Study & Evaluation Scheme with Syllabus

For

B.Tech. Second Year

(Mechanical Engineering/ Production Engineering, Industrial & Production Engineering, Mechanical & Industrial Engineering, Manufacturing Technology, Automobile Engineering, Aeronautical Engineering)

On

Choice Based Credit System

(Effective from the Session: 2017-18)
### 2nd Year III-SEMESTER

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>L-T-P</th>
<th>Th/Lab ESE</th>
<th>Sessional</th>
<th>Total</th>
<th>Credit</th>
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<tbody>
<tr>
<td>1.</td>
<td>RAS301/ROE031 to 036, 038, 039</td>
<td>Mathematics-III/ Science Based OE</td>
<td>3-1-0</td>
<td>70</td>
<td>20 10</td>
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<td>2.</td>
<td>RVE301/RAS302</td>
<td>Universal Human Values &amp; Professional Ethics / Environment &amp; Ecology</td>
<td>3-0-0</td>
<td>70</td>
<td>20 10</td>
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<td>3.</td>
<td>RCE303</td>
<td>Fluid Mechanics</td>
<td>3-0-0</td>
<td>70</td>
<td>20 10</td>
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<td>4.</td>
<td>RME301</td>
<td>Material Science</td>
<td>3-0-0</td>
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<td>5.</td>
<td>RME302</td>
<td>Thermodynamics</td>
<td>3-1-0</td>
<td>70</td>
<td>20 10</td>
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<td>6.</td>
<td>RME303</td>
<td>Mechanics of Solids</td>
<td>3-0-0</td>
<td>70</td>
<td>20 10</td>
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<td>7.</td>
<td>RCE353</td>
<td>Fluid Mechanics Lab</td>
<td>0-0-2</td>
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<td>RME351</td>
<td>Material Science &amp; Testing Lab</td>
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<td>Thermodynamics Lab</td>
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<td>10.</td>
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<td>Computer Aided Machine Drawing–I Lab</td>
<td>0-0-2</td>
<td>50</td>
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<td>11.</td>
<td>RME101*</td>
<td>Elements of Mechanical Engineering*</td>
<td>3-1-0</td>
<td>70</td>
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<td>12.</td>
<td>RCE151*</td>
<td>Computer Aided Engineering Graphics*</td>
<td>0-0-3</td>
<td>50</td>
<td>30 20</td>
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</tbody>
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**TOTAL**

|           | 1000   | 24    |

CT: Class Test  
TA: Teacher Assessment  
L/T/P: Lecture/ Tutorial/ Practical

*B.Tech. II\textsuperscript{nd} year lateral entry students belonging to B.Sc. Stream, shall clear the subjects RCE151/RCE251 and RME101/201 of the first year Engineering Programme along with the second year subjects.

**Science Based Open Electives:**

a. ROE031/ROE041 Introduction to soft computing  
b. ROE032/ROE042 Nano Science  
c. ROE033/ROE043 Laser System and Application  
d. ROE034/ROE044 Space Science  
e. ROE035/ROE045 Polymer Science & Technology  
f. ROE036/ROE046 Nuclear Science  
g. ROE038/ROE048 Discrete Mathematics  
h. ROE039/ROE049 Applied Linear Algebra
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>L-T-P</th>
<th>ESE Marks</th>
<th>Sessional Marks</th>
<th>Total</th>
<th>Credit</th>
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<td>1.</td>
<td>ROE041 to RAS401</td>
<td>Science Based OE/ Mathematics-III</td>
<td>3-1-0</td>
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<td>2.</td>
<td>RAS402/ RVE401</td>
<td>Environment &amp; Ecology/ Universal Human Values &amp; Professional Ethics</td>
<td>3-0-0</td>
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<td>3.</td>
<td>REE409</td>
<td>Electrical Machines &amp; Controls</td>
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<td>RME401</td>
<td>Measurement and Metrology</td>
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<td>5.</td>
<td>RME402</td>
<td>Manufacturing Science &amp; Technology-I</td>
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<td>RME403</td>
<td>Applied Thermodynamics</td>
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<td>Electrical Machines and Controls Lab</td>
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<td>RME451</td>
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<td>Manufacturing Science &amp; Technology–I Lab</td>
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<td>Computer Aided Machine Drawing-II Lab</td>
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<td>Elements of Mechanical Engineering*</td>
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<td>RCE251*</td>
<td>Computer Aided Engineering Graphics*</td>
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<td><strong>TOTAL</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1000</td>
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NOTE: Practical summer training-1 of 4-weeks after IV semester or Minor fabrication project will be evaluated in VII semester.

**Science Based Open Electives:**
- a. ROE031/ROE041 Introduction to soft computing
- b. ROE032/ROE042 Nano Science
- c. ROE033/ROE043 Laser System and Application
- d. ROE034/ROE044 Space Science
- e. ROE035/ROE045 Polymer Science & Technology
- f. ROE036/ROE046 Nuclear Science
- g. ROE038/ROE048 Discrete Mathematics
- h. ROE039/ROE049 Applied Linear Algebra
RME301: MATERIAL SCIENCE

UNIT I


Ferrous and non-ferrous materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminium alloys. Introduction to BIS & ASTM codes and practice on material and testing.

UNIT II
Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Plastic deformation of single crystal by slip and twinning, Hardness Tests.

Fracture Creep Fatigue: Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

UNIT III
Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid solutions Hume Rothary rule, substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule.

Phase Diagram: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

UNIT IV

UNIT V

Books and References:
UNIT I
First law of thermodynamics: Thermodynamic definition of work, Displacement work and flow work, Displacement work for various non flow processes, Joules’ experiment, First law analysis for closed system (non flow processes), Internal energy and enthalpy. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer.

UNIT II
Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT III
Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb’s function.
Thermodynamic relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.
UNIT IV
**Properties of steam and Rankine cycle:** Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier chart, Dryness factor and it’s measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

**Air-water vapour mixture and Psychrometry:** Psychometric terms and their definitions, Psychrometric chart, Different Psychometric processes and their representation on Psychrometric chart.

UNIT V

Books and References:
1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA
2. Thermodynamics for Engineers by Kroos & Potter, Cengage Learning
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
12. Engineering Thermodynamics by Mishra, Cengage Learning
13. Refrigeration and Air Conditioning by C P Arora, MCGRAW HILL INDIA

RME303: MECHANICS OF SOLIDS

UNIT I
**Compound stress and strains:** Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr’s stress circle, three dimensional state of stress & strain, equilibrium equations, generalized Hook’s law, theories of failure. Thermal Stresses.

UNIT II
**Stresses in Beams:** Pure Bending, normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.
Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay’s method, area moment method, fixed and continuous beams
Torsion: Torsion, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.

UNIT III
Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.
Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler’s theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipments and machines.

UNIT IV
Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, Thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.
Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

UNIT V
Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.
Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Books and References:
2. Mechanics of material by Gere, Cengage Learning
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crandall, MCGRAW HILL INDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Material by Rattan, MCGRAW HILL INDIA
RME351: MATERIALS SCIENCE AND TESTING LAB

In this lab Experiments on Material Science and Experiments on Material Testing are to be conducted as given below:

(A). Experiments on Material Science (at least 5 of the following):
1. Preparation of a plastic mould for small metallic specimen.
2. Preparation of specimen for micro structural examination-cutting, grinding, polishing, etching.
3. Determination of grain size for a given specimen.
4. Comparative study of microstructures of different specimens of different materials (mild steel, gray C.I., brass, copper etc.)
5. Experiments on heat treatment such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after heat treatment.
6. Material identification of, say, 50 common items kept in a box.
7. Experiment on Faraday’s law of electrolysis.
8. Study of corrosion and its effects.
10. Study of Magnetic/ Electrical/Electronic materials.

(B) Experiments on Material Testing (at least 5 of the following):
1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
5. Spring index test on spring testing machine.
6. Fatigue test on fatigue testing machine.
7. Creep test on creep testing machine.
8. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young’s modulus of beam.
10. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.
Minimum 10 experiments out of following:
1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study and working of Two stroke petrol Engine
4. Study and working of Four stroke petrol Engine
5. Determination of Indicated H.P. of I.C. Engine by Morse Test
6. Prepare the heat balance sheet for Diesel Engine test rig
7. Prepare the heat balance sheet for Petrol Engine test rig
8. Study and working of two stroke Diesel Engine
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine
11. Study of Pressure compounded steam turbine
12. Study of Impulse & Reaction turbine
13. Study of steam Engine model.
14. Study of Gas Turbine Model
15. Any other suitable experiment(s) on thermodynamics
RME353: COMPUTER AIDED MACHINE DRAWING-I LAB

**Introduction** (1 drawing sheets)
Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning.

**Orthographic Projections** (3 drawing sheets)
Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

**Fasteners** (2 drawing sheets)
Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

**Riveted joints** (1 drawing sheet)
Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc.

**Assembly drawing** (2 drawing sheets)
Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, plunger block, footstep bearing, bracket etc.

**Free hand sketching** (1 drawing sheet)
Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

**Computer aided drafting** (1 drawing)
Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.

**Books and References:**
2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House
6. Engineering Drawing, Pathak, Wiley
8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY
9. Engineering Graphics with AutoCAD, Bethune, PHI
UNIT I

UNIT II

UNIT III
Modeling of Mechanical System: linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems. Control System: Open loop & closed loop controls, servo mechanisms; concept of various types of system. Signals: Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics.

UNIT IV

UNIT V

Text and Reference Books:
3. K. Ogata, “Modern Control Engineering” Prentice Hall of India.
4. BC Kuo, “Automatic Control systems.” Wiley India Ltd.
5. Irvin L. Kosow, “Electric Machinery and Transformers” Prentice Hall of India.
6. D. Roy Choudhary, “Modern Control Engineering” Prentice Hall of India.
RME401: MEASUREMENT AND METROLOGY

UNIT I
Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

UNIT II
Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement
Measurement of Pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum).
Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.

UNIT III
Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocimetry, Rotameter
Temperature Measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers.
Measurements of Force, Torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments
Measurements of Acceleration, and Vibration: Accelerometers vibration pickups and decibel meters, vibrometers.

UNIT IV
Coordinate measuring machine (CMM): Need, constructional features and types,

UNIT V

Books and References:
1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
5. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
UNIT I

UNIT II

UNIT III

UNIT IV
Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand, sand testing. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting, Sand casting, defects & remedies and inspection. Cupola furnace. Die Casting, Centrifugal casting, Investment casting, Continuous casting, CO₂ casting and Stir casting etc.

UNIT V

Books and References:
1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by PC Pandey
3. Manufacturing Engineering & Technology by Kalpakjian, Pearson
4. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA
7. Materials and Manufacturing by Paul Degarmo.
8. Manufacturing Processes by Kaushish, PHI
9. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
10. Production Technology by RK Jain
EME403: APPLIED THERMODYNAMICS

UNIT I

UNIT II
Vapour Power cycles: Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheating cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.  
Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III
Condenser: Classification of condenser, air leakage, condenser performance parameters.

UNIT IV
Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, Choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.  
Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Books and References:
1. Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2. Applied thermodynamics by Onkar Singh, New Age International
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education
4. Applied Thermodynamics by Venkanna And Swati, PHI
5. Theory of Stream Turbine by WJ Kearton
REE459: ELECTRICAL MACHINER & CONTROLS LAB

Note: To perform at least 7 experiments of Electrical Machines and 3 experiments of Control Systems

A. Electrical Machines
1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine (a) speed- torque characteristics (b) power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using (a) Voltage Control (b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and unity, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load.

B. Control Systems:
1. To determine transient response of a second order system for step input for various values of constant ‘K’ using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To determine speed – torque characteristics of an a.c. 2-phase servo motor.
4. To study and calibrate temperature using Resistance Temperature Detector( RTD)
5. To study dc servo position control system within P and PI configurations.
6. To study synchro transmitter and receiver system and determine output V/s input characteristics.
7. To study open loop and closed loop control of a dc separately excited motor.
RME451: MEASUREMENT & METROLOGY LAB

Minimum 8 experiments out of following (or such experiment) are to be performed:
1. Study the working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
4. Study & angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
7. Use of dial indicator to check a shape run use.
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances.
10. Experiment on measurement of pressure.
11. Study of temperature measuring equipments.
14. Experiment on measurement of flow.
15. Measurement of vibration/power.
16. Experiment on dynamometers.
17 To study the displacement using LVDT.

RME452: MANUFACTURING TECHNOLOGY-I LAB

Minimum 8 experiments out of following (or such experiment) are to be performed:
1. Design of pattern for a desired casting (containing hole).
2. Pattern making with proper allowance.
3. Making a mould (with core) and casting.
4. Sand testing methods (at least one, such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging - hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
13. Powder metallurgy experiment.
15. Any other suitable experiment on manufacturing science / process / technique.
RME453: COMPUTER AIDED MACHINE DRAWING-II LAB

Note: All drawing conform to BIS Codes.


Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modeling: Introduction to part modeling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).


Books and References:
5. Engineering Graphics with AutoCAD, Bethune, PHI
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India
8. Autodesk Inventor by Examples, Sam Tikoo, Wiley