SEMESTER-V

Subject Code	Course Title	Hrs per week			Max. Marks		Total Marks	Credits
		Lecture	T	P	Int.	Ext.		
BMECS1-501	Heat Transfer	3	1	0	40	60	100	4
BMECS1-502	Mechanical Measurement & Metrology	3	0	0	40	60	100	3
BMECS1-503	Automobile Engineering	3	0	0	40	60	100	3
BMECS1-504	Kinematics & Theory of Machines	3	1	0	40	60	100	4
XXXXX	Open Elective	3	0	0	40	60	100	3
BMECS1-505	Mechanical Engineering Lab-III (MMM &HT)**	0	0	2	60	40	100	1
BMECS1-506	Mechanical Engineering Lab-IV (AE &TOM)***	0	0	2	60	40	100	1
BMECS1-507	*Industrial Training	0	0	0	60	40	100	3
Total Credits		**15**	**2**	**4**	**380**	**420**	**800**	**22**

- ***Industrial training to be imparted at the end of 4th semester for six weeks.**
- ** MMM-Mechanical Measurement & Metrology Lab, HT- Heat Transfer Lab**
- ***AE-Automobile Engineering Lab, TOM-Theory of Machine Lab**

HEAT TRANSFER

Subject Code:BMECS1-501 **L T P C** **Duration: 60 Hrs.**

3 1 0 4

Course Objectives:

1. To introduce students different modes of heat transfer like conduction, convection & Radiation. The aim of the course is to build a solid foundation in heat transfer.
2. Able the students to develop solution procedures of governing equations for the different modes of heat transfer. Estimation of heat transfer through composite walls & transient temperature state HT to sudden change.
3. Understand the principles of boiling and condensation including radiation heat transfer related engineering problems.
4. Understand the basic principles of heat exchanger analysis and thermal design.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Formulate and analyze a heattransfer problem involving any of the three modes of heat transfer.
2. Obtain exact/approximate solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
3. Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.
4. Apply the boiling and condensation heat transfer principles to engineering problems.

UNIT-I

Concept of heat transfer, Difference between the subject of "Heat Transfer" and its parent subject "Thermodynamics" Fouier's law of heat conduction, Introduction to three modes Basic modes of Heat Transfer & their mechanisms. Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, Heat transfer through pin fins- Straight fins of uniform cross-section, Straight fins with

varying cross-sectional area Circumferential fins of rectangular cross section, Fin performance: fin effectiveness and fin efficiency, total fin effectiveness, total fin efficiency Optimizing design of fin. Solutions of two dimensional conduction (approximate). **15 Hrs.**

UNIT-II

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. **15 Hrs.**

UNIT-III

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, Plank's law, Kirchoff's law, Lambert's Cosine law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method. Coefficient of radiant heat transfer, Radiation from gases, vapors and flames.Error in Temperature measurement by a thermocouple probe due to radiation losses. **10 Hrs.**

Heat Exchanger: Classification of heat exchangers, LMTD Approach for parallel & Counter flow heat exchangers, NTU approach for parallel/ Counter flow heat exchangers, Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and NTU methods.

8Hrs.

UNIT-IV

Boiling and Condensation heat transfer, Pool boiling curve. Forced convection boiling, heat transfer during pool boiling of a liquid. Nucleationand different theories of nucleation, Condensation, types of condensation, film wise condensation on a vertical and inclined surface, Introduction mass transfer, Similarity between heat and mass transfer. Recent advancement in heat transfer and geothermal systems. **12 Hrs.**

Recommended Books:

1. A.J. Chapman, 'Heat Transfer', McGraw Hill Book Company, New York.

2. Frank P. Incropera and David P. De Witt, Fundamentals of Heat and Mass transfer, JohnWiley.
3. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002
4. Fundamentals of Heat and Mass Transfer by F.P.Incropera and D.P.Dewitt, 4th ed., John Wiley & Sons.
5. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
6. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002.

MECHANCIAL MEASUREMENTS AND METROLOGY

Subject code: BMECS1-502 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objectives:

1. The main objective of this course is to make students familiar with the mechanical measuring systems, and the standard measurement methods.
2. It further aims to make them to understand the basic measuring systems in the real time engineering applications.
3. To educate students on different measurement systems for metrology purpose.
4. To introduce concepts of linear, angular, roughness thread, gear measurements, limits, fits and tolerances.

Course Outcome

Upon successful completion of this course, the student will be able to:

1. Understand the classification of measurements and measurement standards used in industrial applications. To introduce concepts of linear, angular, roughness thread, gear measurements, limits, fits and tolerances.
2. Understand about various errors in measuring systems and evaluate the errors by statistical methods.
3. Know about functions and types of sensors and transducers and their utility in instrumentation.
4. Use various instruments for measurements like pressure, flow, temperature etc. In process industry manufacturing.

UNIT-I

Mechanical Measurement and Measurement systems: Definition, significance of measurement, generalized measurement system, Methods of Measurement, Classification of measuring instruments, Selection of measuring instruments, Input output configuration of measuring instruments, Methods of correction for interfering & modifying inputs, definitions and concept of Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and

linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. **6 Hrs.**

Errors in Measurement: Errors in Measurement: Sources of errors; Gross, Systematic and Random errors; Statistical analysis of test data- single sample test and multi sample test; Probable error – average and standard deviation for normal curves; Rejection of test data.

3 Hrs.

UNIT-II

Metrology: Line, end and wavelength standards; linear measurements - vernier scale and micrometer, vernier height gauge and depth guage; Angular measurements - sine bar, clinometer, angle gauge. Precision instrumentation based on laser principles; coordinate measuring machines: structure, modes of operation, probe, operation and applications; Optical measuring techniques: tool maker's microscope, profile projector, optical square; Basics of optical interference and interferometry, optoelectronics measurements. **6 Hrs.**

Comparators: Introduction; need of comparators, basic principles of operation, uses, essential characteristics, classification of comparators; mechanical, optical, mechanical optical, pneumatic, fluid displacement. **4 Hrs.**

UNIT-III

Surface finish measurement: Introduction; Different surface texture, elements of surface texture, factors affecting surface finish, reasons for controlling surface texture, methods of measuring surface finish, indication of surface roughness symbols used. **6 Hrs.**

Pressure and Flow Measurement: Bourdon tube; diaphragm and bellows; Vacuum measurement – McLeod gauge; thermal conductivity gauge and ionization gauge; dead weight gauge tester. Electromagnetic flux meters; ultra-sonic flow meters and hot wire anemometer. Flow visualization techniques. **6 Hrs.**

UNIT-IV

Transducers: Variable resistance transducers, variable capacitance transducers, piezo-electric transducers, photoelectric transducers, strain gauges, use of various transducers. Measurement of strain and temperature: Theory of strain gauges, types, electrical resistance strain gauge, preparation

and mounting of strain gauges, gauge factor, methods of strain measurement. Temperature compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque, Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer. **6 Hrs.**

Speed and Force Measurementwith the help of latest measurement systems: Mechanical tachometers; vibration reed tachometer and stroboscope; proving ring;. Hydraulic and pneumatic load cells. Recent trends in Signal Processing: Sensing elements, Types of Signals, Signal Processing and Conditioning elements, Data Acquisition Digital Techniques in Mechanical Measurements, Readouts and Data Processing, analysis and Data Presentation elements.

Current Trends in Instrumentation, Fiber Optic Instrumentation, Fiber Optic Sensors such as Pressure Sensors, Voltage Sensor, Liquid Level Monitoring, Temperature Sensors, Stress Sensor. Fiber Optic Gyroscope Polarization Maintainingfiber. **8 Hrs.**

Recommended Books:

1. A. Bewoor and V. Kulkarni, 'Metrology and Measurement', McGraw-Hill, 2009.
2. E.O Doebelin, Measurement System: Application and Design, McGraw Hill, 2008.
3. J.P Holman, Experimental Methods for Engineers, McGraw Hill.
4. Instrumentation, Measurment and Analysis by B.C.Nakra and K.K.Chaudhary, TMH.
5. T.G. Beckwith, R.D. Marangoni and J.H. Lienhard, *Mechanical Measurements*, 5th Ed., Addison Wesley, 1993.
6. Measurement & Instrumentation Principles", Alan S MorrisPrentice Hall of India, 1996.

AUTOMOBILE ENGINEERING

Subject code: BMECS1-503 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objectives.

1. Understand the layout, constructional and working of power unit and fuel supply system of an automobile.
2. To understand functioning of lubrication, cooling andsuspension system of an automobile.
3. To understand construction and working of transmission, steering and braking system of an automobile.
4. To understand working of starting and electrical systems of an automobile. Also to get knowledge of the recent developments in the automobile field.

Course Outcomes:

Students successfully completing this course will be able to -

1. Know the layout, constructional and working of power unit and fuel supply system of an automobile.
2. Know the functioning of lubrication, cooling and suspension system of an automobile.
3. Know construction and working of transmission, steering and braking system of an automobile.
4. Know working of starting and electrical systems of an automobile. Also get knowledge of recent developments in the automobile field.

UNIT-I

Introduction: Basic structure, general layout and type of automotive vehicles, Frameless and unitary construction; position of power unit; Components of the Automobile; Functions of Major Components of an Automobile.

Power Unit: Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system, silencers, types of pistons and rings.

Fuel Supply System: Air cleaner and fuel pumps; Air fuel requirements and carburation; constructional details of carburetor and fuel injection systems; MPFI (Petrol), Diesel Engine fuel

supply system - cleaning, injection pump, injector and nozzles, Individual Pump and Common Rail fuel supply systems. **12 Hrs.**

UNIT-II

Lubrication and Cooling Systems: Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crank case ventilation and dilution. Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.

Chassis and Suspension: Loads on the frame, considerations of strength and stiffness, engine mounting, independent suspension systems (Mac Pherson, Trailing Links, Wishbone), shock absorbers and stabilizers; wheels and tyres, tyre wear types, constructional details of plies **11 Hrs**

UNIT-III

Transmission System: Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission

Steering System: Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering, Ball re-circulating mechanism

Braking System: General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances, Anti-Braking systems.

10 Hrs.

UNIT-IV

Starting System: Principle, starting torque, engine resistance torque, and power required for starting of engine. Starter motor and its circuit. Types of drive mechanisms: Bendix drive, pinion type, axial sliding armature starter. Slipping and overrunning of clutches, automatic switches for starting, cold starting devices: Glow plug & choke.

Electrical and electronic Systems: Classification, Introduction to Conventional and transistorized ignition systems; Charging, capacity ratings and battery testing; voltage and current regulation, wiring, fuse system, circuit breakers, Relays, Switches. Layout and Wiring diagram of vehicles, automotive accessories and safety features in automobile.

Latest Trends in automobile sector: Introduction of Gas, Electrical and Hybrid, solar powered vehicles.

Maintenance: Preventive maintenance, trouble shooting and rectification in different systems; engine tuning and servicing, major tools used for maintenance of automobiles. **12 Hrs.**

Recommended Books

1. Kamaraju Ramakrishna, 'Automobile Engineering', PHI Course, New Delhi, 2012.
2. Jain &Asthana, 'Automobile Engineering', Tata McGraw-Hill, New Delhi, 2002.
3. W.H. Crouse, 'Automotive Mechanics', McGraw Hill.
4. J. Heitner, 'Automotive Mechanics', East West Press.
5. Kirpal Singh, 'Automobile Engineering', Vol. I and II, Standard Publishers.
6. P.S Gill, 'Automobile Engineering', S.K. Kataria.

KINEMATICS AND THEORY OF MACHINES

Subject code:BMECS1-504 **L T P C** **Duration: 60 Hrs.**

3 1 0 4

Course Objectives:

1. The primary object of the course is to make the student understand the concept of: displacement, velocity and acceleration of simple mechanisms, cams and cam profiles of various cams, using different followers and motions.
2. The students will able to understand constructional and working features of important machine elements.
3. The students should be able to understand various parts involved in kinematics of machines including balancing of single and multiple rotating masses Gyroscopic motion and couples.
4. The students should be able to understand gear trains, belt rope and chains, and governors.

Course outcomes:

Upon the completion of this module students shall be able to understand, analyze and solve design problems related to:

1. Four bar chain, displacement, and velocity and acceleration analysis of simple mechanisms.
2. Cams and its displacement, velocity and acceleration diagrams, cams profiles, gears and gear trains.
3. Belts, ropes, chains and different types of governors.
4. Balancingof reciprocating masses, engines rotors and gyroscopic motion couples and robotic motions.

UNIT-I

Introduction: Kinematic Pairs, mechanisms, degree of freedom, Grashof's law, Inversions of four bar chain and slider crank chain, quick return mechanism. **6 Hrs.**

Velocity and acceleration analysis: Displacement, Velocity and acceleration analysis of simple mechanism, graphical velocity analysis using instantaneous centres, Coriolis component of acceleration.Universal joint- single and double, calculation of maximum torque. Oldham’s Coupling, steering mechanism including Ackermann’s and Davis steering mechanism. Mechanism with lower

pairs, pantograph, exact and approximate straight line motion,

6 Hrs.

UNIT-II

Cams: Classification of cam and follower -terminology and definitions- displacement diagrams - uniform velocity, parabolic, simple harmonic and cycloidal motions, follower motions, circular and tangent cams- roller and flat face follower **8 Hrs.**

Gear and Gear trains: Involute and cycloidal gear profiles, gear parameters, fundamental laws of gearing, and spur gear contact ratio and interference /undercutting. Helical, bevel, worm, rack and pinion gears Gear trains, types of gear trains simple, compound, Epicyclic and Compound Epicyclic gear trains, problems involving their applications. **8 Hrs**.

UNIT-III

Belts ropes & chains: Belt , ropes and chain drives , flat and V-belts, rope and chain drives, idle pulley ,crowning of pulley , loose and fast pulley , ratio of tension on tight and slack side of belt , length of belt , creep and slip , power transmitted by belt. **7 Hrs.**

Governors: Function, Porter and Proell governors, Hartnell and Willson-Hartnell spring loaded governors, Sensitivity, stability, Isochronism and hunting of governor, Governor effort and power, controlling force curve, effect of sleeve friction **10 Hrs.**

UNIT-IV

Balancing: Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses, partial unbalanced primary force in an engine, balancing of reciprocating masses, and condition of balance in multi cylinder in line V-engines, concept of direct and reverse crank, balancing of machines, rotors, reversible rotors **10 Hrs.**

Gyroscopic Motion and Couples: Effect on supporting and holding structures of machines. Stabilization of ships and planes, gyroscopic effect on two and four wheeled vehicles.An introduction to ModernRobot mechanisms for robotic motions. **5 Hrs.**

Recommended Reference &Text Books

1. John, Gordon, and Joseph, ‘Theory of Machines and Mechanisms’, Oxford University Press.
2. S.S. Rattan, ‘Theory of Machines’, Tata McGraw Hill, New Delhi.
3. JagdishLal, ‘Theory of Machines and Mechanisms’, Metropolitan Book Co.

4. Sandor G.N., Erdman A.G "Theory of Machines", Prentice Hall Publications,
5. J.S Rao and R.V Dukkipati Mechanism and Machine theory NEWAGE international Publishers.
6. Shigley J.E., Uiker J.J "Theory of Mechanisms & Machines", McGraw Hill Int., 1985.
7. Ghosh A, Mallik A "Theory of Mechanisms & Machines, Ed", Aff. East-West Press, 3rd 1998.

MECHANICAL ENGINEERING LABORATORY-III (MMM & HT)

Subject code: BMECS1-505 **L T P C**

0 0 2 1

Course Objectives:

1. To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
2. To illustrate the use of various measuring tools.
3. To understand calibration techniques of various measuring devices.
4. To enable the student to apply conduction, convection and radiation heat transfer concept to practical applications.
5. To enable the student to perform analysis and interpret results to draw valid conclusions through standard test procedures
6. To enable the student to determine thermal properties and performance of heat exchange and other heat transfer devices.

Contents:

1. Measurement of an angle with the help of sine bar.
2. Measurement of surface roughness of a machined Plate, Rod and Pipe.
3. Measurement of gear elements using profile projector.
4. Measurement of thread element by Tool maker microscope.
5. Use of stroboscope for measurement of speed of shaft.
6. Calibration of Micrometer using slip gauges.
7. To study and compare temperature distribution, heat transfer rate, overall heat transfer in parallel flow and counter flow heat exchanger.
8. To find out total thermal resistance and total thermal conductivity of composite wall.
9. To study the temperature distribution along the length of fin in Forced convection and Natural Convection
10. To determine heat transfer coefficient in drop wise and film wise condensation.
11. To study the phenomenon of the boiling heat transfer and to plot the graph of heat flux versus temperature difference.
12. To determine the emissivity of given test plate surface.

Course Outcome

The student will be able to:

1. Define metrology and apply concept of metrology to engineering applications
2. Understand the basic measurement units and able to calibrate various measuring devices.
3. Use measuring tools such as Sine bar, surface roughness tester, profile projector, Tool Maker Microscope, stroboscope, Micrometer, etc.
4. Perform steady state conduction experiments to estimate temperature distribution and thermal conductivity of different materials.
5. Perform transient heat conduction experiments
6. Estimate heat transfer coefficient in natural, forced convection and condensation and boiling process also.
7. Determine surface emissivity of different surfaces and Stefan Boltzmann's constant.

MECHANICAL ENGINEERING LABORATORY-IV (AE & TOM)

Subject code: BMECS1-506 **L T P C**

0 0 2 1

Course Objectives

1. To deliver basic knowledge of different components of automobiles
2. To understand functioning of different systems of automobile.
3. To enhance knowledge of fault diagnosis and troubleshooting capabilities of different systems of an automobile.
4. The main objective of the course is to make the student understand regarding link pair and chains, motorized gyroscope, gear and gear trains and Cams.
5. The students will understand gear train speed of different gears.
6. They will also gain knowledge of gyroscopic effect, gyroscope active and reactive couple for ships.

Contents:

1. Study and demonstration of layout of an Automobile
2. Trouble shooting in cooling system of an automotive vehicle.
3. Trouble shooting in the fuel supply system of Petrol and Diesel engine vehicles.
4. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.
7. Disassembling of engine: inspection of engine components, servicing of components, measurement of dimensions of different components of engine, compare with standard specifications, piston ring setting, assembling using special tools.
8. To determine the position of sleeve against controlling force and speed of Hartnell Governor and to plot the characteristic curve of radius of rotation.

9. To analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
10. Velocity ratios of simple, compound, Epicyclic and differential gear trains.
11. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker andOscillating cylinder mechanisms.
12. Cam & follower and motion studies.

Course Outcomes:

The student will be able to:

1. Identifythe different components of the automobile.
2. Understand the functioning of different systems of automobile.
3. Do fault diagnosis and troubleshooting capabilities of different systems of an automobile.
4. Construct different types of cam profile for a given data &for opening and closing of valves.
5. Do kinematic synthesis and different applications of gyroscopic effect, gyroscope active and reactive couple for ships and aeroplanes.