Maharshi Dayanand University
Rohtak

Syllabus and Courses of Reading for
B.Tech. V & VI Semester
(Mechanical Engg.)

Session - 2009-2010

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MAHARSHI DAYANAND UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATIONS
B.Tech 3rd YEAR (SEMESTER – V) MECHANICAL ENGINEERING
Effective from the Session 2007-08

Course No.	Course Title	Teaching Schedule				Marks for Class work	Marks for Examination		Total Marks	Duration of Exam
		L	T	P	Total		Theory	Practical		
ME-301 E	Kinematics of Machines	3	1	-	4	50	100	-	150	3
ME-303 E	Machine Design-I	3	2	-	5	50	100	-	150	4
ME-305 E	Fluid Machines	3	1	-	4	50	100	-	150	3
ME-307 E	Internal Combustion Engines & Gas Turbines	3	1	-	4	50	100	-	150	3
ME-309 E	Manufacturing Science	3	1	-	4	50	100	-	150	3
ME-311 E	Applied Numerical Techniques & Computing (ME, AE)	3	1	-	4	50	100	-	150	3
ME-313 E	Kinematics of Machines Lab	-	-	2	2	25	-	25	50	3
ME-315 E	Fluid Machines Lab	-	-	2	2	25	-	25	50	3
ME-317 E	Internal Combustion Engines & Gas Turbines Lab.	-	-	2	2	25	-	25	50	3
ME-319 E	Applied Numerical Techniques & Comp-uting Lab. (ME, AE)	-	-	2	2	25	-	25	50	3
ME-321 E	Practical Training - I	-	-	2	2	-	-	-	-	3
	Total	18	7	10	35	400	600	100	1100	

Note : 1. Assessment of Practical Training-I, undergone at the end of IV semester, will be based on seminar, viva-voce, report and certificate of practical Training obtained by the student from the industry. According to performance Letter Grades A, B, C, F are to be awarded. A student who is awarded 'F' grade is required to repeat Practical Training.

2. Students will be allowed to use Non-Programmable Scientific Calculator. However, Sharing of calculator will not be permitted in the examination.

ME- 301 E KINEMATICS OF MACHINES

L T P
3 1 -

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Unit I Introduction: mechanism and machines, kinematic links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

Unit II Kinematic Analysis of Plane Mechanisms: displacement analysis, general plane motion, instantaneous center of velocity, graphical and analytical methods of velocity and acceleration analysis, problems.

Unit III Cams: classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical and analytical approaches, cams with specified contours, tangent and circular are cams, problems.

Unit IV Gears : fundamental law of gearing, involute spur gears, characteristics of involute action, Interference and undercutting, center distance variation, involutometry, non standard gear teeth, helical, spiral bevel and worm gears, problems.

Unit V Gear Trains: synthesis of simple, compound and reverted gear trains, analysis of epicylic gear trains, problems.

Unit VI Kinematic synthesis of Mechanisms. Type, number and dimensional synthesis, function generation, path generation and body guidance two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, Freudenstein's equation, precision positions, structural error; Chebychev spacing, transmission angle, problems.

Unit VII Kinematics of Spatial Mechanisms: introduction, link coordinate system, homogeneous transformation matrix, loop closure equation, kinematics of robotic manipulators, problems.

Text Books :

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Mallik, Third Edition Affiliated East-West Press.

2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.

Reference Books :

1. Mechanism and Machine Theory : J.S. Rao and R.V. Dukkipati Second Edition New age International.

2. Theory and Machines : S.S. Rattan, Tata McGraw Hill.

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME- 303 E MACHINE DESIGN -I

	Sessional	: 50 Marks
	Theory	: 100 Marks
L T P	Total	: 150 Marks
3 2 -	Duration of Exam	: 4 Hrs.

Unit I Design Philosophy : Problem identification- problem statement, specifications, constraints, Feasibility study-technical feasibility, economic & financial feasibility, societal & environmental feasibility, Generation of solution field (solution variants), Brain storming, Preliminary design, Selection of best possible solution, Detailed design, Selection of Fits and tolerances and analysis of dimensional chains.

Unit II Selection of Materials: Classification of Engg. Materials, Mechanical properties of the commonly used engg. Materials, hardness, strength parameters with reference to stress-strain diagram, Factor of safety.

Unit III Mechanical Joints: ISO Metric Screw Threads, Bolted joints in tension, Eccentrically loaded bolted joints in shear and under combined stresses, Design of power screws, Design of various types of welding joints under different static load conditions.

Unit IV Riveted Joints, Cotter & Knuckle Joints: Design of various types of riveted joints under different static loading conditions, eccentrically loaded riveted joints, design of cotter and knuckle joints.

Unit V Belt rope and chain drives: Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives, design of chain drives with sprockets.

Unit VI Keys, Couplings & Flywheel: Design of Keys – Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, design of flywheel – solid disk & rimmed flywheels.

Unit VII Clutches: Various types of clutches in use, Design of friction clutches – Disc. Multidisc, Cone & Centrifugal, Torque transmitting capacity.

Unit VIII Brakes: Various types of Brakes, Self energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

Text Books:

1. Mechanical Engg. Design - First Metric Editions: Joseph Edward Shigley-MGH, New York.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
3. PSG Design Data Book

Reference Books :

1. Engineering design – George Dieter, MGH, New York.
2. Product Design and Manufacturing , A.K.Chitale and R.C.Gupta, PHI.
3. Machine Design An Integrated Approach: Robert L.Norton, Addison Wesley.
4. Machine Design : S.G. Kulkarini - Tata MacGraw Hill.
5. Design of machine elements-C S Sharma, Kamlesh Purohit, PHI.

Note :

1. **In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.**
2. **The paper setter will be required to mention in the note in the question paper that the use of only PSG Design Data book is permitted.**

ME- 305 E FLUID MACHINES

L	T	P
3	1	-

Sessional	:	50 Marks
Theory	:	100 Marks
Total	:	150 Marks
Duration of Exam	:	3 Hrs.

Unit I Impact of free jets : Impulse – momentum principle, jet impingement - on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vane and a series of vanes, Jet striking tangentially at the tip of a stationary vane and moving vane(s), jet propulsion of ships. Problems

Unit II Impulse Turbines: Classification – impulse and reaction turbines, water wheels, component parts, construction, operation and governing mechanism of a Pelton wheel, work done, effective head, available head and efficiency of a Pelton wheel, design aspects, speed ratio, flow ratio, jet ratio, number of jets, number of buckets and working proportions, Performance Characteristics, governing of impulse turbines. Problems

Unit III Francis Turbines: Component parts, construction and operation of a Francis turbine, governing mechanism, work done by the turbine runner, working proportions and design parameters, slow, medium and fast runners, degree of reaction, inward/outward flow reaction turbines, Performance Characteristics, Problems.

Unit IV Propeller and Kaplan turbines: Component parts, construction and operation of a Propeller, Kaplan turbine, differences between the Francis and Kaplan turbines, draft tube - its function and different forms, Performance Characteristics, Governing of reaction

turbine, Introduction to new types of turbine, Deriaz (Diagonal), Bulb, Tubular turbines, Problems.

Unit V Dimensional Analysis and Model Similitude: Dimensional homogeneity, Rayleigh's method and Buckingham's π-theorem, model studies and similitude, dimensionless numbers and their significance. Unit quantities, specific speed and model relationships for turbines, scale effect, cavitations – its causes, harmful effects and prevention, Thomas cavitation factor, permissible installation height, Problems.

Unit VI Centrifugal Pumps: Classification, velocity vector diagrams and work done, manometric efficiency, vane shape, head capacity relationship and pump losses, pressure rise in impeller, minimum starting speed, design considerations, multi-stage pumps. Similarity relations and specific speed, net positive suction head, cavitation and maximum suction lift, performance characteristics. Brief introduction to axial flow, mixed flow and submersible pumps, Problems.

Unit VII Reciprocating Pumps: Construction and operational details, discharge coefficient, volumetric efficiency and slip, work and power input, effect of acceleration and friction on indicator diagram (pressure – stroke length plot), separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank, characteristic curves, centrifugal vs reciprocating pumps, brief introduction to screw, gear, vane and radial piston pumps, Problems.

Unit VIII Hydraulic systems: Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic

ram, Problems.

Text Books :

- Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi
- Hydraulic Machines – Jagdish Lal, Metropolitan

Reference Books :

- Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers
- Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill
- Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME- 307 E INTERNAL COMBUSTION ENGINES & GAS TURBINES

		Sessional	: 50 Marks
		Theory	: 100 Marks
L	T P	Total	: 150 Marks
3	1 -	Duration of Exam	: 3 Hrs.

UNIT – I **Air Standard Cycles:** Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles;

air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

UNIT – II Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems.

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

UNIT – IV Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

UNIT – V Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems.

UNIT – VI Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

UNIT – VII Rotary Compressors: Root and vane blowers; Static and total head values; Centrifugal compressors-Velocity diagrams, slip factor, ratio of compression, pressure coefficient, pre-whirl; Axial flow compressor-Degree of reaction, polytropic efficincy, surging, choking and stalling, performance characteristics, Problems.

UNIT – VIII Gas Turbines: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multi stage compression with inter-cooling; multi stage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems.

Text Books :

1. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
2. Gas Turbines - V. Ganesan, Pub.- Tata McGraw Hill.
3. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India

Reference Books:

1. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York
2. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME- 309 E MANUFACTURING SCIENCE

	Sessional	: 50 Marks
	Theory	: 100 Marks
L T P	Total	: 150 Marks
3 1 -	Duration of Exam	: 3 Hrs.

Unit I Mechanism of Metal Cutting: Deformation of metal during machining, nomenclature of lathe, milling tools, mechanics of chip formation, built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal cutting, factors affecting tool forces. Cutting speed, feed and depth of cut, surface finish. Temperature distribution at tool chip interface. Numericals on cutting forces and Merchant circle.

Unit II Cutting Tool Materials & Cutting Fluids: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.

Unit III Tool Wear and Machinability: Types of tool wear, tool life, factors governing tool life,

Machinability : Definition and evaluation. Economics of machining. Numericals on tool life.

Unit IV Gear Manufacturing: Introduction, methods of manufacture. Gear generation and forming: Gear

cutting by milling, single point form tool, gear hobbing and shaping. Gear finishing operations: Gear shaving, gear burnishing, gear grinding, lapping.

Unit V Unconventional Machining Processes : Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electro-chemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining : Generation of electron beam, relative merits and demerits. Laser beam machining : Principles and applications.

Unit VI Jigs & Fixtures: Introduction, location and location devices, clamping and clamping devises, Drill Jigs, Milling Fixtures.

Unit VII Manufacturing Accuracy: Product cycle in manufacturing, part print analysis, location principles, tolerance stacking, accuracy of machining, operation selection, tolerance analysis.

Unit VIII Metrology & Machine Tools Testing: Tolerances, limits and fits, methods of linear measurement and angular measurement, Go and No Go gauges. Introduction to Machine tools testing**,** measuring instruments used for testing, test procedures, acceptance tests of machine tools.

Text Books

1. Manufacturing Technology – Metal cutting and machine Tools: P.N. Rao, T.M.H, New Delhi

2. Introduction to Jig and Tool Design: Kempster M.H.A, Hodder & Stoughton, England

Reference Books

1. Principles of Machine Tools – G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg.& Tech, Kalpakian, Serope Addison - Wisly Publishing Co. New York.
3. Modern Machining Processes: P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
4. Text Book of Production Engineering: P.C. Sharma, S.Chand & Sons.

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME – 311 E APPLIED NUMERICAL TECHNIQUES AND COMPUTING

	Sessional Marks	: 50 Marks
	Theory Marks	: 100 Marks
L T P	Total Marks	: 150 Marks
3 1 -	Duration of Exam	: 3 Hrs.

UNIT – I ERRORS IN NUMERICAL CALCULATIONS

Introduction, Numbers and their accuracy, Absolute, relative and percentage errors and their analysis, General error formula.

UNIT – II INTERPOLATION AND CURVE FITTING

Taylor series and calculation of functions, Introduction to interpolation, Lagrange approximation, Newton Polynomials, Chebyshev Polynomials, Least squares line, curve fitting, Interpolation by spline functions.

UNIT – III NUMERICAL DIFFERENTIATION AND INTEGRATION

Approximating the derivative, Numerical differentiation formulas, Introduction to Numerical quadrature, Newton-Cotes formula, Gaussion Quadrature.

UNIT – IV SOLUTION OF NONLINEAR EQUATIONS

Bracketing methods for locating a root, Initial approximations and convergence criteria, Newton-Raphson and Secant methods, Solution of problems through a structural programming language such as C or Pascal.

UNIT – V SOLUTION OF LINEAR SYSTEMS

Direct Methods, Gaussian elimination and pivoting, Matrix inversion, UV factorization, Iterative methods for linear systems, Solution of problems through a structured programming language such as C or Pascal.

UNIT – VI EIGEN VALUE PROBLEMS

Jacobi, Given's and Householder's methods for symmetric matrices, Rutishauser method for general matrices, Power and inverse power methods.

UNIT – VII SOLUTION OF DIFFERENTIAL EQUATIONS

Introduction to differential equations, Initial value problems, Euler's methods, Heun's method, Runge-Kutta methods, Taylor series method, Predictor-Corrector methods, Systems of differential equations, Boundary valve problems, Finite-difference method, Solution of problems through a structured programming language such as C or Pascal.

UNIT – VIII PARTIAL DIFFERENTIAL EQUATIONS, EIGENVALUES AND EIGENVECTORS

Solution of hyperbolic, parabolic and elliptic equations, The eigenvalue problem, The power method and the Jacobi's method for eigen value problems, Solution of problems through a structural programming language such as C or Pascal.

Text Books :

1. Numerical Methods for Mathematics, Science and Engineering by John H.Mathews, PHI New Delhi.
2. Applied Numerical Methods – Carnahan, B.H., Luthar, H.A. and Wilkes, J.O., Pub.- J. Wiley, New York

Reference Books :

1. Numerical Solution of Differential Equations, by M.K. Jain, Published by Wiley Eastern, New York.
2. Introductory Methods of Numerical Analysis by S.D. Sastry, Published by Prentice Hall of India.
3. Numerical Methods – Hornbeck, R.W. , Pub.- Prentice Hall, Englewood Cliffs, N.J.

Note :

1. **Programming exercises may be done in MATLAB.**
2. **The Instructor of the course may cover the use of software MATHEMATICA in the tutorial class.**
3. **In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attend only 5 questions.**

ME- 313 E KINEMATICS OF MACHINES LAB

L	T	P
-	-	2

Sessional Marks : 25 Marks
Practical Marks : 25 Marks
Total Marks : 50 Marks
Duration of Exam : 3 Hrs.

List of Experiments :

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study various type of cam and follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.
7. To generate spur gear involute tooth profile using simulated gear shaping process.
8. To study various types of gears – Helical , cross helical worm, bevel gear.
9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
10. To find co-efficient of friction between belt and pulley.
11. To study the working of Screw Jack and determine its efficiency.
12. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.

13. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.

14. To design a cam profile by using the requirement graph using on-line engineering handbook and verify the same using a 3D mechanism on CAD.

Note :

1. **At least Ten experiments are to be performed in the Semester.**

2. **At least eight experiments should be performed from the above list. However these experiments should include experiments at Sr. No. 12, 13 and 14. Remaining two experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus.**

ME- 315 E FLUID MACHINES LAB.

L	T	P
-	-	2

Sessional Marks : 25 Marks
Practical Marks : 25 Marks
Total Marks : 50 Marks
Duration of Exam : 3 Hrs.

List of Experiments :

1. To study the constructional details of a Pelton turbine and draw its fluid flow circuit.

2. To draw the following performance characteristics of Pelton turbine-constant head, constant-speed and constant efficiency curves.

3. To study the constructional details of a Francis turbine and draw its fluid flow circuit.

4. To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.

5. To study the construction details of a Kaplan turbine and draw its fluid flow circuit.

6. To draw the constant head, speed and efficiency curves for a Kaplan turbine.

7. To study the constructional details of a Centrifugal Pump and draw its characteristic curves.

8. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.

9. To study the construction details of a Gear oil pump and its performance curves.

10. To study the constructional details of a Hydraulic Ram and determine its various efficiencies..

11. To study the constructional details of a Centrifugal compressor.

12. To study the model of Hydro power plant and draw its layout.

NOTE :

1. **At least ten experiments are to be performed in the Semester.**

2. **At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.**

ME- 317 E I.C. ENGINES & GAS TURBINES LAB

		Sessional Marks	: 25 Marks
		Practical Marks	: 25 Marks
L	T P	Total Marks	: 50 Marks
-	- 2	Duration of Exam	: 3 Hrs.

List of Experiments :

1. To study the constructional details & working principles of two-stroke/ four stroke petrol engine.
2. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
3. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat Apparatus.
4. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
5. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
6. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp,fhp, vs speed (ii) volumetric efficiency & indicated specific specific fuel consumption vs speed.
7. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & by motoring method.
8. To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and A/F and (ii) bhp vs mep, mech efficiency & sfc.
9. To measure CO & Hydrocarbons in the exhaust of 2-stroke / 4-stroke petrol engine.

10. To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.
11. To draw the scavenging characteristic curves of single cylinder petrol engine.
12. To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.

NOTE :

1. **At least ten experiments are to be performed in the Semester.**
2. **At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.**

ME- 319 E APPLIED NUMERICAL TECHNIQUES AND COMPUTING LAB.

		Sessional Marks	: 25 Marks
		Practical Marks	: 25 Marks
L	T P	Total Marks	: 50 Marks
-	- 2	Duration of Exam	: 3 Hrs.

The students will be required to carry out the following exercises, that are based on the theory course ME-311 Numerical Methods and Computing, with the help of MATLAB software / Pascal / C / C++ on personal computer.

1. Solution of Non-linear equation in single variable using the method of successive bisection.
2. Solution of Non-Linear equation in single variable using the Newton Raphson, Secant, Bi – Section and Modified Eualer's, method.

3. Solution of a system of simultaneous algebraic equations using the Gaussian elimination procedure.

4. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method.

5. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method employing the technique of successive relaxation.

6. Numerical solution of an ordinary differential equation using the Euler's method.

7. Numerical solution of an ordinary differential equation using the Runge - Kutta 4^{th} order method.

8. Numerical solution of an ordinary differential equation using the Predictor – corrector method.

9. Numerical solution of a system of two ordinary differential equation using Numerical intergration.

10. Numerical solution of an elleptic boundary value problem using the method of Finite Differences.

ME – 321 E PRACTICAL TRAINING – I

At the end of fourth semester each student would undergo six weeks Practical Training in an industry/ Professional organization / Research Laboratory with the prior approval of the Director-Principal/ Principal of the concerned college and submit a written typed report along with a certificate from the organization. The report will be a evaluated during V Semester by a Board of Examiners to be appointed by the Director-Principal/ Principal of the concerned college who will award one of the following grades:

Excellent	:	A
Good	:	B
Satisfactory	:	C
Not satisfactory	:	F

A student who has been awarded 'F' grade will be required to repeat the practical training.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATIONS
B.Tech. 3rd YEAR (SEMESTER – VI) MECHANICAL ENGINEERING
Effective from the Session 2007-08

Course No.	Course Title	Teaching Schedule				Marks for Class work	Marks for Examination		Total Marks	Duration of Exam
		L	T	P	Total		Theory	Practical		
ME-302 E	Dynamics of Machines	3	1	-	4	50	100	-	150	3
ME-304 E	Machine Design - II	3	2	-	5	50	100	-	150	4
ME-306 E	Heat Transfer (ME.AE)	3	1	-	4	50	100	-	150	3
ME-308 E	Automatic Controls	3	1	-	4	50	100	-	150	3
ME-310 E	Measurements & Instrumentation	3	1	-	4	50	100	-	150	3
ME-312 E	Industrial Engineering	3	1	-	4	50	100	-	150	3
ME-314 E	Dynamics of Machines lab	-	-	2	2	25	-	25	50	3
ME-316 E	Heat Transfer Lab	-	-	3	3	25	-	50	50	3
ME-318 E	Measurements & Instrumentation Lab.	-	-	2	2	25	-	25	50	3
GPME -320 E	Professional Practices (Proficiency)*	-	-	-	-	50	-	-	50	3
	Total	18	7	7	32	450	600	100	1150	

Note :

1. Each student has to undergo Practical training of 6- weeks during summer vacation and its evaluation shall be carried out in the VIIth semester.
2. Students will be allowed to use Non-Programmable Scientific Calculator. However, Sharing of calculator will not be permitted in the examination.
3. The practical hours for the subject ME-316E (Heat Transfer Lab.) have been increased from 2 hours to 3 hours. The marks for the class work and practical Examination in the subject have also been increased from 25 each to 50 each. Thus the total marks of the subject shall be 100 in place of 50 marks w.e.f. the session 2007-08.
4. The grand total of the semester shall be 1150 in-place of 1100 marks from the session 2007-08.
5. *The subject GPME-320E (General Proficiency) code has been changed to GPME-302-E and will be effective from 2007-08.

ME- 302 E DYNAMICS OF MACHINES

		Sessional	: 50 Marks
		Theory	: 100 Marks
L	T P	Total	: 150 Marks
3	1 -	Duration of Exam	: 3 Hrs.

Unit I Static and Dynamic Force Analysis : Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.

Unit II Dynamics of Reciprocating Engines : engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces.

Unit III Balancing of Rotating Components : static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, field balancing.

Unit IV Balancing of Reciprocating Parts : Balancing of single cylinder engine, balancing of multi cylinder; inline, radial and V type engines, firing order.

Unit V Governors : introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors.

Unit VI Dynamometers : types of dynamometers, Prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer.

Unit VII Gyroscope : gyroscopes, gyroscopic forces and couples, gyroscopic stabilization, ship stabilization,

stability of four wheel and two wheel vehicles moving on curved paths.

Text Books:

1. Theory of Mechanisms and Machines : Amitabha Ghosh and Ashok kumar Mallik, Third Edition Affiliated East-West Press.

2. Theory of Machines and Mechanisms : Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition Mc Graw Hill, Inc

Reference Books:

1. Mechanism and Machine Theory : J.S. Rao and R.V. Dukkipati, New age International.

2. Theory and Machine (S I units) S.S. Rattan, Tata McGrawHill.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME- 304 E MACHINE DESIGN –II

		Sessional	: 50 Marks
		Theory	: 100 Marks
L	T P	Total	: 150 Marks
3	2 -	Duration of Exam	: 4 Hrs.

Unit I Design for Production ; Erogonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining. Variable Loading : Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration

factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

Unit II Shafts : Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration.

Unit III Springs : Types of Springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem.

Unit IV Bearings : design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

Unit V Gears : Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth -Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

Text Books :

1. Mechanical Engg. Design- Joseph Edward Shigley-Mc Graw Hill Book Co.

2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.

Reference Books :

1. Engineering design – George Dieter, McGraw Hill, New York.

2. Product Design and Manufacturing –: A.K.Chitale and R.C.Gupta, PHI, New Delhi.

3. Machine Design An Integrated Approach: Robert L.Norton,Second Edition –Addison Wisley Longman

4. Machine Design : S.G. Kulkarni , TMH , New Delhi.

Note :

1. In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

2. The paper setter will be required to mention in the note of the question paper that the use of only PSG Design Data book is permitted.

ME –306E HEAT TRANSFER

		Sessional	:	50 Marks
		Theory	:	100 Marks
L	T P	Total	:	150 Marks
3	1 -	Duration of Exam	:	3 Hrs.

UNIT I Basics and Laws : Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.

UNIT II Steady State Heat Conduction : Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, Conduction equation in Cartesian, polar and spherical co-ordinate systems, Numericals.

UNIT III Steady State Conduction with Heat Generation : Introduction, 1 – D heat conduction with heat sources, Extended surfaces (fins), Fin effectiveness 2-D heat conduction , Numericals.

UNIT IV Transient Heat Conduction : Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Chart solution, Relaxation Method, Numericals.

UNIT V Convection : Forced convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations, Some results for flow over a flat plate and flow through tube, Fluid friction and heat transfer (Colburn analogy), Free convection from a vertical flat plate, Empirical relations for free convection from vertical and horizontal o\planes & cylinders, Numericals.

UNIT VI Thermal Radiation: The Stephen-Boltzmann law, The black body radiation, Shape factors and their relationships, Heat exchange between non black bodies, Electrical network for radiative exchange in an enclosure of two or three gray bodies, Radiation shields, Numericals.

UNIT VII Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, Numericals.

UNIT VIII Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Free convective, Nucleate and film boiling, Numericals.

Text Books :

1. Heat Transfer – J.P. Holman, John Wiley & Sons, New York.
2. Fundamentals of Heat & Mass Transfer–Incropera, F.P. & Dewill, D.P –John Willey New York.

Reference Books :

1. Conduction of Heat in Solids – Carslow, H.S. and J.C. Jaeger – Oxford Univ. Press.
2. Conduction Heat Transfer – Arpasi, V.S. – Addison – Wesley.
3. Compact Heat Exchangers – W.M. Keys & A.L. Landon, Mc. Graw Hill.
4. Thermal Radiation Heat Transfer – Siegel, R. and J.R. Howell, Mc. Graw Hill.
5. Heat Transmission – W.M., Mc.Adams , Mc Graw Hill.

NOTE :

1. **In the semester examination, the examiner will set Eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.**
2. **The paper setter will be required to mention in the note of question paper that the use of Steam tables, Charts, Graphical plots is permitted.**

ME- 308 E AUTOMATIC CONTROLS

L	T	P
3	1	-

Sessional	:	50 Marks
Theory	:	100 Marks
Total	:	150 Marks
Duration of Exam	:	3 Hrs.

Unit I Introduction And Applications: Types of control systems ; Typical Block Diagram : Performance Analysis; Applications – Machine Tool Control, Boiler Control, Engine Governing, Aerospace Control, Active Vibration Control; Representation of Processes & Control Elements – Mathematical Modeling. Block Diagram Representation, Representation of Systems or Processes, Comparison Elements; Representation of Feedback Control systems – Block Diagram & Transfer Function Representation, Representation of a Temperature, Control System, Signal Flow Graphs, Problems.

Unit II Types of Controllers : Introduction : Types of Control Action; Hydraulic Controllers; Electronic Controllers; Pneumatic Controllers; Problems.

Unit III Transient And Steady State Response: Time Domain Representation; Laplace Transform Representation; System with Proportional Control; Proportional – cum – Derivative control; Proportional – cum – Integral Control; Error Constants; Problems.

Unit IV Frequency Response Analysis: Introduction; Closed and Open Loop Transfer Function; Polar Plots; Rectangular Plots; Nichols Plots: Equivalent Unity Feed Back Systems; Problems.

Unit V Stability Of Control Systems : Introduction; Characteristic Equation; Routh's Criterion; Nyquists Criterion, Gain & Phase Margins: Problems.

Unit VI Root Locus Method : Introduction; Root loci of a Second Order System; General Case; Rules for Drawing Forms of Root loci; Relation between Root Locus Locations and Transient Response; Parametric Variation; Problems.

Unit VII Digital Control System : Introduction; Representation of Sampled Signal; Hold Device; Pulse Transfer Function; Block Diagrams; Transient Response; Routh's Stability Criterion; Root Locus Method; Nyquists Criterion; Problems.

Unit VIII State Space Analysis Of Control Systems: Introduction; Generalized State Equation; Techniques for Deriving System State – Space Equations; Transfer Function from State Equations; Solution of State Vector Differential Equations; Discrete Systems; Problems.

Text Books :

1. Theory & Applications of Automatic Controls by B.C. Nakra, Published by New Age International Pvt. Ltd. Publishers, New Delhi.

2. Modern Control Engg. by Ugata, Prentice Hall of India, New Delhi.

Reference Books :

1. Automatic Control Systems by Kuo' Published by Prentice Hall of India, New Delhi.

2. Control System Engineering, I. J. Nagrath and M. Gopal, New Age , New Delhi.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME – 310 E MEASUREMENTS AND INSTRUMENTATION

L	T	P
3	1	-

Sessional	:	50 Marks
Theory	:	100 Marks
Total	:	150 Marks
Duration of Exam	:	3 Hrs.

Unit I Instruments and Their Representation : Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration.

Unit II Static and Dynamic characteristics of Instruments : Introduction, Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Dead Band, Backlash, Drift, Formulation of Differential Equations for Dynamic Performance- Zero Order, First Order and Second order systems, Response of First and Second Order Systems to Step, Ramp, Impulse and Harmonic Functions.

Unit III Transducer Elements : Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric, Inductive Self Generating and Non-Self Generating Types, Electromagnetic, Electrodynamic, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, Piezo-Electric

Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Single Double and Four Active Arm Bridge Arrangements, Temperature Compensation, Balancing and Calibration, Ionisation Transducers, Mechano Electronic Transducers, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Volatic Transducers, Digital Transducers, Frequency Domain Transducer, Vibrating String Transducer, Binary codes, Digital Encoders.

Unit IV Intermediate, Indicating and Recording Elements : Introduction Amplifiers, Mechanical, Hydraulic, Pneumatic, Optical, Electrical Amplifying elements, Compensators, Differentiating and Integrating Elements, Filters, Classification of Filters, A-D and D-A Converters, Digital Voltmeters (DVMs), Cathode Ray Oscillo scopes (CROs), Galvanometric Recorders, Magnetic Tape recorders, Data Acquisition Systems, Data Display and Storage.

Unit V Motion, Force and Torque Measurement : Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices, Seismic Devices, Spring Mass & Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter.

Unit VI Pressure and Flow Measurement : Pressure & Flow Measurement, Introduction : Moderate Pressure Measurement, Monometers, Elastic Transducer, Dynamic Effects of Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing, Quantity Meters, Positive Displacement Meters, Flow Rate Meters, Variable

Head Meters, Variable Area Meters, Rotameters, Pitot-Static Tube Meter, Drag Force Flow Meter, Turbine Flow Meter, Electronic Flow Meter, Electro Magnetic Flow meter. Hot-Wire Anemometer.

Unit VII Temperature Measurement : Introduction, Measurement of Temperature, Non Electrical Methods – Solid Rod Thermometer, Bimetallic Thermometer, Liquid-in-Glass thermometer, Pressure Thermometer, Electrical Methods – Electrical Resistance Thermometers, Semiconductor Resistance Sensors (Thermistors), Thermo–Electric Sensors, Thermocouple Materials, Radiation Methods (Pyrometry), Total Radiation Pyrometer, Selective Radiation Pyrometer.

Unit VIII Basic Statistical Concepts : Types of Measured Quantities (Discrete and Continuous), Central Tendency of Data, Mode, Median, Arithmetic Mean, Best Estimate of true Value of Data, Measures of Dispersion, Range, Mean Deviation, Variance, Standard Deviation, Normal Distribution, Central Limit Theorem, Significance Test, Method of Least Squares, Graphical Representation and Curve Fitting of Data.

Text Books :

1. Measurement systems Application and Design. Ernest O. Doebelin, Tata McGraw Hill Edition (Fourth Edition) 2002.
2. Measurement and Instrumentation in Engineering, Francis S. Tse and Ivan E. Morse, Marcel Dekker.

Reference Books :

1. Principles of Measurement and Instrumentation – Alan S. Morris Prentice Hall of India.
2. Mechanical Measurements : T.G. Beckwith, W.L. Buck and R.D. Marangoni Addison Wesley.

3. Instrumentation, Measurement and Analysis – B.C. Nakra and K.K. Chaudhary, TMH.

4. Mechanical Measurements by D. S. Kumar, Kataria & Sons.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME-312 E INDUSTRIAL ENGINEERING

		Sessional	:	50 Marks
		Theory	:	100 Marks
L	T	Total	:	150 Marks
3	1 -	Duration of Exam	:	3 Hrs.

UNIT - I

Definition of Industrial Engineering: Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement - various methods, time study PMTS, determining time, Work sampling, Numericals.

UNIT - II

Productivity & Workforce Management :Productivity - Definition, Various methods of measurement, Factors effecting productivity, Strategies for improving productivity, Various methods of Job evaluation & merit rating, Various incentive payment schemes, Behavioural aspects, Financial incentives.

UNIT - III

Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour,

material, overhead in volume, rate & efficiency, Break even Analysis, Marginal costing & contribution, Numericals.

UNIT - IV

Materials Management : Strategic importance of materials in manufacturing industries, Relevant costs, Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Purchase discounts, Sensitivity analysis, Inventory control systems - P,Q,Ss Systems, Service level, Stock out risk, determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED and three dimensional, Numericals.

UNIT - V

Quality Management: Definition of quality, Various approaches, Concept of quality assurance systems, Costs of quality, Statistical quality Control (SQC), Variables & Attributes, X, R, P & C - charts, Acceptance sampling, OC - curve, Concept of AOQL, Sampling plan - Single, Double & sequential, Introduction to TQM & ISO - 9000.

UNIT - VI

Production Planning & Control (PPC) : Introduction to Forecasting - Simple & Weighted moving average methods, Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other decision areas, Decision options - Basic & mixed strategies, Master production schedule (MPS), Scheduling Operations Various methods for line & intermittent production systems, Gantt chart, Sequencing - Johnson algorithm for n-Jobs-2 machines, n- Jobs-3 machines, 2 Jobs n-machines, n-Jobs m-machines Various means of measuring effectiveness of PPC, Introduction to JIT, Numericals.

UNIT - VII

Management Information Systems (MIS) : What is MIS ? Importance of MIS, Organizational & information system

structure, Role of MIS in decision making, Data flow diagram, Introduction to systems analysis & design, Organizing information systems.

UNIT – VIII

Product Design and Development: Various Approaches, Product life cycle, Role 3S's – Standardization, Simplification, Specialization, Introduction to value engineering and analysis, Role of Ergonomics in Product Design.

Text Books :

1. Production & Operations Management - Chary, TMH, New Delhi.
2. Management Information Systems - Sadagopan, PHI New Delhi.
3. Modern Production Management – S.S. Buffa, Pub.- John Wiley.

Ref.Books :

1. Operations Management - Schroeder, McGraw Hill ISE.
2. Operation Management - Monks, McGraw Hill ISE.
3. Production & Operations Management - Martinich, John Wiely SE.
4. Industrial & Systems Engineering - Turner, MIZE, CHASE, Prentice Hall Pub.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME- 314 E DYNAMICS OF MACHINE LAB

			Sessional	: 25 Marks
			Theory	: 25 Marks
L	T	P	Total	: 50 Marks
-	-	2	Duration of Exam	: 3 Hrs.

List of Experiments :

1. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
2. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability & sensitivity.
3. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
4. To study gyroscopic effects through models.
5. To determine gyroscopic couple on Motorized Gyroscope.
6. To perform the experiment for static balancing on static balancing machine.
7. To perform the experiment for dynamic balancing on dynamic balancing machine.
8. Determine the moment of inertial of connecting rod by compound pendulum method and tri-flair suspension pendulum.

Note :

1. **Ten experiments are to be performed in the Semester.**
2. **At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed & set by the concerned Institution as per the scope of the syllabus.**

ME- 316 E HEAT TRANSFER LAB.

L	T	P			
			Sessional	:	25 Marks
			Theory	:	25 Marks
			Total	:	50 Marks
-	-	2	Duration of Exam	:	3 Hrs.

List of Experiments :

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. To determine the thermal conductivity of a solid by the guarded hot plate method.
4. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
5. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.
6. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.

7. To determine average heat transfer coefficient for a externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
8. To measure the emmisivity of the gray body (plate) at different temperature and plot the variation of emmisivity with surface temperature.
9. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
10. To verify the Stefen-Boltzmann constant for thermal radiation.
11. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.
12. To study the two phases heat transfer unit.
13. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.
14. Design of Heat exchanger using CAD and verification using thermal analysis package eg. I-Deas etc.

Note:

1. **At least ten experiments are to be performed in the semester.**
2. **At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.**

ME- 318 E MEASUREMENTS & INSTRUMENTATION LAB.

	Sessional	:	25 Marks
	Theory	:	25 Marks
L T P	Total	:	50 Marks
- - 2	Duration of Exam	:	3 Hrs.

List of Experiments :

1. To Study various Temperature Measuring Instruments and to Estimate their Response times.
   - (a) Mercury – in glass thermometer
   - (b) Thermocouple
   - (c) Electrical resistance thermometer
   - (d) Bio-metallic strip
2. To study the working of Bourdon Pressure Gauge and to check the calibration of the gauge in a dead-weight pressure gauge calibration set up.
3. To study a Linear Variable Differential Transformer (LVDT) and use it in a simple experimental set up to measure a small displacement.
4. To study the characteristics of a pneumatic displacement gauge.
5. To measure load (tensile/compressive) using load cell on a tutor.
6. To measure torque of a rotating shaft using torsion meter/ strain gauge torque transducer.
7. To measure the speed of a motor shaft with the help of non-contact type pick-ups (magnetic or photoelectric).

8. To measure the stress & strain using strain gauges mounted on simply supported beam/cantilever beam.
9. To measure static/dynamic pressure of fluid in pipe/tube using pressure transducer/pressure cell.
10. To test experimental data for Normal Distribution using Chi Square test.
11. To learn the methodology of pictorial representation of experimental data and subsequent calculations for obtaining various measures of true value and the precision of measurement using Data acquisition system/ calculator.
12. Vibration measurement by Dual Trace Digital storage Oscilloscope.
13. To find out transmission losses by a given transmission line by applying capacitive /inductive load.
14. Process Simulator.

Note:

1. **At least ten experiments are to be performed in the Semester.**
2. **At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the Syllabus.**