. W. Hendryn; Pergamon Press, Pergamon Press, 1977.

[2] Experimental Stress Analysis; Sadhu Singh; Khanna Publishers, 1996.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Vibration Engineering	ME 506	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit-I

Multi Degree of Freedom Systems: Free Vibration Equation of Motion; Forced Vibrations of Undamped System and Modal Analysis; Numerical Methods - (I) Rayleigh's Method, (II) Rayleigh-Ritz Method (III) Holzer's Method (IV) Methods of Matrix Iterations (V) Transfer Matrix Method, Impulse Response and Frequency Response Functions **[2]**. **(07 Hours)**

Unit-II

Vibration Continuous Systems: Free & Forced Vibrations of Prismatic Bars; Torsional Vibration of Circular Shafts; Free Lateral Vibrations of Prismatic Bar with Different End Conditions; Effects of Axial Force on Lateral Vibration of Bars; Vibration of Strings-Wave Equation Vibration of Beams with Variable Cross-Section.

Random Vibrations: Introduction to Above Types of Vibration; Random Process; Stationary; Ergoetic Random Process; Frequency Response Functions for Single; DOF System Under Random Excitation; Mean Square Value; Spectral Density; White Noise and Band-Limited White Noise **[3]**. **(11 Hours)**

Unit-III

Transient Vibrations: Response of A Single Degree of Freedom System to Step and any Arbitrary Excitation, Convolution (Duhamel's) Integral, Impulse Response Functions **[1]**.

Vibration Control: Balancing of Rotating Machine, In-Situ Balancing of Rotors; Control of Natural Frequency Introduction of Damping; Vibration Isolation and Vibration Absorbers **[1] [2]**. **(11 Hours)**

Unit-IV

Vibration Measurement: FFT Analyzer; Vibration Exciters; Signal Analysis, Time Domain and Frequency Domain Analysis of Signals; Experimental Modal Analysis; Machine Conditioning and Monitoring, Fault Diagnosis **[2]**. **(06 Hours)**

Unit-V

Non-Linear Vibrations: Introduction to Above Types of Vibration; Classification of Different Types of Non Linearties; Phase-Plan Method; for Single DOF Oscillators. Mathew's Eqn. Doffing Eqn. Jump Phenomenon; Self Excited and Parametrically Excited Vibration **[1]**. **(06 Hours)**

Unit-VI

Basics of Noise: Noise Characteristics; Sources of Noise; Noise Level Measurement Techniques; Noise Testing and Measurement; Mechanism of Noise Generation; Noise Control Methodologies **[2]**. **(04 Hours)**

Text Books:

[1] Theory of vibration & application; W. T. Thompson; PHI Pvt Ltd; New Delhi; 1979.

[2] Mechanical Vibration Analysis; F Shrinivasan; Tata McGraw Hill; New Delhi; 1982.

[3] Mechanical Vibrations, S. S. Rao, Addison-Wesley Publishing Co

Reference Books:

[1] Fundamentals of Vibration, Leonard Meirovitch, McGraw Hill International Edison.

[2] Noise; pollution & control: S. P. Singal; Narosa Publishing House; New Delhi; 2005.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing / Design Engineering)	Composite Materials and Analysis	ME 536	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit – I

Introduction: Introduction to Composites; Functions of Matrix, Reinforcement and Interface; Difference between Engineering Materials and Composites; ; Classification- Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites; Current and Potential Advantages and Applications of Composite Materials **[1, 2]. (07 hours)**

Unit – II

Fabrication Techniques for Composites: Polymer Composites; Liquid Resin Impregnation Routes; Pressurized Consolidation of Resin Pre-Pregs; Consolidation of Resin Molding Compounds; Injection Molding of Thermoplastics; Hot Press Molding of Thermoplastics; Metal Composites: Squeeze Infiltration; Stir Casting; Spray Deposition; Powder Blending and Consolidation; Diffusion Bonding of Foils; Physical Vapour Deposition (PVD)**;** Ceramic Composites: Powder-Based Routes; Reactive Processing; Layered Ceramic Composites; Carbon/Carbon Composites **[1, 2]. (08 hours)**

Unit – III

Characterization and Testing: Characterization of Constituent Materials; Physical Characterization of Composite Materials; Determination of Tensile Compressive and Shear Properties of Unidirectional Lamina; Determination of inter Laminar Fracture Toughness; Characterization of Composite with Stress Concentration **[1, 2]. (07 hours)**

Unit – IV

Mechanics of Composites: Rule of Mixture -Volume and Mass Fractions – Density - Void Content; Evaluation Of Four Elastic Moduli Based on Strength of Materials Approach and Semi-Empirical Model-Longitudinal Young's Modulus; Transverse Young's Modulus–Major Poisson's Ratio-in-Plane Shear Modulus; Ultimate Strengths of a Unidirectional Lamina; Characteristics of Fiber-Reinforced Lamina–Laminates; Lamination Theory; Inter Laminar Stresses; Micromechanics Models for Stiffness and Strength **[1, 2].**

(08 hours)

Unit – V

Macro-mechanical Behavior of a Lamina: Hooke's Law for Different Types of Materials; Anisotropic Material; Monoclinic Material; Orthotropic Material (Orthogonally Anisotropic) / Specially Orthotropic; Transversely Isotropic Material; Isotropic Material; Hooke's Law for a Two-Dimensional Unidirectional Lamina; Plane Stress Assumption; Reduction of Hooke's Law in Three Dimensions to Two Dimensions; Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina; Maximum Stress Failure Theory; Strength Ratio; Failure Envelopes; Maximum Strain Failure Theory; Tsai–Hill Failure Theory; Tsai–Wu Failure Theory **[1, 2].**

(08 hours)

Unit – VI

Analysis and Design of Laminates: Failure Criterion for a Laminate; Design of a Laminated Composite; Other Mechanical Design Issues; Sandwich Composites; Long-Term Environmental Effects; Inter Laminar Stresses; Impact Resistance; Fracture Resistance; Fatigue Resistance **[1, 2].**
(07 Hours)

Text Books:

[1] Composite Materials - Science and Engineering; Krishan K. Chawla; Springer.

[2] Composites Manufacturing Materials, Product, and Process Engineering; Sanjay K. Mazumdar; CRC Press.

Reference Books:

[1] Fiber Reinforced Composites: Materials; Manufacturing and Design; P. K. Mallick; Marcel Dekker Inc; 1993.

[2] Analysis and Performance of Fiber Composites; B. D. Agarwal and L. J. Broutman; John Wiley and Sons; New York; 1990.

[3] Principles of Composite Material Mechanics; Ronald Gibson; Tata McGraw Hill; 1994.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	Fundamentals of Mechatronics	ME 542	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit – I

Introduction: Definition of Mechatronics, Mechatronics in Manufacturing, Products, and Design. Comparison between Traditional and Mechatronics Approach **[1-4].** **(05 Hours)**

Unit – II

Mechanical Elements in Mechatronic: Introduction, Synergy of Systems, Definition of Mechatronics, Applications of Mechatronics in Design and Modeling, Actuators and Sensors, Intelligent Controls, Robotics, Manufacturing etc., Objectives, Advantages and Disadvantages of Mechatronics, Examples of Mechatronics Systems in Industry.

Mechanical Components in Mechatronics, Force, Friction and Lubrication, Materials, Mechanical Behavior of Materials, Mechanisms used in Mechatronics, Lever and Four Bar Mechanisms, Bearing, Belt, Chain, Cam, Slider Crank, Clutches etc. **[1-4].** **(08 Hours)**

Unit – III

Electronics Elements in Mechatronics: Conductors, Insulators and Semiconductors, Passive Electrical Components, Resistors, Capacitor and Inductor, Transformer, Active Elements, Semiconductor Devices, Transistors and Integrated Circuits, Digital Electronics Components Like Logic Gates, Flip-Flops, Shift Register, Multiplexer and Counter. Computing Elements in Mechatronics, Analog Computer, Timer, Analog to Digital Converter, Digital to Analog Converter, Digital Computer, Microprocessor and its Architecture, Micro-controllers, Programming Logic Controllers, their Basic Structures, Mnemonics **[1-4].** **(08 Hours)**

Unit – IV

System Modeling and Analysis: Control System Concepts, Transfer Function of Physical Systems, Block Diagrams Representation of Systems, Transfer Function of a System, Standard Input Signals, Time Response of a First and

Second Order Systems to a Step Input, Frequency Response Analysis, Automatic Control Systems, Digital Control Systems. Motion Control Devices, Actuator Types & Application Areas, Hydraulic and Pneumatic Actuators, Electrical Actuators, DC Servomotor, AC Servomotor and Stepper Servomotor, Micro-actuators, Drive Selection and Applications **[1-4]. (08 Hours)**

Unit – V

Sensors and Transducers: Their Static and Dynamic Performance Characteristics, Internal Sensors, External Sensors and Micro-sensors, Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors, Selection of Sensors. Stages in Designing Mechatronics Systems, Traditional and Mechatronic Design, Possible Design Solutions, Case Studies of Mechatronics Systems, Pick and Place Robot, Automatic Car Park Systems, Engine Management Systems etc. **[1-4]. (08 Hours)**

Unit – VI

Mechatronics in Industry: Autotronics, Bionics and Avionics and their Various Applications, Mechatronics in Manufacturing, Features of Mechatronics in Manufacturing, Flexible Manufacturing Systems, Manufacturing Automatic Protocol, Computer Integrated Manufacturing, Just in Time Production Systems, CNC Machines, Adaptive Control Machine System, CNC Machine Operations, Challenges in Mechatronics Production Units **[1-4]. (08 Hours)**

Text Books:

[3] A Kuttan; Introduction to Mechatronics; Oxford University Press, 2010.

[4] David Alciatore & Micael Histand; Introduction to Mechatronics & Measurement Systems; 4e", McGrawHill Education, 2014.

[5] Mechatronics; HMT Ltd. Tata McGraw-Hill, New Delhi, 1988.

[6] Musa Jouaneh, Fundamentals of Mechatronics, 1st Edition, Cengage Learning, 2012.

Reference Books:

[4] Rolf Iserman; Mechatronic Systems: Fundamentals; Springer, 1st Edition, 2005

[5] Lawrence J. Kamm; Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics; Prentice – Hall of India Pvt., Ltd., 2000.

[6] K. P. Ramachandran, G. K. Vijayaraghavan, M. S. Balasundaram; Mechatronics: Integrated Mechanical Electronic Systems; Wiley.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Mechanical Behavior of Materials	ME 508	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit – I

Introduction: Plastic Deformation and Dislocation Theory; Lattice Defects; Deformation in a Perfect Lattice; Dislocation in Crystal and Deformation; Strain Hardening of Single Crystal; Low Angle Grain Boundaries; Yield Point and Strain Ageing. Stress Field of a Dislocation; Forces Between Dislocations; Dislocation Climb and Jog; Interaction with Vacancy and Impurity. Multiplication of Dislocation and Pile-Up **[1]**. **(07 Hours)**

Unit – II

Material Properties: Behavior Under Tension; Engineering and True Stress-Strain Curves; Strength Coefficient and Strain Hardening Exponent; Necking or Instability in Tension; Effects of Gauge Length on Strength and Elongation; Effects of Strain Rate and Temperature on Tensile Properties; Yield Point Phenomenon; Fracture Under Tension and Torsion **[1]**. **(06 Hours)**

Unit – III

Fatigue: Effects Fatigue of Metals; Stress Cycle; Fatigue Curve; Fatigue Fracture Characteristics; Fatigue Testing and Testing Machines; Determination of Fatigue Strength; Factors Affecting Fatigue- Size; Surface; Stress Concentration; Superimposed Static Stress; Corrosion; Contact Under Pressure. Under Stressing; Coaxing and Overstressing; Effects of Metallurgical Impurities **[1]**. **(08 Hours)**

Unit – IV

Creep of Metals: Creep Strain and Creep-Time Curves; Low Temperature and High Temperature Creep Theories; Fracture at Elevated Temperature; Stress Rupture; Creep Parameters and Practical Applications; Effects of Metallurgical Variables and Materials for High Temperature Applications **[1]**. **(07 Hours)**

Unit – V

Material Failure: Brittle Failure and Behavior Under Impact; The History of Failure of Engineering Structures and Parts; High Strain Rate; Stress Concentration and Low Temperature Effects; Impact Tests and Results; Transition Temperature and Factors Affecting Transition Temperature; Flow and Fracture Under Rapid Loading; Temper and Hydrogen Embrittlement **[1]**.

(09 Hours)

Unit – VI

Smart Materials- Study of Smart Materials and their Integration into Novel Designs; Classification According to their Response and Stimuli Ability; Effects of Crystalline Structures in the Properties of Piezoelectric Materials; Magnetostrictive Materials; Shape Memory Alloys; Electro Rheological Fluids; Magneto-Rheological Fluids; Application of Smart Materials into Mechanics of Structures; Passive and Active Vibration Control and on the Principles of Actuators and Sensors **[1]**. **(08 Hours)**

Text Books:

[1] Mechanical Behavior Materials; Marc Andre Meyers; K.K. Chawla; PHI.

Reference Books:

[1] Mechanical Metallurgy; GE Dieter; McGraw-Hill Book Co. Kogakusha Co. Ltd.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design Engg.)	Finite Element Methods Lab	ME 523	SM+ET 50+50
Semester	**Credits**	**L-T-P**	**Exam.**
I	3	1-0-3	3 Hours

Perform 10 of the Following-

17. Introduction to Commercial Software, Ansys/ABAQUS and Practice Session on Handling Assembly, Boundary Conditions etc.

18. To Learn Applying Static and Variable Loading and Boundary Conditions in FE Solvers.

19. Study of Types of Elements Used in Finite Elements Analysis and their Applications.

20. To Solve Structural Problems (*e.g.* Trusses, Beams Frames, Pressure Vessels etc.) Using Ansys/ABAQUS, Involving Deformation, Stresses.

21. To Solve Problems involving Plasticity and Fracture Using Ansys/ABAQUS.

22. To Study Buckling Behavior of Columns and Find Out Eigen Values of – Simple Materials and Composites both.

23. To Perform Vibration Analysis and Find out Natural Frequencies and Modes of Vibrations.

24. To Study Heat Transfer Problems.

25. To Perform Thermal-Displacement Coupled Problems.

26. To Study Stresses in Rotating Bodies.

27. To Study Stress Concentration and Crack Propagation Problems.

28. To Study Impact on Structures Problems.

29. To Study Coupled Friction-Heat Generation Problems.

30. Introduction to Developing Code for Finite Element Analysis in MATLAB.

31. To Develop Programs in MATLAB to Solve Typical FEA Problems.

32. To Execute a Medium Size Project.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Manufacturing Engineering)	Automation, Machine Vision and Robotics	ME 531	(SM+MT) +ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit I

Introduction to Automation: Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation, Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control, Computer Process Control. Hardware Components for Automation and Process Control, Sensors, Actuators, Analog to Digital Converters, Digital to Analog Converters, Input/Output Devices for Discrete Data **[1].** **[8 Hours]**

Unit II

Automated Production Lines: Fundamentals of Automated Production Lines, Application of Automated Production Lines, Analysis of Transfer Lines, Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Quantitative Analysis of Assembly Systems, Automatic Identification Methods, Barcode Technology, Radio Frequency Identification, Other AIDC Technologies **[1].** **[8 Hours]**

Unit III

Group Technology and Cellular Manufacturing: Part Families and Machine Groups; Cellular Manufacturing; Applications of Group Technology; Analysis of Cellular Manufacturing. Opitz Parts Classification and Coding System.

Flexible Manufacturing Cells and Systems: Introduction to Flexible Manufacturing System; FMC/FMS Components; FMS Application Considerations; Analysis of Flexible Manufacturing Systems; Alternative Approaches to Flexible Manufacturing **[1]**. **[8 Hours]**

Unit IV

Product Design and CAD; CAM, CAD/CAM, and CIM; Quality Function Deployment.

Machine Vision - Image Acquisition and Digitization, Image Processing and Analysis, Interpretation, Training the Vision System; Machine Vision Applications **[1]**. **[6 Hours]**

Unit V

Industrial Robotics: Robotic Configuration, Robot Anatomy and Related Attributes, Robot Control Systems, End Effectors, Sensors in Robotics, Industrial Robot Applications, Robot Accuracy and Repeatability, Different Types of Robotics, Various Generations of Robots, Degrees of Freedom – Asimov's Laws of Robotics Dynamic Stabilization of Robots **[2]**. **[7 Hours]**

Unit VI

Methods of Robot Programming: Leadthrough Programming Methods; A Robot Program as a Path in Space; Motion Interpolation; Wait, Signal, and Delay Commands; Branching; Capabilities and Limitations Of Leadthrough Methods.

Robot Languages: The Textual Robot Languages; Generations of Robot Programming Languages; Robot Language Structure; Constants, Variables, and Other Data Objects; Motion Commands; End Effector and Sensor Commands; Computations and Operations; Program Control and Subroutines; Communications and Data Processing; Monitor Mode Commands **[2]**. **[8 Hours]**

Text Books:

[1] Automation, Production Systems, and Computer Integrated Manufacturing; Mikell P. Groover Fourth Edition, Pearson 2015.

[2] Industrial Robotics – Technology, Programming and Applications; Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey, Ashish Dutta, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi.

[3] Introduction to Industrial Robotics; Ramachandran Nagarajan; Pearson 2016.

Reference Books:

[1] Robotics for Engineers –Yoram Koren, McGraw Hill International, 1st Edition, 1985.

[2] Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Design Engg.)	Product Design & Development	ME 505	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Introduction to Product Design: Introduction to PDD; Applications; Relevance; Scope; Terminology; Design Definitions; The Role and Nature of Design; Old and New Design Methods; Design by Evolution; Product Development Process; Product Development Organizations; Identifying the Customer Needs; Establishing the Product Specifications; Concept Generation; Concept Selection **[1] [2]**. **(08 Hours)**

Unit - II

Product Architecture: Product Architecture; Implication of the Architecture; Establishing the Architecture; Related System Level Design Issues **[1]**.

(06 Hours)

Unit - III

Industrial and Manufacturing Design: Need for Industrial Design; Impact of Industrial Design; Industrial Design Process; Assessing the Quality of Industrial Design; Human Engineering Consideration **[1] [2]**. **(08 Hours)**

Unit - IV

Prototyping and Economic Analysis: Principles of Prototyping; Planning for Prototypes; Elements of Economic Analysis; Base Case Financial Model; Sensitivity Analysis; Influence of the Quantitative Factors **[2]**. **(08 Hours)**

Unit - V

Product Appraisal: Information and Literature Search; Patents; Standards and Codes; Environment and Safety Considerations; Existing Techniques such as Work-Study; SQC etc. which could be used to Improve Method & Quality Of Product; Innovation Versus Invention; Technological Forecasting **[1]**.

(08 Hours)

Unit - VI

Product Development Projects: Sequential; Parallel and Coupled Tasks; Baseline Project Planning; Project Budget; Project Execution; Project Evaluation **[2]**. **(07 Hours)**

Text Books:

[1] Product Design & Manufacturing; A. K. Chitab & R. C. Gupta; PHI (EEE).

[2] The Technology of Creation Thinking; R. P. Crewford – Prentice Hall.

Reference Books:

[1] Product Design and Development; Karal .T. Ulrich; Steven D. Eppinger; McGraw Hill.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	CNC Machines and Programming	ME 533	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Computer Numerical Control and CNC Hardware: Introduction; Numerical Control; Numerical Control Mode; Numerical Control Elements; NC Machine tool,

Structure of CNC Machines; Spindle Design; Drives; Actuation Systems; Feed Back drives; Axes- Standards **[1, 2].** **(07 Hours)**

Unit - II

CNC Machine Tools, Control Systems and CNC Tooling: CNC Machining Centers; CNC Turning Centers; High Speed Machine Tools; Machine Control Units Support Systems; Tough Triggers Probe.

Cutting Tool Materials; Turning Tool Geometry; Milling Tool System; Tool Presetting; Automatic Tool Changers; Work Holding; Cutting Process Parameter Selection **[1].** **(08 Hours)**

Unit - III

CNC Programming: Part Programming Fundamentals; Manual Part Programming Methods; Preparatory Functions; Miscellaneous Functions; Program Number; Tool Length Compensation; Canned Cycle; Cutter radius compensation. **(08 Hours)**

Unit - IV

Turning Center Programming: Comparison between machining center and turning centre; Tape Formats; Axes System; General Programming Functions; Motion Commands; Cut Planning; Thread Cutting; Canned Cycles **[1].**

(08 Hours)

Unit - V

Advanced Part programming Methods: Polar Coordinates; Parameters; Looping and jumping; Subroutines; Mirror Imaging and Scaling; Special Canned Cycles **[1].** **(07 Hours)**

Unit - VI

Computer Aided Part Programming: Concept of Computer aided part programming (CAP); APT Language structure; Geometry Commands

Motion Commands; Postprocessor commands; Compilation Control Commands; Repetitive Programming; Complete part program in APT; CAM Systems **[1].**

(07 Hours)

Text Books:

[7] Machine Tool Design and Numerical Control; N. K. Mehta; McGraw Hill Education (India) Private Limited, New Delhi.

[8] CAD/ CAM Principles and Applications; P. N. Rao; McGraw Hill Education (India) Private Limited, New Delhi.

[9] CNC Programming; Binit Kumar Jha; Vikas Publishing House Private Limited, Noida.

Reference Books:

[1] Numerical Control and Computer Aided Manufacturing; T. K. Kundra, P. N. Rao and N. K. Tewari; Tata McGraw-Hill, New Delhi.

[2] Computer Numerical Control – Concepts and Programming; W. S. Seames; Delmar Publishers Inc, New York, 1986.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	Welding Engineering	ME 535	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Physics of Welding Arc: Evolution of Welding; Classification of Welding Processes; Welding Arc: Structure and Characteristics, Efficiency, Arc Blow; Arc Initiation and Maintenance; Arc Stability; Electrode Polarity, Heat Generation**[1].** **(06 Hours)**

Unit - II

Welding Power Sources: Conventional Welding Power Sources; Constructional Features; Static and Dynamic Characteristics; Duty Cycle; Influence of Inductance on Arc and Power Source Characteristics; Internal and External Regulation; Specific Power Source Requirements; Special Welding Power Sources **[1].** **(07 Hours)**

Unit - III

Weldability of Metals: Solidification of Weld Metal; Heat Affected Zone (HAZ); Factors Affecting Properties of HAZ; Gas-Metal, Slag-Metal and Solid State Reactions in Welding and their Influence on Soundness of Weld Joint; Lamellar Tearing and Hydrogen Damage; Weldability; Definition; Factor Affecting the Weldability of Steel Carbon Equivalent; Weldablity of Steel and Cast Iron, Failure Analysis of Welded Joints **[1, 2].** **(10 Hours)**

Unit - IV

Arc Welding Processes: Consumable Electrode Welding Processes; Manual Metal Arc (MMA) Welding; Gas Metal Arc Welding; Pulsed MIG Welding; Submerged Arc Welding, Significance of Flux-Metal Combination; Electroslag

Welding: Heat Generation; Principle; Gas Tungsten Arc Welding; Selection of Polarity, Plasma Arc Welding; Transferred and Non-Transferred Plasma Arc Welding; Selection of Gases; Welding Parameters; Keyhole Technique.

Modern Trends in Welding: Friction Welding; Explosive Welding; Diffusion Bonding; High Frequency Induction Welding; Ultrasonic Welding; Electron Beam Welding; Plasma Arc Welding; LASER Welding **[1].** **(10 Hours)**

Unit - V

Heat Flow in Welding: Effect of Welding Parameter on Heat Distribution; Calculation of Peak Temperatures; Thermal Cycles; Cooling Rate and Solidification; Residual Stresses And Their Distribution In Welds; Influence of Residual Stresses in Static and Dynamic Loading, Distortion**[1, 2]. (06 Hours)**

Unit - VI

Inspection and Testing of Welding and Casting: Defects; Destructive Tests; Non-destructive Testing Techniques; Surface Treatments-safety Aspects in Welding Processes; Specific Welding Applications and Innovations **[1].**

(06 Hours)

Text Books:

[7] Welding Processes and Technology, 3rd Edition; R. S. Parmar, Khanna Publishers, 2015, ISBN – 81-7409-126-2.

[8] Welding Metallurgy, 2nd Edition, Sindu Kou, John Wiley and Sons. Inc. USA, 2003; ISBN – 0-471-43491-4.

Reference Books:

[10] Principles of Welding (Processes, Physics, Chemistry and Metallurgy), Robert and Messler, John Wiley and Sons. Inc. Publishers; 1999, ISBN – 978-0-471-25376-1.

[11] The Metallurgy of Welding, Lancaster, William Andrew Publishing, NY.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	Thermo-fabrication Processes	ME 537	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Design of Casting and Quality Control: Introduction to Casting and Features of Casting Problems; Factors to be Considered in Casting Design; Design Considerations in Pattern Making; Moulding Techniques; Core Making and Assembly; Cooling Stresses and Hot Spots in Casting and Modification in Casting Geometry to Overcome them; Casting Quality Control-Casting Defects and Factors Responsible for them; Different Inspection and Testing Methods to Evaluate the Casting; Quality Control Activities in a Foundry; Salvaging Methods of Defective Casting **[1].** **(08 Hours)**

Unit - II

Principles of Gating and Risering: Purpose of the Gating System; Components of Gating System and its Functions; Design of Gating System; Types of Gates; Gating Ratio and its Functions; Effects of Gates on Aspiration; Turbulence and Dross Trap; Recent Trends; Functions; Types and Applications of The Riser; Use of Insulating Material and Exothermic Compounds in Risers; Riser Design; Risering Curves; NRL Method of Riser Design; Feeding Distance; Risering of Complex Casting; Risering of Alloys Other Than Steel; Riser Design by Geometrical Programming **[1].** **(10 Hours)**

Unit - III

Welding Metallurgy: Welding as Compared with Other Fabrication Processes; Classification of Welding Processes; Heat Affected Zone and its Characteristics; Effects of Alloying Elements on Weldability; Weldability of Steels; Stainless Steel; Cast Iron; and Aluminum and Titanium Alloys; Weld Testing Standards;

Hydrogen Embrittlement; Lammellar Tearing; Residual Stresses and its Measurement; Heat Transfer and Solidification; Analysis of Stresses in Welded Structures; Pre and Post Welding Heat Treatments; Metallurgical Aspects of Joining; Conditions of Soldering; Brazing and Welding of Materials **[2, 3].**

(10 Hours)

Unit - IV

Weld Design & Quality Control: Principles of Sound Weld Design; Welding Joint Design; Welding Defects; Testing of Weldament; Material Joining Characteristics; Welding Positions; Allowable Strength of Welds Under Steady Loads; Weld Throat Thickness; Weld Quality; Discontinuities in Welds; Their Causes and Remedies and Quality Conflicts **[2, 3].** **(07 Hours)**

Unit - V

Modern Trends in Welding: Friction Welding; Explosive Welding; Diffusion Bonding; High Frequency Induction Welding; Ultrasonic Welding; Electron Beam Welding; Plasma Arc Welding; LASER Welding **[2, 3].** **(05 Hours)**

Unit - VI

Inspection and Testing of Welding and Casting: Defects; Destructive Tests; Non-destructive Testing Techniques; Surface Treatments-Safety Aspects in Welding Processes; Specific Welding Applications and Innovations **[2, 3].**

(05 Hours)

Text Books:

[9] Manufacturing Technology: Foundry, Forming and Welding (Vol. 1); P. N. Rao; Tata McGraw Hill; New Delhi.

[10] Welding Processes and Technology, 3rd Edition; R. S. Parmar, Khanna Publishers, 2015, ISBN – 81-7409-126-2.

[11] Welding Metallurgy, 2nd Edition, Sindu Kou, John Wiley and Sons. Inc. USA, 2003; ISBN – 0-471-43491-4.

Reference Books:

[12] Metal Casting: Principles and Practice; T. V. Rammana Rao; New Age International.

[13] Advanced Welding Processes; Nikodaco & Shansky; MIR Publications

[14] Welding Technology and Design; V. M. Radhakrishnan; New Age International.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	Micromachining and Nanofinishing	ME 539	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit – I

Introduction to Micromachining Processes: Introduction; Micromachining; Mechanical Advanced Micromachining (Ultrasonic Micromachining, Thermal Advanced Micromachining Processes, Electro Discharge Micromachining, Electron Beam Machining, LASER Beam Micromachining, Electrochemical Micromachining); Advanced Nano Finishing Processes – Abrasive Flow Machining, Chemical Mechanical Finishing, Elastic Emission Machining, Magnetic Abrasive Machining, Magneto-Rheological Finishing, Magneto-Rheological Abrasive Flow Finishing, Magnetic Float Finishing **[1, 2]. (08 Hours)**

Unit – II

Diamond Turn Machining: Introduction; Components of Diamond Turn Machine (DTM); Material Removal Mechanism In Diamond Turn Machining; Classification of Finishing Techniques; Tools for DTM; Requirements of DTM Tools, Tool Geometries for Single Crystal Diamond Tools, Tool Setting; Applications and Advances in DTM **[1, 2]. (08 Hours)**

Unit – III

Electro-chemical Spark Micromachining: Introduction; Mechanics of Machining in Electro-chemical Micromachining (ECSMM); ECSMM Equipment – Sinking and Drilling ECSMM, Travelling Wire ECSMM, Milling ECSMM **[1, 2]. (06 Hours)**

Unit – IV

Chemo Mechanical Polishing: Introduction; Chemo-mechanical Polishing (CMP); Mechanism of Material Removal in Silicon Wafer; Parametric Analysis; Global Planarization; Removal Rate; CMP Slurry;

Slurry Flow Rate; Abrasives in CMP Slurry; Particle Surface Coating and Particle-Less Slurry; Agglomeration of CMP Slurry; Rheological Studies of Slurry; Slurry Solution, pH Value and Organic Alkali; Low Stress Slurry and Effect of Surfactant; Polishing Pads and Effect of Temperature on Polishing Pad; Non-Uniformity of Pad and Physical and Chemical Changes In Pad; Defects and Contamination; Forces Responsible oor Contaminant on Wafer Surface; Post CMP Cleaning Process;Applications; Advantages and Disadvantages**[1,2].(08 Hours)**

Unit – V

Magnetorheological Nanofinishing Processes: Nanofinishing; Smart Rheological Fluids; Magnetorhelogical Polishing (MRP) Fluids; Magnetorhelogical Characteristic of MRP- Fluids; Magnetorheological Finishing (MRF) Process; Magneto-Rheological Abrasive Flow Finishing Process; Performance Analysis of MRAFF Process; Magnetorheological Jet Finishing (MRJF) Process **[1, 2]. (07 Hours)**

Unit – VI

Metrology of Micromachined Components: Introduction; Scanning Electron Microscopy (SEM); Optical Microscopy; Scanning White Light Interferometry; Confocal LASER Scanning Microscopy; Fringe Projection Microscopy; Scanning Probe Microscopy; Computed Tomography; Digital Volumetric Imaging; Molecular Measuring Machine; Micro Coordinate Measuring Machine; Microfabricated Scanning Grating Interferometry; Autofocusing Probing; Scanning LSAER Doppler Vibrometry; Digital Holographic Microscope Systems **[1, 2]. (08 Hours)**

Text Books:

[15] Introduction to Micromachining; V. K. Jain; 2010; Narosa Publishers.

[16] Fundamentals of Microfabrication: The Science of Miniaturization; Marc J. Madou; CRC Press.

Reference Books:

[3] A New Direction in Manufacturing; Kluwer; Academic Publishers, London, 1997.

[4] Advanced Methods of Machining; J. A. Mcgeough Chapman and Hall; London, 1988.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	Modeling of Metal Forming Processes	ME 543	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Introduction and Process Modeling: Introduction; Uniform Energy Method; Slab Method; Slip Line Field Method; Upper Bound Method; Visioplasticity Method; Finite Element Method **[1].**

Plasticity Fundamentals: Introduction; Von Misses Criterion; Tresca Criterion; Experimental Verification of Yield Criterion; Plastic Anisotropic; Anisotropic Yield Criterion; Plastic Instability; Generalized Necking Failure Conditions **[1].**

(07 Hours)

Unit - II

Uniform Energy and Slab Methods: Introduction; Uniform Energy Method; Application - Comparison of Flat Plate Between Two Parallel Platten; Rolling of Flats; Direct Extrusion; Wire Drawing; Tube Drawing **[1].**

Slab Method: Introduction; The Slab Method; Open Die Forging – Low and High Slipping Friction Conditions; Mixed Friction Conditions; Load Calculations; Strip Drawing; Wire and Rod Drawing; Tube Drawing; Extrusion; Strip Rolling **[1].**

(09 Hours)

Unit - III

Slip Line Field Technique: Introduction; Plane Strain; Alpha and Beta Lines; Stress Equation; Velocity Equation; Hencky's First Theorem; Hencky's Second Theorem; Velocity Discontinuities; Stress Discontinuities; Stress Boundary Conditions; Construction of Slip Line Fields; Construction of Hodographs; Application of Field Line Technique for Rolling Extrusion etc. **[1].** **(08 Hours)**

Unit - IV

Upper Bound Technique: Introduction; Principle of Virtual Work; Principle of Maximum Work; Upper Bound Theorem; Application of Upper Bound Technique for Frictionless Square Die; Extrusion Through a Smooth Circular Die; Rolling of Sheets; Axisymmetric Extrusion; Axisymmetric Deep Drawing **[1].** **(07 Hours)**

Unit - V

Visioplasiticity Technique: Introduction; Visioplasticity Analysis – Stress Distribution Under Plane Strain and in Axial Symmetry; Application **[1].**

(06 Hours)

Unit - VI

Finite Element Method: Introduction; Finite Element Method; Eulerian Rigid Plastic FEM Formulation for Plane Strain Rolling – Governing Equation; Domain and Boundary Conditions; Integral Form; Finite Element Approximation; Finite Element Equation; Solution Procedure **[1].** **(08 Hours)**

Text Books:

[12] Modeling Techniques for Metal Forming Processes; G. K. Lal; P. M. Dixit; N. Venkata Reddy; Narosa Publisher

[13] Technology of Metal Forming Processes; Surender Kumar; Prentice Hall of India.

[14] Metal Forming: Fundamentals and Applications; Taylor Altan; Soo I .K. Oh; Harold. L. Gegel; ASM; Metals Park; Ohio; USA; 1983.

Reference Books:

[17] Handbook of Metal Forming; Kurt Lange; Society of Manufacturing Engineers. Michigan; USA; 1988.

[18] Metal Forming - Processes and Analysis; Avitzur; Tata McGraw-Hill Co.; New Delhi; 1977.

[19] ASM Metals Handbook. Vol.14; Forming and Forging; Metals Park; Ohio; USA; 1990.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Manufacturing Engineering)	Design of Manufacturing Systems	ME 545	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Essential of Manufacturing Systems: Basic System Concepts; System Design; Manufacturing Systems; Structural and Transformation Aspect of Manufacturing Systems; Integrated Manufacturing Systems and its Frame Work **[1-3]. (06 Hours)**

Unit – II

Process System for Manufacturing: Modes of Production-Mass Production; Multi-Product Small Batch Production; Group Technology Based Production; Cellular and Flexible Manufacturing Systems; Automation Systems for Manufacturing; CAM/CIM; Economic Evaluation of Processes **[1-3]. (06 Hours)**

Unit - III

Discrete Part Manufacturing Systems: Different Types and Management Decision System Models; Basic Approach of Modeling; Analytical Vs Simulation Models; Modelling Approach; Long Run Analysis; Deterministic Models; Binomial Approximation; Sample Path Analysis; Markov Models **[1-3]. (09 Hours)**

Unit - IV

High Volume Production System: Automated Flow Lines; Method of Work Part Transport; Transfer Mechanism; Automation for Machining Operations; Analysis of Automated Flow Lines; Automated Flow Lines With/Without Buffer Storage; Computer Simulation of Automated Flow Lines; Automated Assembly System; Design for Automated Assembly; Analysis of Multi-Station Assembly Machines; Assembly Systems and Line Balancing **[1-3]. (08 Hours)**

Unit - V

Manufacturing Process Design: Process Planning and Design; Process Design Operation Design; Optimum Routing Analysis; Facility Location and Layout Planning; Single and Multiple Facility Placement Problem; Continuous Facility Location; Computer Aided Plant Layout; Material Handling System Design; Storage & Warehousing; Automated Storage and Retrieval Systems; Simultaneous Development of Plant Layout and Material Handling **[1-3].**

(08 Hours)

Unit - VI

Management and Information systems for Manufacturing: Managerial Information Flow in Manufacturing Systems; Decision Problem in Managerial Information; Flow; Production Planning and Scheduling; Production Control; Scope and Problems; Quality Control & Function Deployment.

Fundamentals of Information Technology Information Systems; Information Networking; Computerized Manufacturing Information Systems **[1-3].**

(08 Hours)

Text Books:

[1] Manufacturing System Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics, Katsundo Hitomi; Taylor and Francis.

[2] Manufacturing Facilities: Location, Planning, and Design; Dileep R. Sule; PWS-Kent Pub. Co., 1988

[3] Automation; Production Systems & Computer Integrated Manufacturing Mikell P. Groover; PHI Learning Private Ltd., New Delhi.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design/Manuf./Thermal Engineering)	Research Methods and Techniques	ME 501	(SM+MT)+ET 30+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit I

An Introduction to Research Methodology: Meaning of Research*;* Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research and Scientific Method; Importance of Knowing How Research is Done; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India**[1].**

Defining the Research Problem: What is a Research Problem?; Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem; An Illustration**[1].** **(07 Hours)**

Unit II

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; Developing a Research Plan**[1].**

Sampling Design: Census and Sample Survey; Implications of a Sample Design; Steps in Sampling Design; Criteria of Selecting a Sampling Procedure; Characteristics of a Good Sample Design; Different Types of Sample Designs; How to Select a Random Sample?; Random Sample from an Infinite Universe; Complex Random Sampling Designs **[1].** **(07 Hours)**

Unit III

Measurement and Scaling Techniques: Measurement in Research; Measurement Scales; Sources of Error in Measurement; Tests of Sound Measurement; Technique of Developing Measurement Tools; Scaling; Meaning of Scaling; Scale Classification Bases; Important Scaling Techniques; Scale Construction Techniques **[1].**

Methods of Data Collection: Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Difference between Questionnaires and Schedules; Some Other Methods of Data Collection; Collection of Secondary Data; Selection of Appropriate Method for Data Collection **[1].** **(08 Hours)**

Unit IV

Processing and Analysis of Data: Processing Operations; Some Problems in Processing; Elements/Types of Analysis; Statistics in Research; Measures of Central Tendency; Measures of Dispersion; Measures of Asymmetry (Skewness); Measures of Relationship; Simple Regression Analysis; Multiple Correlation and

Regression; Partial Correlation; Association in Case of Attributes; Other Measures **[1].**

Sampling Fundamentals: Need for Sampling; Some Fundamental Definitions; Important Sampling Distributions; Central Limit Theorem; Sampling Theory; Sandler's *A*-test; Concept of Standard Error; Estimation; Estimating the Population Mean (u); Estimating Population Proportion; Sample Size and its Determination; Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level; Determination of Sample Size through the Approach Based on Bayesian Statistics **[1]. (08 Hours)**

Unit V

Testing of Hypotheses: What is a Hypothesis?; Basic Concepts Concerning Testing of Hypotheses; Procedure for Hypothesis Testing; Flow Diagram for Hypothesis Testing; Measuring the Power of a Hypothesis Test; Tests of Hypotheses; Important Parametric Tests; Hypothesis Testing of Means; Hypothesis Testing for Differences between Means; Hypothesis Testing for Comparing Two Related Samples; Hypothesis Testing of Proportions; Hypothesis Testing for Difference between Proportions; Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance; Testing the Equality of Variances of Two Normal Populations; Hypothesis Testing of Correlation Coefficients; Limitations of the Tests of Hypotheses **[1].**

Analysis of Variance and Covariance: Analysis of Variance (ANOVA); What is ANOVA?; The Basic Principle of ANOVA; ANOVA Technique; Setting up Analysis of Variance Table; Short-cut Method for One-way ANOVA; Coding Method; Two-way ANOVA; ANOVA in Latin-Square Design; Analysis of Co-variance (ANOCOVA); ANOCOVA Technique; Assumptions in ANOCOVA **[1]. (08 Hours)**

Unit VI

Interpretation and Report Writing: Meaning of Interpretation; Why Interpretation?; Technique of Interpretation; Precaution in Interpretation; Significance of Report Writing; Different Steps in Writing Report; Layout of the Research Report; Types of Reports; Oral Presentation; Mechanics of Writing a Research Report; Precautions for Writing Research Reports **[1].**

Application of results and ethics - Environmental Impacts; Ethical Issues; Ethical Committees, Commercialisation, Copy Right, Royalty; Intellectual Property Rights and Patent Law; Trade Related Aspects of Intellectual Property Rights; Reproduction of Published Material, Plagiarism, Citation and Acknowledgement, Reproducibility and accountability **[2]. (07 Hours)**

Text Books:

[1] C. R. Kothari; Research Methodology: Methods and Techniques; New Age International.

[2] B. L. Garg, R. Karadia, F. Agarwal, F. and U. K. Agarwal; An introduction to Research Methodology, RBSA Publishers.

[3] B. L. Wadehra; Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications; Universal Law Publishing.

Reference Books:

[1] S. C. Sinha and A. K. Dhiman; Research Methodology, Ess Ess Publications, 2 Volumes.

[2] W.M.K. Trochim; Research Methods: the Concise Knowledge Base, Atomic Dog Publishing.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Design/Manuf./Thermal Engineering)	Finite Element Methods and Analysis	ME 503	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit - I

Introduction: Basic Concept; Historical Background; Engineering Applications; General Description. Introduction; Weak Formulations; Weighted Residual Methods; Variational Formulations; Weighted Residual; Collocation; Subdomain; Least Square and Galerkin's Method; Direct Method; Potential Energy Method **[1]**. **(08 Hours)**

Unit - II

One-Dimensional Analysis: Basis Steps; Discretization; Element Equations; Linear and Quadratic Shape Functions; Assembly; Local and Global Stiffness Matrix and its Properties; Boundary Conditions; Applications to Solid Mechanics; Heat and Fluid Mechanics Problems; Axisymmetric Problems **[1] [3]**. **(08 Hours)**

Unit - III

Plane Truss and Beams: Local and Global Coordinate Systems; Stress Calculations; Example Problems. Introduction; Euler-Bernoulli Beam Element; Numerical problems **[1] [2]**. **(08 Hours)**

Unit - IV

Scalar Field Problems in 2-D: Triangular and Rectangular Elements; Constant Strain Triangle; Iso-parametric Formulation; Higher Order Elements; Six Node Triangle; Nine Node Quadrilateral; Master Elements; Numerical Integration; Computer Implementation **[2]**.

(07 Hours)

Unit - V

Bending of Elastic Plates: Review of Classical Plate Theory; Plate Bending Elements; Triangular and Rectangular Elements; Shear Deformation Plate Theory; Numerical Problems **[2]**.

(07 Hours)

Unit - VI

Applications to Heat Transfer Problems: Variational Approach; Galerkin Approach; One Dimensional and Two Dimensional Steady State Problems for Conduction; One and Two Dimensional Formulation of Fin; Transient Problems **[1] [3]**. **(07 Hours)**

Text Books:

[1] An Introduction to the Finite Element Method; J.N. Reddy / Tata McGraw Hill; 3rd Ed.; 2007

[2] The Finite Element Method in Engineering – Singiresu S Rao; Elsevier Butterworth Heinemann; 4th Ed; 2005

[3] Introduction to Finite Elements in Engineering; R. Tirupathi; Chandrupatla; Ashok D. Belagundu; Prentice- Hall India; 3rd Ed; 2002.

Reference Books:

[1] Concepts and Applications of Finite Element Analysis; Robert Cook. et al.; John Wiley & Sons; 4th Ed.; 2003.

[2] Applied Finite Element; G. Ramamurthy; I K International; New Delhi; 2nd Ed; 2010.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Advanced Heat and Mass Transfer	ME 561	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit- I

Introduction: Reviews of Basic Laws of Conduction; Convection and Radiation; Steady State Heat Conduction: Thermal Insulation Problem; Extended Surfaces-Fins with Uniform Cross-Sectional Area; Fins of Variable Cross-Sectional Area-Circumferential; Triangular And Parabolic Shape; Fin Effectiveness and Efficiency; Thermal Contact Resistance; Multi-Dimensional Heat Conduction: Analytical Method and Numerical Methods. **(08 Hours)**

Unit- II

External Forced Convection: Introduction; The Exact and Approximate Integral Solutions for the Flow over Flat Plate; Hydrodynamic & Thermal Boundary Layer; Boundary Layer Thickness; Drag Coefficient; The Local & Average Heat Transfer Coefficient; Mass Flow through the Boundary; Turbulent Flow over Flat Plate; Reynolds Analogy; Reynolds-Colburn Analogy; Drag & Heat Transfer in Mixed Boundary Layer; Flow across Cylinders. **(08 Hours)**

Unit – III

Internal Forced Convection: Introduction; Entrance Region; Fully Developed Region; Mean Velocity; Mean Temperature; Governing Differential Equation and Velocity Profile for Fully Developed Laminar Tube Flow; Hagen-Poiseuille Equation; Fanning Friction Coefficient; Heat Transfer for Fully Developed Laminar Tube Flow; Convection Correlations for Turbulent Flow in Tubes. **(08 Hours)**

Unit – IV

Two Phase Heat Transfer: Heat Transfer with Change of Phase: Laminar Film Condensation on a Vertical Plate; Drop-Wise Condensation; Boiling Regimes; Nucleate and Film Boiling; Heat Pipe. **(07 Hours)**

Unit –V

Heat Exchangers: Introduction; Heat Exchanger Analysis using LMTD and Effectiveness–NTU Method for Multi-Pass Plate Type and Evaporative Tubular Heat Exchanger; Heat Exchanger Design; Optimization of Heat Exchanger. **(08 Hours)**

Unit –VI

Thermal Radiation: Review of Basic Laws for Radiation; Black Body Concept; Gray Body Radiation; Solar Radiations; Radiation between Surfaces; Shape Factor Correlations; Radiation Exchange between Surfaces in Black Enclosure; Radiation Exchange in Gray Enclosure; Apparent Emissivity of a Cavity; Radiation Shields; Radiations in Emitting and Absorbing Media. **(06 Hours)**

Text Books:

1. Heat and Mass Transfer; Y. A. Cengel; McGraw-Hill; 3rd Edition; 2007.
2. Fundamentals of Heat and Mass Transfer; Frank P. Incropera et. al.; John Wiley & Sons; New York; 7th Edition; 2011.
3. Heat & Mass Transfer; P. K. Nag; Tata-McGraw hill; 3rd Edition; 2011.

Reference Books:

1. Fundamentals of Engineering Heat and Mass Transfer; R. C. Sachdeva; New Age International (P) Limited; New Delhi; 2nd Revised edition; 2006.
2. Heat Transfer; J. P. Holman; Tata-McGraw Hill; 9th Edition; 2004.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Advanced Thermodynamics	ME 563	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit –I

Review of Thermodynamic Laws and Corollaries: Recapitulation of Zeroth; First and Second Laws of Thermodynamics; Closed and Open Systems; Concepts of Entropy; Irreversibility; Availability; Exergy; Evaluation of Thermodynamic Properties of Working Substance; General Conditions for Thermodynamic Equilibrium; Introduction to Instability of Thermodynamic Equilibrium.

(09 Hours)

Unit - II

Single Phase Systems: Simple System; Equilibrium Conditions; Fundamental Relation; Relation between Thermodynamic Properties; Ideal Gas Mixture and Real Gas Mixtures. **(07 Hours)**

Unit - III

Exergy Analysis: Work Potential of Energy; Reversible Work and Irreversibility; Second Law Efficiency; Exergy Change of a System; Exergy Transfer by Heat, Work, and Mass; Exergy Balance. **(07 Hours)**

Unit - IV

Multi-Component Systems: Energy Minimization Principle; Instability; Clapeyron Relation; Phase Diagrams – Gibbs Phase Rules; Single-Component Substances; Two Component Mixtures and Corresponding States; General Conditions for Thermodynamic Equilibrium: Criteria for Equilibrium; Stability Conditions. **(08 Hours)**

Unit - V

Thermodynamics of Reactive Mixtures: Chemical Reactions and Combustion; Thermo-Chemistry; First and Second Law Analysis of Chemically Reacting Systems; Reaction Direction and Chemical Equilibrium. **(06 Hours)**

Unit - VI

Availability Analysis of Reacting Systems: Introduction; Entropy Generation through Chemical Reactions; Availability; Adiabatic Combustion; Maximum Work Using Heat Exchanger and Adiabatic Combustor. **(08 Hours)**

Text Books:

1. Advanced Thermodynamics Engineering; Annamalai Kalyan and Ishwar K Puri; CRC Press; 2nd Edition; 2011.
2. Thermodynamics: An Engineering Approach; Y. A. Çengel; M. A. Boles; Tata McGraw Hill; 3rd Edition; 2002.
3. Advanced Engineering Thermodynamics; Adrian Bejan; John Wiley & Sons; 3rd edition; 2006.

Reference Books:

1. Advanced Thermodynamics for Engineers; K. Wark; McGraw Hill; 1st Edition; 1995.
2. Engineering Thermodynamics: A Generalized Approach; P. L. Dhar; Elsevier Publications; 2008.
3. Engineering Thermodynamics; M. J. Moran and H. N. Shapiro; John Wiley & Sons; 8th Edition; 2007.

Gautam Buddha University Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Measurement and Process Control	ME 565	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 **Hours**

Unit – I

Need And Objective Of Experimental Study: Introduction; Measurement Systems; Performance Terms; Wind Tunnels: Introduction; Classification; Low-Speed Wind Tunnels; Power Losses in Wind Tunnel; Instrumentation and Calibration of Wind Tunnels; Wind Tunnel Balance; Data Acquisition System; Static and Dynamics Characteristic of Instruments.

(08 Hours)

Unit – II

Flow Visualization: Introduction; Classification of Visualization Techniques; Interferometer; Schlieren and Shadowgraph; Hot-Wire Anemometry: Introduction; Operating Principle; Hot-Wire Filaments; Constant Current Hot-Wire Anemometer (CCA); Constant Temperature Hot-Wire Anemometer; Hot-Wire Probes; Limitations of Hot-Wire Anemometer.

(07 Hours)

Unit – III

Analog Methods: Introduction; Hale-Shaw Apparatus; Electrolytic Tank; Hydraulic Analogy; Hydraulic Jumps; Pressure Measurement Techniques: Introduction; Barometers; Manometers; Dial Type Pressure Gauge; Pressure Transducers; Pitot; Static; and Pitot-Static Tube and Its Characteristics; Flow Direction Measurement Probes and Low Pressure Measurement Gauges.

(06 Hours)

Unit – IV

Velocity Measurement: Introduction; Velocity & Mach Number from Pressure Measurements; Laser Droplet Anemometer- LDA Principle; Doppler Shift Equation; Reference Beam System; Fringe System. Measurement of Velocity by Hot-Wire Anemometer; Measurement of Velocity Using Vortex Shedding Technique; Fluid Jet Anemometer; Mass & Volume Flow Measurement. **(09 Hours)**

Unit – V

Temperature Measurement: Introduction; Types of Thermometers; Thermocouples; RTD; Thermistors; Pyrometers; Temperature Measurement in Fluid Flow. **(06 Hours)**

Unit – VI

Uncertainty Analysis: Introduction; Estimation of Measurement Errors; External Estimation of Errors; Internal Estimate of The Error; Uncertainty Analysis- Uses of Uncertainty Analysis; Uncertainty Estimation; General Procedure- Uncertainty in Flow Mach Number; Uncertainty Calculation.

(09 Hours)

Text Books:

1. Instrumentation; Measurements and Experiments in Fluids; E. Rathakrishnan; CRC press; 2007.
2. Experimental methods for Engineers; Jack Philip Holman; Walter J. Gajda; McGraw-Hill; 4th Edition; 1984.
3. Measurement Systems; Ernest Doebelin; McGraw Hill Professional; 2003.

Reference Books:

1. Mechanical Measurements; Thomas G. Beckwith; Nelson Lewis Buck; Addison-Wesley Pub. Co.; 5th Edition; 1961.
2. Instrumentation for Process Measurement and Control; Norman A. Anderson; CRC Press; 3rd Edition; 1997.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Thermal Engineering)	Air Conditioning and Ventilation Systems	ME 567	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit I

Psychrometry: Calculation of Moist Air Properties; Psychrometer; Correlation of WBT with Temperature of Adiabatic Saturation; Lewis Number; Psychrometric Chart; Physiological Principles: Comfort; Thermal Interchanges with Environment; Physiological Body Regulatory Processes against Heat or Cold; High and Low Temperature Hazards; Extreme Environmental Conditions; Heat Stress Index; ASHRAE Comfort Standards. **(09 Hours)**

Unit II

Simultaneous Heat and Mass Transfer: Direct Contact Transfer Equipment; Simple Air Washer and Indirect Evaporative Cooling; 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. (**08 Hours)**

Unit III

Extended Surface Heat Transfer Apparatus: Cooling and Dehumidifying Coils; Types and Classification of Extended Surfaces; Design of Finned Surfaces; Adsorption Cooling Systems. **(08 Hours)**

Unit IV

Ventilation: Requirements; 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; Filtration.

(07 Hours)

Unit V

Air Cleaning: Physical and Chemical Vitiation of Air; Permissible Concentration of Air Contaminants; Mechanical and Electronic Air Cleaners; Dry and Wet Filters; Air Sterilization; Odour Control.

(07 Hours)

Unit VI

Design of Air-conditioning system: Design of 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.

(06 Hours)

Text Books:

1. Refrigeration and Air-conditioning; Stoecker & Jones; McGraw Hill; 2nd Edition; 1983.
2. Air Conditioning Engineering; William Peter Jones; Elsevier publication; 5th Edition; 2005.
3. Fundamentals of Industrial Ventilation; V.V. Baturin; Pergamon Press; Digital Edition; 2007.

Reference Books:

1. Extended Surface Heat Transfer; By Allan D. Kraus; Abdul Aziz; James Welty; Wiley e books; 2001.
2. Thermal Environmental Engineering; J. L. Threlkeld; Prentice Hall; U.S.A.; First Edition; 1970.
3. ASHRAE Handbook – ASHRAE (Fundamentals); 2013.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Advanced Fluid Mechanics	ME 569	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit –I

Review of Basic Concept: Concept of Continuum; Types of Fluids; Basic Laws in Integral Form: Reynolds's Transport Theorem; Integral Form of Continuity; Momentum and Energy Equations; Navier–Stokes Equation. **(05 Hours)**

Unit –II

Potential Flow: Uniform Flow; Source & Sink; Free Vortex Flow; Source & Uniform Flow (Flow Past a Half Body); Source-Sink Pair; Doublet; Flow Past a Cylinder (Doublet & Uniform Flow); Flow Past a Rankine Oval Body (Source; Sink & a Uniform Flow); Flow Past a Cylinder with Circulation (Doublet ; Vortex And Uniform Flow).

(09 Hours)

Unit –III

Turbulent Flow: Introduction; Growth of Instability and Transition from Laminar to Turbulent Flow; Effects and Classification of Turbulence; Turbulent Intensity; Scale of Turbulence; Reynolds Equations of Turbulence; Turbulence Modeling; Boussinesq Eddy Viscosity Concept; Prandtl Mixing Length Concept; Von-Karman Similarity Concept; Empirical Correlations for Coefficient of Friction; Average Velocity Distribution for Smooth and Rough Pipes.

(08 Hours)

Unit –IV

Compressible Flow: Introduction; Wave propagation and sound velocity; Mach number and compressible flow regimes; Mach Core; Mach angle and mach Line; Basic equations for one dimensional compressible flow; Continuity equation; Momentum equation; Energy equation; Isentropic flow relations; Compressibility correction factor; Flow through nozzles and from a reservoir.

(08 Hours)

Unit –V

Normal Shock Waves: Continuity Equation; Momentum Equations & Energy Equations; Flow with Oblique Shock Wave; Nature of Flow Through Oblique Shock Wave; Prandtls's Equation; Rankine-Hugoniot Equation. **(07 Hours)**

Unit –VI

Viscous Flow in Ducts: Stress-Deformation Relation; Navier-Stokes Equations; Reynolds Number Regimes; Internal vs External Viscous Flow; Flow in Circular Pipes; Alternate Forms of Moody Charts; Flow in Non-Circular Ducts; Minor Losses in Pipe System; Fluid Meters. **(08 Hours)**

Text Books:

1. Fundamentals of Compressible Flow; S.M. Yahya; New Age International Publishers; 3rd Ed.; 2003
2. Fluid Mechanics; John F Douglas; Janusz M. Gasiorek; John A; Swaffield; Pearson Education; 4th Ed.; 2007
3. Advanced Engineering Fluid Mechanics; K Muralidhar & G. Biswas; Alpha Science International Ltd; 2005

Reference Books:

1. Fluid Mechanics; Frank M. White; McGraw Hill; 6th Ed.; 2011
2. Viscous Fluid Flow; Frank M. White; Tata McGraw Hill; 3rd Ed.; 2013

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Advanced IC engines and Gas Turbines	ME 571	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit I

Review of IC Engines: Thermodynamic Analysis of I.C. Engine Cycles; Effect of Design and Operating Parameters on Cycle Efficiency; Modified Fuel-Air Cycle Considering Heat Losses and Valve Timing; Engine Dynamics and Torque Analysis; Use of Combustion Chart; Thermodynamic Cycles with Supercharging for S.I. and C.I. Engines; Limits of Supercharging; Methods of Supercharging and Superchargers.

(06 Hours)

Unit II

Combustion in IC Engines: Fuels and Fuel Rating; Essential Features of SI Engine Combustion Process; Design Consideration of SI Engine Combustion Chambers; Fundamentals of Ignition Systems; Abnormal Combustion; Carburetion and Fuel Injection Systems; Essential Features of CI Engine Combustion Process; Types of Diesel Combustion Systems; Knocking in CI Engine; Ignition Delay and its Related Correlations; Diesel Injection Systems; Modern Developments in IC Engines such as Stratified Charged Engine; Variable Compression Ratio (VCR) Engines; Dual Fuel and Multi-Fuel Engines; EGR, HCCI, CRDI etc. **(09 Hours)**

Unit III

Pollutant Emissions from IC Engines : Pollutant Formation Mechanisms; In-Cylinder and after-Treatment Strategies for Emission Control in SI And CI Engines; Effect of Design and Operating Variables on Emissions in SI And CI Engines; Measuring Instrumentation, Pollution Control Strategies, Emission Norms-EURO and Bharat Stage.

(08 Hours)

Unit IV

Introduction of gas turbine: Its Development; Classification and Field of Applications; Gas Turbine Cycle**:** Ideal and Actual Cycles; Multi-Stage Compression; Reheating; Regeneration; Combined and Cogeneration.

(07 Hours)

Unit V

Turbines: 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.

(08 Hours)

Unit VI

Gas Turbine Power Plants: Fuel and Fuel Feed Systems; Combustion Systems-Design Considerations and Flame Stabilization; Regenerator Types And Design; Gas Turbine Power; Plant Performance And Matching; Applications.

(07 Hours)

Text Books:

1. Fundamentals of I.C. Engines; H.B.Heywood; McGraw Hill.
2. I.C. Engine Theory and Practices; Vol.I & II C.F. Taylor; MIT Press.
3. I.C. Engine; Mathur and Sharma; Dhanpat Rai and Sons.
4. Gas Turbine Theory; Henry Cohen; G. F. C. Rogers; H. I. H. Saravanamuttoo; 2nd Edition; Pearson; 2001.

Reference Books:

1. Alternative Fuels: Emissions; Economics and Performance; T. T. Maxwell and J. Jones; Society of Automotive Engineers; 2002.
2. Gas Turbines; V. Ganesan; 2nd Edition; Tata McGrawHill; 2006.

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Energy Engineering and Management	ME 573	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
I	4	3-1-0	3 Hours

Unit - I

Energy Management Principle: General Energy Problem; Energy Uses Patterns and Scope of Conversion; Organizing and Managing an Energy Management Program. Energy Auditing: Elements and Concepts; Type of Energy Audits Instruments Used in Energy Auditing. **(06 Hours)**

Unit – II

Energy Conservation: Technologies for Energy Conservation; Design for Conservation of Energy Materials; Energy Flow Networks; Critical Assessment of Energy Usage; Formulation of Objectives and Constraints; Synthesis of Alternative Options and Technical Analysis of Options; Process Integration. **(08 Hours)**

Unit – III

Social and Economic Benefits: Energy Accounting and Analysis; Pollution Control Impact; Life Cycle Costing; Payback Period; Energy Management in Deregulated Environment. **(07 Hours)**

Unit – IV

Thermodynamics of Energy Conservation: Energy Conservation in Boilers and Furnace; Energy Conservation in Stream and Condensate System; Cogeneration- Concepts; Type of Cogeneration System; Performance Evaluation of a Cogeneration System. **(08 Hours)**

Unit – V

Waste Heat Recovery: Potential; Benefit; Waste Heat Recovery Equipment; Space Heating; Ventilation Air Conditioning (HVAC) and Water Heating of Building; Transfer of Heat; Space Heating Methods; Ventilation and Air

Conditioning; Heat Pumps; Insulation; Cooling Load; Electric Water Heating Systems; Electric Energy Conversation Methods' **(08 Hours)**

Unit – VI

Energy Conservation in Electric Utility and Industry: Energy Cost and Two -Part Tariff; Energy Conservation in Utility by Improving Load Factor; Load Curve Analysis; Energy Efficient Motors; Energy Conservation in Illuminating System; Importance of Power Factor in Energy Conservation - Power Factor Improvement Methods; Energy Conservation in Industries.

(08 Hours)

Text Books:

1. Energy Engineering and Management; Amlan Chakrabarti; Prentice Hall of India; 1st Edition; 2011.
2. Electrical Energy Utilization and Conservation; S.C. Tripathy; Tata McGraw-Hill; 1991.
3. Computer Based Energy Management Systems: Technology and Applications; Chun H. Cho; Academic Press; 1st Edition; 1984.

Reference Books:

4. Energy Management Handbook; Wayne C. Turner & Steve Doty; CRC Press Publications 6th Edition; 2007.

Industrial Energy Conservation: A Handbook for Engineers and Managers; D.A. Reay; Pergamon Press; 2nd Edition; 1979.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100

M. Tech. (Thermal Engineering)	Cryogenic Technology	ME 575	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit - I

Introduction to Cryogenic System: Introduction; Historical Development; Mechanical Properties; Thermal Properties; Electric and Magnetic Properties; Properties of Cryogenic Fluids. **(06 Hours)**

Unit - II

Gas Liquefaction: Minimum Work for Liquefaction; Methods to Produce Low Temperature; Liquefaction Systems for Neon, Hydrogen and Helium; Liquefaction of Other Gases like Oxygen, Nitrogen, Argon, Methane etc. **(06 Hours)**

Unit - III

Components of Liquefaction Systems: Heat Exchangers: Tubular; Giauque Hampson; Plate Fin; Perforated Plate; Compressors and Expanders; Expansion Valve; Losses for Real Machines. **(08 Hours)**

Unit - IV

Gas Separation and Purification System: Properties of Mixtures; Principles of Mixtures; Principles of Gas Separation; Air Separation Systems; Cryogenic Refrigeration System; Working Media: Solids; Liquids and Gases. **(08 Hours)**

Unit - V

Cryogenic Fluid Storage & Transfer: Cryogenic Storage Systems; Storage Vessel; Insulation Fluid Transfer Mechanics; Cryostat; Cryo-Coolers; Transportation and Transfer of Cryogenic Fluids; Mechanical Design of Vessels; Safety and Storage.

(09 Hours)

Unit - VI

Applications: Space Technology, Cryogenics Propellants for Rocket Propulsions; Flight Air Separation and Collection of LOX; Gas Industry; Biology; Medicine; Electronics. **(08 Hours)**

Text Books:

1. Cryogenic Heat Transfer; Randall F. Barron; Gregory Nellis; John M. Pfotenhauer; Taylor and Francis; 1st Edition; 1999.
2. Fundamentals of Cryogenic Engineering; Mamata Mukhopadhyay; Prentice Hall India; 1st edition; 2010.
3. Cryogenic Engineering; Thomas M. Flynn; Taylor & Francis; 2nd Edition; 2005.

Reference Books:

1. Cryogenic Engineering; B. A. Hands; Academic Press; 1st Edition; 1986.
2. Handbook of Cryogenic Engineering; J. G. Weisend; Taylor & Francis Group; 1st Edition; 1998.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100

M. Tech. (Thermal Engineering)	Solar Energy	ME 577	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
I	4	3-1-0	3 Hours

Unit – I

Introduction: Solar Energy Option; Specialty and Potential; Sun-Earth–Solar Radiation; Beam and Diffuse Measurement; Estimation of Average Solar Radiation on Horizontal and Tilted Surfaces; Problems and Applications.

(07 Hours)

Unit – II

Capturing Solar Radiation: Physical Principles of Collection; Types; Liquid Flat Plate Collectors; Construction Details; Performance Analysis; Concentrating Collection; Flat Plate Collectors with Plane Reflectors; Cylindrical Parabolic Collectors; Orientation and Tracking; Performance Analysis.

(08 Hours)

Unit – III

Power Generation: Solar Central Receiver System; Heliostats and Receiver; Heat Transport System; Solar Distributed Receiver System; Power Cycles; Working Fluids and Prime Movers.

(07 Hours)

Unit – IV

Thermal Energy Storage: Introduction; Need; Methods of Sensible Heat Storage using Solids and Liquids; Packed Bed Storage; Latent Heat Storage; Working Principle; Construction; Application and Limitations; Other Solar Devices: Stills; Air Heaters; Dryers; Solar Ponds & Solar Refrigeration.

(08 Hours)

Unit – V

Direct Energy Conversion: Introduction; Conversion from Solid; State Principles; Semiconductors; Solar Cells; Energy Conversion: Performance; Factor; Modular Construction; Applications.

(08 Hours)

Unit – VI

Economics: Principles of Economics Analysis; Discounted Cash Flow; Solar System; Life Cycle Costs; Cost Benefit Analysis and Optimization; Cost Based Analysis of Water Heating and Photo Voltaic Applications.

(07 Hours)

Text Books:

1. Principles of Solar Engineering; Kreith and Keride; Taylor & Francis;
2. Solar Engineering of Thermal Processes; Duffie & Beckman; John Wiley and sons; 4th Edition; 2013.
3. Solar Energy; S.P. Sukhatme; Tata McGraw Hill; 1st Edition; 2008.

Reference Books:

1. Solar Energy: Fundamental and Applications; Garg and Prakash; 1st Editions; Tata McGraw Hill; 2006.
2. Solar Power Engineering; B. S. Magal; 1st Editions; Tata McGraw Hill; 1990.
3. Solar Energy Conversion: The Solar Cell; R.C. Neville; Elsevier; 2nd Edition; 1995.

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Advanced Refrigeration and Air-conditioning	ME 562	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 **Hours**

Unit – I

Review of Refrigeration Systems and Refrigerants: Air Refrigeration; Vapour Compression; Vapour Absorption; Thermodynamic Properties of Refrigerants; Ozone Depletion Potential and Global Warming of Refrigerants; Future Refrigerants.

(08 Hours)

Unit – II

Review of Air Conditioning: Psychrometric Properties and Process in Air Conditioning; Comfort Design Conditions; Cooling Load Calculations and Applied Psychrometrics; Examples. **(06 Hours)**

Unit – III

Non-Conventional Refrigeration Systems: Steam Jet Refrigeration System; Vortex Tube; Magnetic Refrigeration System; Pulse Tube Refrigeration; Cryogenics: Principle of Liquefaction of Gases; Dry Ice Manufacturing.

(06 Hours)

Unit – IV

Ice Manufacturing and Food Preservation: Principle of Ice Production; Different Systems of Ice Manufacturing; Treatment of Water; Brines; Freezing Tanks; Ice Cans; Food Preservation: Factors; Causes; Methods; Freezing Methods; Cold Storage; Ice Rinks.

(07 Hours)

Unit – V

Commercial and Industrial Air Conditioning: Houses and Offices; Hotels and Restaurants; Departmental Stores; Theatres and Auditorium; Hospitals; Textile Industry. **(09 Hours)**

Unit – VI

Transport Air Conditioning: Introduction; Automobile Air Conditioning; Railway Air-Conditioning; Marine Air-Conditioning; Aircraft Air-Conditioning; Example and Case Study.

(09 Hours)

Text Books:

1. Refrigeration and Air Conditioning; Stoecker and Zones; McGraw Hill; 2nd Ed.; 1983.
2. Refrigeration and Air Conditioning; Domkundwar and Arora; Dhanpat Rai and Sons; 8th Ed.; 2014.
3. Refrigeration and Air Conditioning; Manohar Prasad; New Age International; 2nd Ed.; 2003.

Reference Books:

1. Refrigeration and Air Conditioning; P.L. Balaney; Khanna Publications;13th Ed.;2005.
2. Refrigeration and Air Conditioning; C.P.Arora; Tata McGraw Hill; 2nd Ed.; 2000.
3. Principles of Refrigeration; R.J. Dossat; Pearson educations; 4th Ed.; 2009.

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Computational Fluid Dynamics	ME 564	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 **Hours**

Unit – I

Introduction: Governing Equations of Fluid Flow and Heat Transfer; Partial Differential Equations - Physical and Mathematical Classification - Parabolic; Elliptical and Hyperbolic Equations. **(05 Hours)**

Unit – II

Finite Difference Method: Discretization: Converting Derivatives To Discrete Algebraic Expressions; Taylor's Series Approach; Polynomial Fitting Approach; Discretization Error; Heat Conduction –Steady One and Two Dimensional in Cartesian and Cylindrical Co-Ordinates; Handling of Boundary Conditions.

(09 Hours)

Unit – III

Finite Volume Method: Discretization of governing equations; Steady one-dimensional conduction equation; Uunder-relaxation and over relaxation; Solution of simultaneous equations – direct and iterative methods; Tridiagonal Matrix algorithm**.**

(06 Hours)

Unit – IV

Two Dimensional Steady State Conduction Problems in Cartesian: Point By Point and Line by Line Method of Solution; Dealing of Dirichlet; Neumann and Robbins Type Boundary Conditions; Formation of Discretized Equations for Regular Boundaries, Irregular Boundaries and Interfaces.

(09 Hours)

Unit – V

Transient Heat Conduction Problems in Cartesian and Cylindrical Co-ordinates: Explicit; Implicit; Crank Nicholson and ADI Methods- Stability of Each System; Conservation, Consistency, Stability and Convergence for Marching Problems; Discrete Perturbation Stability Analysis; Fourier or Von Neumann Stability Analysis.

(09 Hours)

Unit – VI

Discretization Equation for Two-Dimensions: Calculation for The Flow-Field-Stream Function-Vorticity Approach; SIMPLE; SIMPLER and SIMPLEC Algorithm; Numerical Marching Techniques; Two Dimensional Parabolic Flows with Heat.

(07 Hours)

Text Books:

1. Computational Methods for Fluid Dynamics; J. H. Ferziger and M Peric; Springer; 3rd Edition; 2002.
2. An Introduction to CFD: The Finite Volume Method; H. K. Versteeg and W. Malalasekera; Longman Scientific and Technical; 2007.
3. Numerical Heat Transfer and Fluid Flow; S. V. Patankar; Tayler and Francis; 1980.

Reference Books:

1. Computational Fluid Dynamics; J. D. Anderson; Jr.; McGraw Hill; 2008.
2. Computational Fluid Dynamics: An Introduction; J. F. Wendt; Springer; 3rd Edition; 2008.

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Experimental Methods in Thermal Engineering	ME 566	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit I

Importance of experimental investigation: Methodology, Error; Accuracy; Reproducibility and Uncertainty; Systematic and Random Errors; Absolute and Relative (Percentage) Errors- Error and Propagation Formulae; ASME Recommended Procedure for Estimation of Error and Uncertainty.

(08 Hours)

Unit II

Review of Statistical Concepts: Random Variable; Normal Distribution; Mean and Variance; Point and Interval Estimation; Types of Estimators; Efficient; Unbiased & Maximum; Likelihood Estimates; Tests of Hypotheses; Design of Experiments; One Way & Two Way Classification Tests with & without Interaction. **(08 Hours)**

Unit III

Basic Concepts in Static and Dynamic Measurements: Calibration and Standards; Generalized Measurements Systems; Basic Concepts in Dynamic Measurements; Performance Characteristics of Dynamic Measurement; Data Acquisition Systems.

(06 Hours)

Unit IV

Measurement of Thermal Properties: Pressure measurements; Manometers and electric pressure transducers; Temperature measurements; Thermocouple and its calibration; Resistance and radiation thermometer; Heat flux measurements; Nuclear and thermal radiation measurements; Examples.

(08 Hours)

Unit V

Measurement of transport properties: Velocity Measurements; Pitot Tubes; Thermal and Optical Anemometers; Flow Measurements; Flow Obstruction Methods and Electric Transducers for Volumetric and Mass Flow Rate Measurements; Particle Image Velocimetry.

(07 Hours)

Unit VI

Measurements in RAC systems: Hygrometry; Electrical; Psychometric and Condensation Methods; Duct Sensor for Relative Humidity and Temperature; Thermostat; Frost Potential Thermostat; Air Quality Sensors; CO_2 Sensor and Leak Detectors. **(08 Hours)**

Text Books:

1. The CRC Handbook of thermal engineering; Frank kreith. CRC Press; 1st Edition; 2000.
2. Theory and Design for Mechanical Measurements; Richard S. Figliola and Donald E. Beasley; John Wiley and Sons; 3rd Edition; 2005.
3. Experimental Methods for Engineers; Jack Phillip Holman; Mc Graw-Hill Series in Mechanical Engineering; 7th Edition; 2001.

Reference Books:

1. Mechanical Measurements; TG Beckwith; RD Marangoni ; J.H. Lienhard V ; Pearson Education; Sixth Edition;2007
2. A course in Mechanical Measurements and Instrumentation; A. K. Sawhney ;Dhanpat Rai & Sons; First Edition; 2000.
3. Experimental and Uncertainty Analysis for Engineers; H.W. Coleman; W.G Steele; John Wiley & sons; 2nd Edition; 1999.

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Alternate Fuels	ME 568	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 **Hours**

Unit - I

Introduction: Working Processes in I.C. Engine; Fuel Efficiency; Fuel Requirement; Rating of Fuels; Ignition Quality; Volatility; Sources of Fossil Fuels; Scope of Availability of Fossil Fuels; Need For Alternative Fuels; Calculation of Air / Fuel Ratio; Calorific Value; Engine Efficiency; Engine Life.

(07 Hours)

Unit - II

Alcohols: Sources; Methanol & Ethanol; Production Methods; Properties of Methanol & Ethanol as Engine Fuels; Use of Alcohols in S.I. & C.I. Engines; Performance of Methanol & Gasoline Blends; Alcohol Diesel Emulsions; Dual Fuel Systems; Emission Characteristics.

(09 Hours)

Unit - III

Hydrogen: Properties of Hydrogen with Respect to its Utilization as a Renewable Forms of Energy; Sources of Hydrogen; Production; Transportation; Storage; Application & Economics of Hydrogen. **(07 Hours)**

Unit - IV

Fuel Cells and Solar Power: Hydrogen; Methanol Fuel Cells; Power Rating and Performance; Heat Dissipation; Layout of a Fuel Cell Vehicle; Solar Power; Solar Cells for Energy Collection; Layout of Solar Powered Automobiles. **(07 Hours)**

Unit - V

Bio-Diesels and Engine Performance: Karanji Oil; Neem Oil; Rice Bran Oil; Linseed Oil; Sunflower Oil; Properties; Diesel & Vegetable Oil Blends; Engine Performance; Surface Ignition; Additives; Hybrid Power Plants and Fuel Cells.

(07 Hours)

Unit - VI

Electric Vehicles: Layout of an Electric Vehicles; Advantage & Limitations; Significations; Systems Components; Electronic Controlled Systems; High Energy & Power Density Batteries; Hybrid Vehicles.

(08 Hours)

Text Books:

1. C. I. Engine Performance for Use with Alternative Fuels; Society of Automotive Engineers; 2009.
2. Alternative Fuels: The Future of Hydrogen; Hordeski; M. F.; CRC Press; 2006.
3. Commercial Vehicle Alternative Fuels; Society of Automotive Engineers; 2007.

Reference Books:

1. Alternative Fuel: The future of Hydrogen; M. F. Horeski; Taylor and Francis Ltd.; 2008
2. Alternative Fuels: Emissions; Economics and Performance; T. T. Maxwell and J. Jones; Society of Automotive Engineers; 2002.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Turbo Machines	ME 570	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 **Hours**

Unit – I

Introduction: Types of Turbo Machines; Applications of Turbo Machines; Performance Characteristics; Methods of Analysis Dimensional Analysis; Dimensions and Dimensional Homogeneity; Buckingham Pi Theorem; Other Non-Dimensional Parameters for Turbo Machines; Similarity Laws Energy Transfer in Turbo Machines: Review on Fluid Mechanics Related to Turbo Machinery; Energy in Flowing Fluids; Euler Equations; Equations for Axial Flow Machines; Equations for Mixed and Radial Flow Machines; Degree of Reaction.

(08 hours)

Unit - II

Centrifugal Pumps: Basic Construction and Classification; Basic Working Principles; Performance Characteristics; Cavitation; Performance Modifications; Preliminary Design Procedure; Pump Performance Tests Axial Flow Pumps and Fans: Introduction; Flow Over Isolated Airfoils; Axial Flow Cascade; Preliminary Design Procedure; Propellers.

(07 hours)

Unit – III

Centrifugal Fans Blowers and Compressors: Classification Performance Parameters and Characteristics; Change of Performance; Polytropic Efficiency; Preliminary Design of Centrifugal Compressors. **(07 hours)**

Unit – IV

Axial Flow Compressors: Introduction; Basic Theory; Preliminary Design of Compressor Stage; Determination of Stage Efficiency; Axial Flow Compressor Performance; Surge and Stall in Compressor and the Remedies. **(08 hours)**

Unit –V

Gas Turbines: Introduction: Thermodynamics of Axial Flow Turbine; Degree of Reaction; Preliminary Design Procedure for Turbine Stage; Determination of Turbine Stage Efficiency; Axial Flow Turbine Performance; Compressor; Turbine Matching; Radial inflow Gas Turbine; Thermodynamic Processes in Radial Inflow Gas Turbine.

(08 hours)

Unit – VI

Wind Turbines: Introduction to Wind Power; Actuator Theory; Types of Wind Turbines; Wind Turbines Characteristics and Preliminary Design Analysis; Variable Speed Performance of Wind Turbines; Wind Turbine Applications. **(07 Hours)**

Text Books:

1. Fundamentals of Turbo Machinery; W. W. Peng; 1st Edition; John Wiley & Sons;2008.
2. Gas Turbines; V. Ganesan;2nd Edition; Tata McGrawHill; 2006.
3. Principles of Turbo Machinery; D. G. Shepherd;1st Edition; The Macmillan Company; 1956.
4. Gas Turbine Theory; Henry Cohen; G. F. C. Rogers; H. I. H. Saravanamuttoo; 2nd Edition; Pearson; 2001.

Reference Books:

1. Mechanics and Thermodynamics of Propulsion; P. Hill and C. Peterson;2nd Edition; PrenticeHall; 2009.
2. Fluid Mechanics; Thermodynamics of Turbo Machinery; S. L. Dixon; 4th Edition; Elsevier; 1998.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Thermal Engineering)	Advanced and Non-Conventional Energy Systems	ME 572	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit - I

Introduction: E.C Cycles; Gas Turbine & Sterling-Gas Turbine Cycles; Thermodynamic Analysis; Cycle Improvements; Intercoolers; Reheaters; Regenerators; Cogeneration; Systems–Topping & Bottoming Cycles-Performance; Indices of Cogeneration Systems; Heat to Power Ratio; Thermodynamic Performance of Steam Turbine; Cogeneration Systems: Gas Turbine cogeneration Systems.

(09 Hours)

Unit - II

Modern Combustion Technologies: Advance Ultra-Super Critical Technology; Zero Emission Coal Power Plant; Denitrification and Desulphurization; ESP Technologies; Supercritical Power Plants; Heat transfer and Fluid Flow in Nuclear Power Plants; PWR and BWR.

(09 Hours)

Unit - III

Solar Power: Solar Radiation and Collector Systems; Solar Angles; Sun Path Diagrams; Radiation-Extraterrestrial Characteristics; Measurement and Estimation on Horizontal and Tilted Surfaces; Flat Plate Collector; Thermal Analysis; Testing Methods; Evacuated Tubular Collectors; Concentrator Collectors; Classification, Design and Performance Parameters; Tracking Systems; Compound Parabolic Concentrators; Parabolic Trough Concentrators; Concentrators with Point Focus; Heliostats; Performance Of The Collectors.

(09 Hours)

Unit - IV

Thermal Technologies: Principle of Working; Types; Design and Operation of Solar Heating and Cooling Systems; Thermal Energy Storage Systems; Solar Desalination; Solar Cooker: Domestic, Community; Solar Pond; Solar Drying.

(09 Hours)

Unit - V

Solar PV Technologies: Semiconductor; Properties; Energy Levels; Basic Equations of Semiconductor Devices; Solar Cells-P-N Junction; Homo And Hetro Junctions-Metal-Semiconductor Interface; Dark and Illumination Characteristics; Merits of Solar Cell; Efficiency Limits; Variation of Efficiency with Band-Gap and Temperature; Efficiency measurements; High Efficiency Cells.

(09 Hours)

Text Books:

1. Goswami, D.Y., Kreider, J. F. and & Francis., Principles of Solar Engineering, Taylor and Francis,2000
2. Chetan Singh Solanki, Solar Photovoltaic's–Fundamentals, Technologies and Applications, PHI Learning Private limited, 2011
3. Sukhatme S P, J K Nayak, Solar Energy–Principle of Thermal Storageand collection, Tata McGraw Hill, 2008.

Reference Books:

1. Solar Energy International, Photovoltaic–Design and Installation Manual–New Society Publishers, 2006
2. Roger Messenger and Jerry Vnetre, Photovoltaic Systems Engineering,CRC Press, 2010

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Heat Exchanger Analysis and Design	ME 574	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit - I

Classification of Heat Exchangers: Definition, Applications, Various Methods of Classification of Heat Exchangers with Examples; Overview of Heat Exchanger Design Methodology; Process and Design Specifications; Thermal and Hydraulic Design; Mechanical Design; Manufacturing Considerations and Cost Estimates; Trade-Off Factors; Optimum Design; Other Considerations; Interactions among Design Considerations. (**06 Hours)**

Unit - II

Basic Thermal Design: Theory for Recuperators; Formal Analogy between Thermal and Electrical Entities; Heat Exchanger Variables and Thermal Circuit; The ∈-NTU Method; Effectiveness; Number of Transfer Unit Relationships; The P-NTU Method; P–NTU Relationships; The Mean Temperature Difference Method; F Factors For various Flow Arrangements; Comparison of The ∈-NTU; P–NTU and MTD Methods; Determining Exchanger Effectiveness; Heat Exchanger Design Problems. **(08 Hours)**

Unit - III

Thermal Design: Theory for Regenerators; Heat Transfer Analysis; The ∈-NTU Method; Influence of Longitudinal Wall Heat Conduction; Influence of Transverse Wall Heat Conduction; Influence of Pressure and Carryover Leakages; Influence of Matrix Material; Size and Arrangement.

(07 Hours)

Unit - IV

Heat Exchanger Pressure Drop Analysis: Introduction; Extended Surface Heat Exchanger Pressure Drop; Regenerator Pressure Drop; Tubular Heat Exchanger Pressure Drop; Plate Heat Exchanger Pressure Drop; Pressure Drop associated with Fluid Distribution Elements; Pressure Drop Presentation; Pressure Drop Dependence on Geometry and Fluid Properties.

(08 Hours)

Unit - V

Surface Basic Heat Transfer and Flow Friction Characteristics: Basic Concepts; Dimensionless Groups; Experimental Techniques for Determining Surface Characteristics; Analytical and Semi-Empirical Heat Transfer and Friction Factor Correlations for Simple Geometries; Experimental Heat Transfer and Friction Factor Correlations for Complex Geometries; Influence of Temperature-Dependent Fluid Properties; Influence of Superimposed Free Convection and Radiation. **(08 Hours)**

Unit - VI

Heat Exchanger Surface Geometrical Characteristics: Tubular Heat Exchangers; Tube-Fin Heat Exchangers; Plate-Fin Heat Exchangers; Regenerators with Continuous Cylindrical Passages; Shell-and-Tube Exchangers with Segmental Baffles; Gasketed Plate Heat Exchangers; Heat Exchanger Design Procedures: Fluid Mean Temperatures; Plate-Fin Heat Exchangers; Tube-Fin Heat Exchangers; Plate Heat Exchangers; Shell-And-Tube Heat Exchangers; Heat Exchanger Optimization. **(08 Hours)**

Text Books:

1. Compact Heat Exchangers; Kays, W. M. and London, A. L.; 2nd Edition, McGraw – Hill, New York.
2. Fundamentals of Heat Exchanger Design; R.K. Shah & D. P. Sekulic; John Wiley & Sons; 1st Edition; 2003.
3. Heat Exchangers: Selection; Rating; and Thermal Design; Sadik Kakaç; Hongtan Liu; Anchasa Pramuanjaroenkij; CRC Press; 3rd Edition; 2002.

Reference Books:

1. Thermal Design of Heat Exchangers: A Numerical Approach Direct Sizing and Stepwise Rating; Eric M. Smith; Wiley; 1st Edition; 1997.
2. Thermal Design and Optimization; A. Bejan; G. Tsatsaronis and M. Moran; John Wiley and Sons; 1st Edition; 1996.
3. Heat Exchanger Design Handbook; T. Kuppan; CRC Press; 1st Edition; 2000.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. (Thermal Engineering)	Aircraft and Rocket Propulsion	ME 576	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam**
II	4	3-1-0	3 Hours

Unit – I

Principles of Jet Propulsion: Introduction; Fundamentals of Jet Propulsion; Air-Breathing Engines: Introduction; Thermodynamics of Aircraft Jet Engines; Turbo Jet; Turbo Fan; Turbo Prop and Ramjet Engines; Typical Engine Performance. **(07 Hours)**

Unit – II

Aero Thermodynamics of Inlet; Combustors and Nozzles: Introduction; Subsonic Inlets; Supersonic Inlets; Gas Turbine Combustors; After Burners and Ram Jet Combustors; Supersonic Combustion; Exhaust Nozzles.

(08 Hours)

Unit – III

Performance of Rocket Vehicles: Introduction; Static Performance; Vehicle Acceleration; Gravity-Free Drag; Free Space Flight; Forces Acting on a Vehicle in the Atmosphere; Basic Relations of Motion; Space Flight; Flight Maneuvers; Effect of Propulsion System on Vehicle Performance; Flight Vehicles; Military Missiles; Flight Stability; Chemical Rockets.

(08 Hours)

Unit – IV

Liquid Propellant Rocket Engine Fundamentals: Types of Propellants; Propellant Tanks; Propellant Feed Systems; Gas Pressure Feed Systems; Tank Pressurization; Turbo-Pump Feed Systems and Engine Cycles; Solid Propellant Rocket Fundamentals; Basic Relations and Propellant Burning Rate; Other Performance Issues; Propellant Grain and Grain Configuration; Propellant Grain Stress and Strain; Attitude Control and Side Maneuvers with Solid Propellant Rocket. **(09 Hours)**

Unit – V

Liquid Propellants: Propellant Properties; Liquid Oxidizers; Liquid Fuels; Liquid Monopropellants; Gelled Propellants; Gaseous Propellants; Safety and Environmental Concerns.

(07 Hours)

Unit – VI

Solid Propellants: Classification; Propellant Characteristics; Hazards; Propellant
Ingredients; Other Propellant Categories; Liners; Insulators and Inhibitors; Propellant Processing and Manufacture.

(06 Hours)

Text Books:

1. Mechanics and Dynamics of Propulsion; Philip Hill and Carl Peterson; 2nd Edition; Addison-Wesley; 2009.
2. Rocket Propulsion Elements; P. Sutton & Oscar Billarz; 1st Edition; John Wiley& sons; 2011.
3. Gas Turbine Theory; Henry Cohen; G. F. C. Rogers; H. I. H. Saravanamuttoo; 2nd Edition; Pearson; 2001.

Reference Books:

1. Rocket and Spacecraft Propulsion; Martin J. L. Turner; 3rd Edition; Springer; 2008.
2. Aircraft Propulsion Systems Technology and Design; G. C. Oates; AIAA Series; 1989.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Thermal Engineering)	Optimum Design of Thermal Systems	ME 578	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit - I

Introduction: Design and Mathematical Modeling of Thermal Systems; Approach to Robust Design; Applications of Numerical Methods for Analysis of Thermal and Energy Systems; Closed Form Solutions of 1D And 2D Problems Related to Heat Transfer; Solution of Non Linear Equations; Interpolation; Regression, and Solution Of ODE's; Roots of Polynomials.

(09 Hours)

Unit - II

Design and Analysis of Industrial Equipment; Design Consideration for Engineering Material Selection.

(07 Hours)

Unit - III

Case Studies: Thermal System Analysis and Simulation Using ANSYS; Hydraulic Circuit Design and Analysis; Finite Difference Formulations and Finite Volume Formulations; Application of TDMA Method **(08 Hours)**

Unit - IV

Design and Analysis of Mechanical and Electronic Equipment. **(05 Hours)**

Unit - V

Optimization in Design: Problem Formulation and Optimization; Different Methods; Optimization of mechanical System; Practical Aspects in Optimal Design; Case Studies Related to Optimization of Mechanical Systems.

(09 Hours)

Unit - VI

Optimization for Constrained and Unconstrained Problems; Thermo-economic analysis and optimization of thermal Systems.

(07 Hours)

Text Books:

1. Design and Optimization of Thermal System by Y Jaluria. (2nd Edition) 2014.
2. Handbook for Product Design and Manufacture by G Bralla. (4th Edition) 2016.
3. Thermal Design and Optimization by A Bejan, G Satsoranis and M Moran;(2nd Edition) 2012.

Reference Books:

1. NPTEL Lectures of Hydraulic and Pneumatic Systems.
2. Computational fluid Dynamics by Versteeg and Malalasekhera;(3rd Edition) 2013.

Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	**Course Name**	**Course Code**	**Marks:100**
M. Tech. (Thermal Engineering)	Thermal and Nuclear Power Plants	ME 580	SM+MT+ET 15+15+70
Semester	**Credits**	**L-T-P**	**Exam.**
II	4	3-1-0	3 Hours

Unit - I

Introduction: Sources of Energy; Types of Power Plants; Direct Energy Conversion System; Energy Sources in India; Recent Developments in Power Generation; Combustion of Coal; Volumetric Analysis; Gravimetric Analysis; Flue Gas Analysis.

(06 Hours)

Unit - II

Steam Power Plants: General Layout of Steam Power Plant; Modern Coal-Fired Steam Power Plants; Power Plant Cycles; Fuel Handling; Combustion Equipment; Ash Handling; Dust Collectors; Steam Generators- Types; Accessories; Feed Water Heaters; Performance of Boilers; Water Treatment; Cooling Towers; Steam Turbines; Compounding of Turbines; Steam Condensers; Jet & Surface Condensers; Supercritical And Ultra-Supercritical Power Plants.

(10 Hours)

Unit - III

Gas Turbine Power Plant: Cogeneration; Combined Cycle Power Plants; Analysis; Waste-Heat Recovery; IGCC Power Plants; Fluidized Bed Combustion – Advantages & Disadvantages; Multi-Generation.

(07 Hours)

Unit - IV

Nuclear Power Plants: Recapitulation of Relevant Topics of Nuclear Physics; Nuclear Reactors; Classification: Types of Reactors; Site Selection; Methods of Fuel Enrichment: Uranium and Thorium. **(07 Hours)**

Unit - V

Nuclear Power Plants Safety: By-Products Of Nuclear Power Generation; Economics of Nuclear Power Plants; Nuclear Power Plants in India; Future of Nuclear Power; Nuclear Waste Disposal.

(07 Hours)

Unit - VI

Power Plant Instrumentation: Classification; Pressure Measuring Instruments; Temperature Measurement and Flow Measurement. Analysis of Combustion Gases; Pollution: Types; Methods to Control.

(08 Hours)

Text Books:

1. Power Plant Engineering; Black & Veatch; Springer; 1st Edition; 1996.
2. Nuclear Engineering Handbook; K. D. Kok; CRC Press; 1st Ed.; 2009.
3. Power Plant Engineering; A.K. Raja; A.P. Srivastava; M Dwivedi; New Age Publishers; 1st Ed.; 2006.

Reference Books:

1. Power Plant Technology; M. M. El Wakil; Tata McGraw Hill; New Delhi; 1st Edition;1984.
2. Nuclear Power Plant Engineering; J. H. Rust; Haralson Publishing Company; 1st Ed.; 1979.

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

M. Tech. (Thermal Engineering)	Advanced Thermal Engineering Lab	ME 579	SM+ET 50+50
Semester	**Credits**	**L-T-P**	**Exam.**
I	2	0-0-3	3 Hours

List of Experiments

S. No.	Name of Experiment
1.	Calculation of thermal conductivity of different materials
2.	Two stage air-compressor with intermediate water cooler based analysis
3.	Calculation of Lift and Drag force by wind tunnel
4.	LMTD of a finned and without finned heat exchanger
5.	Experiment on Split Type Air Conditioning Trainer
6.	Experiments on Gas Turbine
7.	Study of Boundary layer formation
8.	Analysis of Flue gases
9.	Cooling load calculation of a sample building
10.	Study of Centralized air-conditioning/duct design for central air-conditioning system

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

M. Tech. (Thermal Engineering)	Computational Fluid Dynamics Lab	ME 582	SM+ET 50+50
Semester	**Credits**	**L-T-P**	**Exam.**
II	2	0-0-3	3 Hours

List of Experiments

S. No.	Name of Experiment
1.	Write code in C++ or any other programming language
	a. to find solution of a set of linear equations b. to solve fin problem using TDMA algorithm c. to solve 1-D transient problem of heat conduction d. to solve 1-D non-linear problem of heat conduction e. to solve a fluid flow problem using SIMPLE algorithm
2.	Using ANSYS-FLUENT software analyse
	a. Heat conduction problem in regular and irregular domain b. Fluid flow over a flat plate c. Fluid flow over a heated vertical and horizontal cylinder d. Fluid flow around a aero foil section e. Natural convection in an enclosure