LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Turret and Capstan Lathes	1 No each
2	Horizontal Milling Machine	2 No
3	Vertical Milling Machine	1 No
4	Surface Grinding Machine	1 No.
5	Cylinderical Grinding Machine	1 No.
6	Radial Drilling Machine	1 No.
7	lathe Tool Dynamometer	1 No
8	Milling Tool Dynamometer	1 No
9	Gear Hobbing Machine	1 No
10	Tool Makers Microscope	1 No
11	CNC Lathe	1 No
12	CNC Milling machine	1 No
13	Gear Shaping machine	1 No
14	Centerless grinding machine	1 No
15	Tool and cutter grinder	1 No

MS8411 INDUSTRIAL TRAINING II L T P C
(INSPECTION AND TESTING OF MECHANICAL ASSEMBLIES) 0 0 0 2

Inspection and testing of lathes, pumps and motors - BIS specification for motors and pump sets – list of testing instrument - functions - foot mounting motor dimensions as per IS: 1231 - importance of name plate and identification of name plate details - trouble shooting of induction motors - type of routine test of induction motor as per IS : 7538 (Performance Calculations) 1) Measurement of stator resistance 2) High voltage test 3) Measurement of insulation resistance 4) Reduced voltage test 5) No load test 6) Full load test 7) Locked rotor test 8) Starting torque and starting current 9) Pull up torque 10) Pull out torque 11) Momentary over load test 12) Temperature rise test - Final inspection and testing for conventional lathes - Test charts - Inspection of the machine tool for BIS and IMTMA standard - Cutting test - Method of inspection testing - Gauges and instruments required – Accuracy requirements - Deviation observed - Study of inspection methods and preparation of inspection format for lathe bed - Head stock body - Tail stock body - Apron body - Threading and feed box – Gear box - Head stock spindle - Tail stock spindle - Gear - Lead screw - Feed shaft - Spine shaft. – Exposure to metrological aspects of components used for lathes, pumps and motors.

MA8491 NUMERICAL METHODS L T P C
4 0 0 4

OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES :
1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

ME8593 DESIGN OF MACHINE ELEMENTS

L	T	P	C
3	0	0	3

OBJECTIVES
- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components
  (Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines - Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS 9

Threaded fastners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT V BEARINGS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings.

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Explain the influence of steady and variable stresses in machine component design.
CO2 Apply the concepts of design to shafts, keys and couplings.
CO3 Apply the concepts of design to temporary and permanent joints.
CO4 Apply the concepts of design to energy absorbing members, bearings and connecting rod.
CO5 Apply the concepts of design to bearings.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2011.

REFERENCES:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
2. Ansel Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.
3. P.C. Gope, "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. R.B. Patel, "Design of Machine Elements", MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
5. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
6. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2015.

MS8501 INDUSTRIAL METALLURGY L T P C
3 0 0 3

OBJECTIVE:

- To understand and learn the fundamental principles of metallurgy and material science and heat treatment processes of metals.

UNIT I CRYSTAL STRUCTURE 9

BCC, FCC and HCP structure- unit cell –crystallographic planes and directions, miller indices-crystal imperfections, point, line, planar and volume defects –Grain size, ASTM grain size number

UNIT II MECHANICAL PROPERTIES AND TESTING 9

Mechanisms of plastic deformation, slip and twinning- types of fracture – testing of materials under tension, compression and shear loads-hardness tests (Brinell, Vickers and Rockwell). Impact test Izod and charpy, S-N curves, fatigue and creep test. High cycle fatigue, Low cycle fatigue, Axial fatigue, Rolling contact fatigue, Bending fatigue and Torsional fatigue. NON DESTRUCTIVE TESTING: Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections, Eddy current testing.

UNIT III CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys –solid solutions, substitutional and interstitial –phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron- Iron carbide equilibrium diagram classification of steel and cast iron microstructure, properties and applications.

UNIT IV HEAT TREATMENT 9

Definition – full annealing, stress relief, recrystallisation and spheroidizing – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on I.T.diagram CCR- hardenability, Jominy end quench test – Austempering, martempering- case hardening, carburizing, nitriding, cyaniding, carbonitriding- Flame and Induction hardening.

UNIT V FERROUS MATERIAL 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) – stainless and tool steels – HSLAmaraging steels – Gray, White malleable, spheroidal – Graphite – alloy castirons. NON FERROUS MATERIALS:Copper, Aluminium, Nickel, Magnesium, Titanium, Lead, Tin. Important alloys –their composition properties and applications.NON METALLIC MATERIALS: Introduction to polymers, Composites and Ceramics. SELECTION OF MATERIALS: Factors to be considered for selection of materials with specific examples. Cost data of metals and alloys.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to relate crystal structure with material properties
- knowledge of material characterisation and testing
- ability to select suitable heat treatment method for improving mechanical properties.
- knowledge of selecting material for engineering application

TEXT BOOK:

1. Kenneth G.Budinski and Michael K. Buinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002

REFERENCES:

1. William D Callister, “Material Science and Engineering”, John Wiley and Sons, 1997.
2. Raghavan V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 1999.
3. Sydney H Avner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 1994.

MS8502 APPLIED THERMODYNAMICS L T P C

3 2 0 4

OBJECTIVES:

- To familiarize the students to understand the fundamentals of thermodynamics.
- To perform thermal analysis on their behavior and performance.

UNIT I BASIC CONCEPTS OF THERMODYNAMICS 9+6

System, property, state and equilibrium, process and cycle, work, heat and other forms of energy. Zeroth law and application, first law statement, applications to closed and open systems, general energy equation and applications to thermal equipments.

UNIT II SECOND LAW OF THERMODYNAMICS 9+6

Statements-heat engines and heat pump, reversibility, Carnot cycle and Carnot theorem ENTROPY: Clausius theorem, Clausius inequality, principle of increase in entropy, T-S relations, availability and irreversibility

UNIT III PROPERTIES OF PURE SUBSTANCE 9+6

Pure substance, phase-change processes, property diagram for phase processes, properties table, Mollier chart. VAPOUR POWER CYCLE : Rankine and modified Rankine cycle, Reheat cycle, Regenerative cycle, Reheat- Regenerative cycle, Binary vapour cycle

UNIT IV PROPERTIES OF IDEAL GASES AND REAL GASES 9+6

Ideal gas equation, evaluation of work and heat, entropy changes, real gases, Van der Waals equation, compressibility - universal compressibility chart and general thermodynamic relations.

UNIT V PSYCHROMETRY 9+6

Mole and Mass fraction, Dalton's and Amgat's Law. Properties of ga mixture – Molar mass, Gas costant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications.

TOTAL: 75 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the Students can able to apply the Thermodynamic Principles to Mechanical Engineering application.
- Apply mathematical fundamentals to study the properties of steam, gas and gas mixtures.

TEXT BOOKS:

1. Cenge Y Al and Boles M A "Thermodynamics, An Engineering Approach" Tata McGraw Hill, 2003.
2. Nag P K, "Engineering Thermodynamics", Tata McGraw Hill, Delhi, 2004.

REFERENCES:

1. Holman J P, "Thermodynamics", Tata McGraw Hill, 1998.
2. Sonntag R E, Borgnakke C and Van Wylen G J, "Fundamentals of Engineering Thermodynamics", John Wiley, 2003.
3. Rogers G FC and Mayhew Y R, "Engineering Thermodynamics Work and Heat Transfer", Pearson, 2003.
4. Kothandaraman C P and Domkundwar S, "Engineering Thermodynamics, Part I, Dhanpat Rai and Sons, Delhi, 2004.
5. John P O Connell and Haile J M, "Thermodynamics Fundamentals for Applications", Cambridge, 2011
6. Yunus A Cengel and Michael A Boles, "Thermodynamics and Engineering Approach", TMH, 2010
7. Jones J B and Dugan R E, "Engineering Thermodynamics", Prentice Hall India, 2007
8. Eugene Silberstein, "Heat Pumps", Thomson, 2010

MS8503 METROLOGY AND QUALITY ASSURANCE L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

UNIT I BASICS OF MEASUREMENT AND DEVICES 9

Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe's Principle, Principle of interferometry- flatness testing, optical interferometer, laser interferometer. Holography and speckle metrology. QUALITY STANDARDS: General cares and rules in measurement, International standardization, SI units and quantities, BIS- NPL – advantages, ISO 9000 quality standards, QS 9000 standards, Environment standards, metrology room measuring standards room.

UNIT II LINEAR MEASUREMENTS 9

Material length standards –line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators- mechanical, electrical, optical and pneumatic, optical projector. GEOMETRICAL MEASUREMENT: Angular measurement – plain vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gague, Taylor's principle, three basic types of limit gauges, surface texture, reasons for controlling surface texture, parameters used , specification of surface texture, drawing and symbols, Tomilson surface meter. CMM.

UNIT III METROLOGY OF MACHINE ELEMENTS 9

Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean room environment.

UNIT IV MACHINE INSTALLATION AND TESTING 9

Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list.

UNIT V STATISTICAL QUALITY CONTROL 9

Process capability, steps in using control charts, basic principles of lot sampling – sampling inspection, single and double sampling, determination of sample size, OC curves, AOQ, ABC standards. QUALITY CONTROL CHARTS: Types, manufacturing specifications, p chart, np chart, c chart, u chart, X and R chart – solving problems using the charts. Design of tool for inspection, gauging design of plug, snap gauges, thread gauges. Gauge repeatability and reproducibility studies.

TOTAL : 45 PERIODS

OUTCOME:

- Upon completion of this course, the students can able to apply the Students can demonstrate different measurement technologies and use of them in Industrial Components

TEXT BOOKS:

1. Gupta I C, "A text book of Engineering Metrology", Dhanpat Rai publications, New Delhi, 2003.
2. Jain R K, "Mechanical and Industrial Measurements", Khanna Publishers Co Ltd., New Delhi, 1985.
3. Holmen J P, "Experimental Methods for Engineers", Tata McGraw Hill Publications Co Ltd,2004.
4. John G Nee, "Fundamentals of Tool Design" Society of Manufacturing Engineers, Fourth Edition, 1998.
5. Dominique Placko, "Metrology in Industry: The Key for Quality", ISTE, 2007.

REFERENCES:

1. Narayana K , "Engineering Metrology", Scitech Publication2006.
2. Kaniska Bedi, "Quality Management", Oxford University Press, Chennai, 2007.

PR8561 **METROLOGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To familiar with different measurement equipments and use of this industry for quality inspection

LIST OF EXPERIMENTS

1. Measurements of angle using Sine bar / bevel protractor
2. Measurement of External and internal Taper angle
3. Measurement of Bore Diameter
4. Calibration of Dial gauge
5. Measurement of Roundness
6. Measurements of Screw Thread Parameters using three-wire method
7. Measurements of Surface Roughness
8. Measurements using Toolmakers Microscope
9. Measurements using Profile Projector
10. Measurements using Vision System
11. Measurements using CMM

TOTAL:60 PERIODS

OUTCOMES:

Upon completion of this course, the students will have

- Ability to handle different basic measurement tools and perform precise measurements.
- Ability to measure the surface roughness both manually and using sophisticated device.
- Ability to measure the dimensions using CMM.
- Ability to measure the dimension using Vision System.
- Ability to calibrate the measuring device.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Vernier Calipers 0-150 mm	5
2	Vernier Calipers 0-300 mm	2
3	Micrometer 0-25 mm	5
4	Micrometer 25-50 mm	2
5	Micrometer 50-75 mm	2
6	Dial gauges LC 10micrometer	3
7	Dial gauge L.C. 2micrometer	12
8	Height gauge Analog	1
9	Height gauge Digital	1
10	Slip gauge set	2 SET
11	Sine Bar 100 mm	1
12	Sine Bar 200 mm	2
13	Toolmakers microscope	1
14	Profile Projector	1
15	Gear tooth verniers	2
16	Flangernic 0-25	1
17	Flangemic 25-50	1
18	Floating carriage micrometer	1
19	Thread plug gauges m24 x 3	1
20	Thread plug gauges m20 x 2.5	1
21	3 wire set box	1
22	Surface roughness measuring Instrument	1
23	Precision spheres different dia	1 SET
24	Dial Guage Caliberator	1

25	Precision level	1
26	Digital Micrometer	1
27	Digital Vernier 0-150 mm	1
28	Digital Ht. Guage	1
29	Bevel Protractor	1
30	CMM	1
31	Vision measuring system	1
32	Boredial gauge 16-35, 35-60	1 BOX
33	Depth Vernier 0-150mm	1
34	Depth micrometer with 6 rods	1
35	Internal micrometer with Extn sleeves	1
36	Precision Rollers 8	2
37	Surface plate	1
38	Bench centre	1

PR8481 **METALLURGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To train the students in observation and interpretation of Microstructure of Engineering materials.
- To train students in Heat treatment, hardenability and surface treatment of Engineering Materials
- To train the students in testing of Foundry sand

LIST OF EXPERIMENTS:

1. Specimen preparation for macro – examination.
2. Specimen preparation for micro examination and study of Micro structure of –
    a) Carbon steel s(High, Medium, and Low)
    b) Cast Iron (Gray, White, Nodular, Malleable)
    c) Brass (70/30), Bronze (tin bronze), Al-Si alloy, cupro-nickel, Ti alloy.
3. Quantitative metallography – Estimation of volume fraction, particle size, size distribution, and shape.
4. Cooling curves
    a) Pure Metal (Pb or Sn)
    b) Alloy (Pb-Sn or Pb-Sb)
5. Heat treatments (carry out the following heat treatment and study the micro structure before and after heat treatments)
    a) Annealing
    b) Normalising
    c) Quench Hardening
    d) Tempering
6. Jominy End Quench Test
7. Foundry Sand testing
    a) Sieve analysis
    b) Strength of moulding sand
    c) Permeability of moulding sand
    d) Clay content of moulding sand
    e) Moisture content of moulding sand
8. Electro-chemical Test
    a) Electro deposition
    b) Electro-chemical etching test

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to interpret the microstructure of different ferrous and non ferrous alloy.
- Ability to perform quantitative metallography.
- Ability to perform heat treatment, surface treatment on metals.
- Ability to analyze the properties of Foundry Sand.
- Ability to perform Electro Chemical Test.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Jominy End Quench Test	1
2	Specimen Mounting Test with Digital Measurements	1
3	Trinocular Microscopes with Objective Lens	2
4	Disc Polishing Machine	2
5	Muffle Furnace	1
6	Optical Microscope with Image Analyzing Software	1
7	Micro Vicker Hardness Tester	1
8	Printer to print the Microstructure	1
9	Hardness Tester (Brinnel or Rockwell)	1

MS8511 INDUSTRIAL TRAINING III L T P C
(PRODUCT DEVELOPMENT AND QUALITY SYSTEMS) 0 0 0 2

Total product knowledge, reverse engineering and quality system skill (Mini Project- I), Detailed constructional knowledge of product assembly, sub assembly, components, Sequential assembly and disassembly procedure, capturing of all geometrical dimensions, drawings, tolerances, fits, form error, material of construction and to understand the product development skills for lathes, drilling machines, submersible pumps, mono block pumps& electric motors - Comparison of design construction of other makes for above products and analysis -To develop any new product with innovation & creativity - Report preparation, presentation and evaluation -Awareness of TQM, ISO9000, ISO14000 and other standards etc. - Process capability studies – Rejection analysis – Six sigma applications – Calibration needs – Calibration authorities – Records – Charts – Applications – Form error understanding and verification- Case studies in quality systems.

ME8651 DESIGN OF TRANSMISSION SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues
  (Use of P S G Design Data Book permitted)