Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Technology and Science

Choice Based Credit System (CBCS) in Light of NEP-2020

M.Tech in Thermal and Design Engineering

(2021-2023)

COURSE CODE	CATE-GORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTME201	DCC	Design of thermal systems	60	20	20	0	0	2	1	0	3

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
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Course Objectives:-

The basic objective of the subject is to have goal of achieving a workable system and of designing an optimum system. The possibility of optimization represents one of the few facets of this subject. Pre requisites: Thermodynamics, Heat & Mass Transfer.

Course Outcomes:-

To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems. To develop representational modes of real processes and systems. To develop thermo economic optimization concerning design of thermal systems.

Syllabus

UNIT- 1 **(8Hr)**

Designing a Workable System and its Economics:

Steps in Arriving at a Workable System, Creativity in Concept Selection, Design of any Thermal Process Plant, Preliminaries to the Study of Optimization

UNIT- 2 **(8Hr)**

Dynamic Behavior of Thermal Systems:

Dynamic Analysis, One Dynamic Element in a Steady State Simulation, Laplace Transformers, Inversion of Laplace Transforms, Feedback Control Loops, Time Constants Blocks, Cascaded Time Constant Blocks, Stability Analysis.

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UNIT- 3 **(8Hr)**

Modeling Thermal Equipment:

Using Physical Insight, Selecting vs Simulating a Heat Exchanger, Evaporators and Condensers, Condensation of a Binary Mixture, Overview of Search Methods, Assessment of Single Variable Searches.

UNIT-4 **(8Hr)**

System Simulation:

Description of System Simulation Uses of Simulation, Information Flow Diagrams, Sequential and Simultaneous Calculations, Taylor Series Expansion, Newton Raphson Method with Multiple Equations.

UNIT- 5 **(8Hr)**

Optimization:

Levels of Optimization, Mathematical Representation of Optimization Problems, Linear Programming, Setting up the Mathematical Statement, Calculus Methods of Optimization, Expansion of Lagrange Multiplier Equations, Unconstrained Optimization.

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Reference:

1. Cengel YA., "Heat Transfer-A Practical Approach", Tata McGraw Hill, New Delhi 2e,2002.
2. Stoecker, WF. Design of Thermal Systems ,McGraw Hill International Editions, New Delhi, 2007
3. Woodson,TT. "Introduction to Engineering Design", McGraw Hill, New York, 1996.
4. Rudd, DF., "Strategy of Process Design", McGraw Hill, New York, 1996.

List of Practical's:

1. Compressibility factor measurement of different real gases.
2. Dryness fraction estimation of steam.
3. Flame propagation analysis of gaseous fuels.
4. Performance test and analysis of exhaust gases of an I.C. Engine.
5. Heat Balance sheet, Volumetric Efficiency and air fuel ratio estimation of an I.C. Engine.
6. COP estimation of vapour compression refrigeration test.
7. Performance analysis of Air conditioning unit.
8. Performance analysis of heat pipe.
9. Solar Flat Plate Collector
10. Evacuative tube concentrator

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MTME202	**DCC**	Design of IC Engine and Components	60	20	20	30	20	2	0	2	3

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Course Objectives:-

The course should enable the students to:

1. Know about various types of materials, properties of materials and various applications of the materials, and computer aided application.
2. Know about the fits, clearance and tolerances concepts, also the design of the helical springs.
3. know about design procedure to design piston and its parts, cylinder and cylinder block,
4. lubrication of piston assembly.

Course Outcomes:-

The students should be able to:

1. Know about the types of materials and material properties, Application of the materials, CAD application in the Automobile industry and Differentiate between the concepts of Fits, Clearance and Tolerance.
2. Design the helical springs and its application. The cylinder block and cylinder parts based on the engine specification of and also based on the engine application and the piston and its parts based on the engine specification of and also based on the engine application.
3. Design the connecting rod and its parts based on the engine specification of and also based on the engine application. The crankshaft and its parts based on the engine specification of and also based on the engine application also with the balancing weight of the crankshaft.
4. Design the valves and its mechanism for both the inlet and exhaust valve based on the engine specification of and also based on the engine application.
5. identify the different types of materials used for the manufacturing of the valve and its components.

Syllabus

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Unit-I **(8Hr)**

General Considerations in Engine Design

Principle of similitude, Choice of cycle, Speed, Fuel, Bore and Stroke, Cylinder arrangement, choice of material, Stress and Fatigue considerations, Design for manufacture, Factors for NHV and Control.

Unit-II **(8Hr)**

Design of Major Components

Piston system, Connecting rod assembly, Crankshaft system, Valve gearing, Stress analyses.

Unit-III **(9Hr)**

Design Of Other Components

Inlet and exhaust manifolds, Cylinder block, Cylinder liner, Cylinder head, Crankcase, Engine foundations and mountings, Gaskets, Bearings, Flywheel. Turbocharger, Supercharger, computer controlled fuel injection system.

Unit-IV **(8Hr)**

Design Of Two-Stroke Engines

Arrangement and sizing of ports, Piston assembly, Intake and exhaust system, Scavenging, application to automotive gasoline and marine diesel engines.

Unit-V **(8Hr)**

Concepts Of Computer Aided Design

Preparation of working drawings of designed components using CAD system.

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MTME202	**DCC**	Design of IC Engine and Components	60	20	20	30	20	2	0	2	3

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Reference Books:

1. Gordon P.Blair, "Basic design of Two-stroke Engines", S.A.E., 1992.
2. Gordon P.Blair, "Advanced Concepts of Two-stroke Engines", S.A.E., 1990.
3. Pounder, C.C., "Marine Diesel Engines", Butterworths, 1981.
4. A.Kolchin and V.Demidov, "Internal Combustion Engine Design", MIR Publishers, Moscow,1984.
5. Gordon P.Blair, "Design and Simulation of Four-Stroke Engines", Society of Automotive Engineers, Inc., USA, 1999.
6. D.E.Winterbone and R.J.Pearson, "Design Techniques for Engine Manifolds", Wave action methods for I.C.Engines, Professional Engineering Publishing Ltd., UK, 2000.
7. John Fenton (Editor), "Gasoline Engine Analysis for Computer Aided Design", Mechanical Engineering Publishing Ltd., UK, 1986.
8. Rodica Baranescu and Bernard Challen (Editors), "Diesel Engine", Society of Automotive Engineers, Inc., USA, 1999.
9. SAE Special Publication SP-700, "Adiabatic Engines and Systems", Society of Automotive Engineers, Inc., USA, 1987.

List of Practical's:

Design of automobile components:

1. Cylinder
2. Piston
3. Connecting rod.
4. Valves

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MTME203	DCC	Dynamics of mecha-nisms design	60	20	20	30	20	2	0	2	3

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Course Objectives:-

The course should enable the students to:

1. To understand the method of static force analysis and dynamic force analysis of mechanisms
2. To study the undesirable effects of unbalances in rotors and engines.
3. To understand the concept of vibratory systems and their analysis
4. To understand the principles of governors and gyroscopes.

Course Outcomes:-

The students should be able to:

1. Students will demonstrate the ability to synthesis, both graphically and analytically, multilink mechanisms.
2. Students will demonstrate the ability to perform mechanism analyses to find the position, velocity, acceleration, and dynamics of multi-bar mechanisms.
3. Students will demonstrate the ability analyze gear trains.

Syllabus

UNIT - I: **(8Hr)**

Angular Motion: Gyroscopes - effect of precession - motion on the stability of moving vehicles such as motorcycle - motorcar - aero planes and ships. Static and Dynamic Force Analysis of planar

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MTME203	DCC	Dynamics of mecha-nisms design	60	20	20	30	20	2	0	2	3

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mechanisms.

UNIT - II: **(10Hr)**

Friction: Inclined plane - Friction of screw and nuts - Pivots and collars - uniform pressure, uniform wear - friction circle and friction axis: lubricated surfaces - boundary friction - film lubrication, Clutches, Single plate, multi plate, cone clutch, centrifugal clutches.

Brakes And Dynamometers: Simple block brake - Internal expanding brake band brake of vehicle. Dynamometers - absorption and transmission types, General description and methods of operation.

UNIT - III: **(9Hr)**

Turning Moment Diagram and Flywheels: Turning moment- Interia torque- connecting rod angular velocity and acceleration-crank effort and torque diagrams-fluctuation of energy - flywheels and their

Governors: Watt, Porter and Proell governors- Spring loaded governors - Hartnell and Hartung with auxiliary springs- Sensitiveness, isochronisms and hunting- effort and power of the governors.

UNIT - IV: **(8Hr)**

Static and dynamic balancing – Balancing of rotating masses-Balancing a single cylinder engine–Balancing of Multicylinder inline, V-engines-Partial balancing in engines Balancing of linkages-Blancing machines Field balancing of discs & rotors

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MTME203	DCC	Dynamics of mecha-nisms design	60	20	20	30	20	2	0	2	3

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UNIT - V: **(8Hr)**

Response of one degree freedom systems to periodic forcing- Harmonic disturbances- Disturbance caused by unbalance- Support motion-transmissibility- Vibration isolation vibration measurement.

Reference:

1. Shigley, "Theory of Machine", Mc Graw Hill Publishers., 2009.
2. Thomas Bevan, "Theory of Machines" , Pearson., 2001.
3. R. K. Bansal, "Theory of Machines" , Lakshmi Publications, 5th Edition, 2008.
4. JS Rao and RV Duggipati, "Mechanism and Machine Theory", New Age., 2009.
5. Sadhu Singh, "Theory of Machines" , Pearson, 3rd Edition, 1999.
6. Ashok G. Ambekar, "Mechanism and Machine Theory" , PHI , Eastern Economy Edition., 2003.

TEXT BOOKS:

1. S. S. Rattan, "Theory of Machines" Mc Graw Hill., 2015.
2. Jagdish Lal, "Theory of Mechanism and Machines", Metropolitan Book Company., 2008.

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MTME206	DCC	Material Behaviour and Vibration	0	0	0	30	20	0	0	2	1

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Course Objectives:-

1. Summarize significance of material science and its role in manufacturing.
2. To provide methods of calculating safe rotating speed range to avoid whirling.
3. Student are able understand estimation of factor of safety of different designing materials.

Course Outcomes:-

1. Classify different engineering material (plastics, composites, smart materials and nanomaterials).
2. Ability to analyze the various properties and manufacturing techniques of plastics materials.
3. Ability of estimation of factor of safety of different designing materials.
4. Ability to use nanomaterials for linear and nanotechnology vibratory systems.
5. General notion on frequency and time response of vibratory systems.

Syllabus

Unit-I **(6Hr)**

Introduction:

Modern materials in design- plastics, composites, smart materials and nanomaterials, Weight reduction using plastics and composites, Properties and uses of plastics, composites, smart materials and nano-materials in the design of mechanical equipments. Estimation of factor of safety in design

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Unit-II **(5Hr)**

Design of Plastic Components:

Analysis of various properties for plastic components, manufacturing techniques of plastics, Various design considerations for plastic components, Applications of plastics in design of mechanical equipments, Mechanical properties of glass filled –polyphenylene, glass filled -polyethylene and glass filled-polyurethane.

Unit-III **(5Hr)**

Nanomaterials:

Nanotechnology, Nanoscale, Design applicaions, Nanotubes, Nano-sized particles in composites, Fabrication of nano-sized particles, nanodevices.

Unit-IV **(6Hr)**

Determination of Natural Frequencies Approximate methods of determining fundamental frequencies: Dunkerleys lower bound approximation and Rayleighs Method. Stodolas Method. The Holzers Method. The Method of Matrix Iteration, Envelop Analysis.

Unit-V

Systems with Multi-degree of Freedom and Continuous Systems. Equations of motion.The Matrix

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method : Eigen values and eigen vectors. Vibration of Strings. Longitudinal vibrations of bars. Torsional vibrations of Circular Members. Transverse Vibrations of Beams.

Reference:

1. A.G. Bratukhin and V.S. Bogolyubov, "Composite manufacturing technology", Chapman & Hall publication.
2. M.V. Gandhi and B.S. Thomson, "Smart Materials and Structures", , Chapman &Hall, 2001.
3. Charles P Poole and Frank J.Owens, "Introduction to Nanotechnology", Wiley-Inderscience,2003
4. Ambekar A. G., "Mechanical Vibrations and Noise Engineering", Prentice Hall of India Pvt. Ltd.,2006.
5. G. K. Grover, "Mechanical Vibrations", Nem Chand and Bros., Roorkee, 2009.

List of Practical's:

1. Experiments using strain gauges.
2. Measurement of strain, temperature effects,
3. Fixing of gauges on surfaces.
4. Experiments using photoelastic bench.
5. Setting of polariscope and calibration of disc, beam and tension model.

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6. Design of power transmission systems – complete design of belt drive and gear reducer and drafting.
7. Determination of natural frequency on single degree of freedom.
8. Determination of fundamental frequency in single degree of freedom
9. Study of torsional vibrations of circular members.
10. Study of transverse vibrations beam.

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M. Tech (Common for all Engineering branches)

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives (CEOs):

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. To analyze and evaluate research works and to formulate a research problem to pursue research.
3. To develop skills related to professional communication and technical report writing.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Understanding and formulation of research problem.
2. Apply quantitative and qualitative methods used in engineering research.
3. Analyze interpret and evaluate data that relate to engineering problems.
4. Develop skills related to professional communication, technical report writing and publishing papers.
5. Act professionally, autonomously, ethically and in teams to produce a professional product.

Syllabus

Unit-I

Introduction to Research Methodology: - An overview of Research process, Types of research; Approaches to research, Importance of criticism in Literature review, identifying research gaps; Formulation of research problem; Research design,

Data: Primary and secondary data-sources, advantages/disadvantages; Sampling and primary data collection, sampling size, random and structured sampling

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Unit-II

Measurement and Scaling Techniques: - Types of scales, Criteria for good measurement, Attitude measurement - Likert's scale, Semantic differential scale, Thurstone-equal appearing interval scale.

Statistical Tools for Data Analysis: - Measure of central tendency, Measures of dispersion, Correlation and Regression, Formulation of hypothesis, Type I & Type II error, Parametric test, non-parametric test.

Unit-III

Research Methods I - Use of computer software in research and understanding the limitations. Multi-attribute decision making methods, Data envelopment analysis, Grey relational analysis etc., Multidisciplinary research problems, Synthesis of disciplinary research findings; Reliability and sensitivity analysis.

Unit-IV

Research Methods II - Modeling and simulation of engineering problem; Mathematical modeling-formulation, calibration, validation, application; measurement design – validity, reliability, scaling and sources of error. Mathematical programming methods, Numerical analysis, Optimization techniques, Design of laboratory experiments and field tests.

Unit-V

Academic Writing Skills and Presentation - Layout of a Research paper, research report, Thesis structure, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Reference Management Software like Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism. Guidelines on how to write research papers. Content of Poster presentation, Power point presentation, Oral presentation

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Text Books -

1. C.R. Kothari, 2012. Research Methodology Methods and Techniques, 3/e, Vishwa Prakashan,
2. Montgomary, Douglas C., 2007. Design and Analysis of Experiments (Wiley India).
3. Chawla, D. and Sodhi, N., 2011. Research methodology: Concepts and cases. Vikas Publishing House.

Reference:

1. Donald H.McBurney, "Research Methods", 5th Edition, Thomson Learning, ISBN: 81-315-0047.
2. Donald R. Cooper, Pamela S. Schindler, "Business Research Methods", 8/e, Tata McGraw-Hill Co. Ltd.,
3. Timothy J. Ross, "Fuzzy Logic with Engg Applications", , Wiley Publications, 2nd Ed[d]
4. Thiel D.V. "Research Methods for Engineering", Published by Cambridge University Press, UK
5. P.J. van Laarhoven & E.H. Aarts, "Simulated Annealing: Theory and Applications" (Mathematics and Its Applications).

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M.Tech in Thermal and Design Engineering

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COURSE CODE	CATE-GORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTME214	DSE	Incompressible and Compressible Flows	60	20	20	0	0	2	1	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives:-

To impart knowledge of various basic principles and equations of fluid flow, exact and approximate solutions of Navier-Stokes equations under various flow conditions and introducing concepts in compressible flow normal shock, oblique shock and Fanno flow and Reyleigh Flow

Course Outcomes:-

The student will be able to

1. Ascertain basic concepts in the fluid flow.
2. Analyze both incompressible and compressible flow conditions.
3. Analyze practical problem in fluid flow.
4. Apply the concepts in the analysis of the fluid flow problems.
5. Capable of using the theories in the real life situation and take appropriate decisions with regards to design of various fluid handling devices.
6. Understand the performance of fluid flow devices in laminar and turbulent flow.
7. Design compressible flow components used in Turbo Machines and Air-Conditioning.

SYLLABUS-

Unit-I **(8Hr)**

Introduction: Introduction to Fluid Mechanics, Properties of Fluids

Fluid Statics: Fluid Statics, Fundamental Equations-Applications of Fundamental Equations, Relative Motion of Liquids Kinematics of Fluids,

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Kinematics of Fluids- Review of basics, Velocity potential, Stream function and Vorticity. **Theory of Stress and Rate of Strain:** General theory of Stress and Rate of Strain Fundamental Equations, Integral form Fundamental Equations, Reynolds Transport Theorem, Applications of the Integral Form of Equations-Numerical.

Unit-II **(9Hr)**

Fundamental Equations in Differential Form: Equations in Differential Form, One-dimensional Inviscid Incompressible Flow, Euler's Equation and Bernoulli's Equation, Applications of the Bernoulli's Equations-Numerical.

Two and Three – dimensional Inviscid Incompressible Flow: Two and Three – dimensional Inviscid Incompressible Flow, Laminar Flow, Flow between Parallel Flat plates, Steady Flows in Pipes, Applications of Laminar Flow-Numericals.

Unit-III **(9Hr)**

The Laminar Boundary layer: The Laminar Boundary layer, Prandtl's Boundary Layer Equations, The Boundary layer along a Flat Plate, Solution to the Boundary Layer Equations,
Momentum Integral Equation, Separation of Boundary Layer and Control-Numericals
Turbulent Flow: Introduction to Turbulent Flow, Modified N-S Equations-Semi, empirical Theories, Turbulent Boundary Layer,Numericals
Dimensional Analysis: Flow over a bluff body, Lift and Drag, Dimensional Analysis and Similitude.

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Unit-IV **(9Hr)**

Introduction to Compressible Flow: Review of Fundamentals Stagnation Properties, Relations and Tables, Numericals

Wave Motion: Propagation of Motion in Compressible Fluids, Mach number and Mach Cone, Numericals, Isentropic Flow

Isentropic Flow: Relations, Flow through Nozzles and Diffusers, Isentropic Flow Relations and Tables, Numericals

Unit-V **(8Hr)**

Flow across Normal Shock and Oblique Shock: Basic Equations, Normal Shock, Prandtl-Meyer Equation, Oblique shock-Property variation, Relations and Tables, Numericals.

Flow through a constant area duct with Friction: Flow through a constant area duct with Friction Fanno, Line Fanno Flow, Variation of Properties, Relations and Tables, Numericals. Flow through a constant area duct with Heat Transfer, Flow through a constant area duct with Heat Transfer Rayleigh Line, Rayleigh Flow.

Reference:

1. S.W. Yuan, "Foundations of Fluid Mechanics", Prentice Hall of India, 2000
2. S.M. Yahya, "Fundamentals of Compressible Flow, with Aircraft and Rocket Propulsion", 4th edition, New Age techno, 2010
3. Schlichting, H., "Boundary Layer Theory", 8th edition, Springer, 2004.
4. White F.M., "Viscous Fluid Flow", 3rd edition, Tata McGraw Hill Book Company, 2011.

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MTME224	DSE	Measurement in thermal engineering	60	20	20	0	0	2	1	0	3

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Course Objectives:-

The objective of the course is to make the students:

1. Introduce to analyze experimental error, static and dynamic characteristics of instruments
2. Learn the working of various measuring instruments used in the field of thermal engineering
3. Learn the measurement of properties like thermal conductivity of solids, liquids and gases
4. Learn the measurement of transport properties like diffusion, convective heat transfer

Course Outcomes (COs):-

After completion of this course the students will be able to:

1. Use appropriate instrument for measurement of specific parameter.
2. Analyze experimental error, Static and Dynamic characteristics of instruments.
3. Use appropriate instrument measurement of transport properties.
4. Practically apply the principles of measurement to engineering applications / projects.

UNIT-I **(8Hr)**

Instrument classification, static and dynamic characteristics of instruments, experimental error analysis, systematic and random errors, statistical analysis, uncertainty, reliability of instruments,
Variable resistance transducers, capacitive transducers, piezoelectric transducers, photoconductive transducers, photovoltaic cells, ionization transducers, Hall effect transducers.

UNIT-II **(8Hr)**

Dynamic response considerations, Bridgman gauge, McLeod gauge, Pirani thermal conductivity gauge, Knudsen gauge, Alphatron.

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UNIT-III **(8Hr)**

Flow measurement by drag effects; hot-wire anemometers, magnetic flow meters, flow visualization methods, interferometer, Laser Doppler anemometer.

Temperature measurement by mechanical effect, temperature measurement by radiation, transient response of thermal systems, thermocouple compensation, temperature measurements in high- speed flow.

UNIT-IV **(8Hr)**

Thermal conductivity measurement of solids, liquids, and gases, measurement of gas diffusion, convection heat transfer measurements, humidity measurements, heat-flux meters.

Detection of thermal radiation, measurement of emissivity, reflectivity and transmissivity, solar radiation measurement.

UNIT-V **(8Hr)**

Review of open and closed loop control systems and servo mechanisms, Transfer functions of Mechanical Systems, input and output systems.

References:

1. Holman, J.P., "Experimental methods for engineers", Tata McGraw-Hill, 7th Edition, 2007.
2. Prebrashensky. V., "Measurement and Instrumentation in Heat Engineering", Vol.1, MIR Publishers, 1980.
3. Raman, C.S. Sharma, G.R., Mani, V.S.V., "Instrumentation Devices and Systems", 2nd Edition, Tata McGraw-Hill., 2001.
4. Morris. A.S, "Principles of Measurements and Instrumentation",3rd Edition, Butterworth-

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Heinemann, 2001.

5. Beckwith & Buck, "Mechanical Measurements", 2001.
6. M. Gopal, "Control Systems, Principles & Design",4th Edition, TMH, 2012.

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