Solapur University, Solapur
Structure of T.E.(Mechanical Engineering) Part I & II
w.e.f. Academic Year 2009-10.

T.E.(Mechanical Engineering) **Part -I**

Sr. No.	Subject	Teaching / Week					Examination Scheme			
		L	T	P	Dr	Total	TP	TW	ORAL	Total
1	Theory of Machine- II	3	-	2	-	5	100	25	25	150
2	Fluid Machinery & Fluid Power	3	-	2	-	5	100	25	-	125
3	Metallurgy	3	-	2	-	5	100	25	25	150
4	Metrology & Mechanical Measurement	3	-	2	-	5	100	25	-	125
5	Industrial Engineering	3	-	1	-	4	100	25	--	125
6	Machine Design -I	3	-	1	-	4	100	25	-	125
7	Workshop Practice – V**	-	-	2	-	2	-	-	-	-
	Total	**18**	**-**	**12**	**-**	**30**	**600**	**150**	**50**	**800**

Note : Vacational Training (to be evaluated at B.E. Part 1) of minimum 15days should be completed in any vacation after SE Part-II but before BE Part-I & the report should be submitted in BE Part-I.

'**' Assessment of Workshop Practice-V & VI shall be done at TE Part-II

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T.E.(Mechanical Engineering) **Part -II**

Sr. No.	Subject	Teaching / Week					Examination Scheme			
		L	T	P	Dr	Total	TP	TW	ORAL	Total
1	Machine Design II	3	-	2	-	5	100	25	25	150
2	Tool Engineering	3	-	2	-	5	100	25	--	125
3	Heat & Mass Transfer	3	-	2	-	5	100	25	25*	150
4	Automatic Control Engineering	3	-	2	-	5	100	25	--	125
5	CAD / CAM	3	-	2	-	5	100	25	-	125
6	General Proficiency & Seminar	1	-	2	-	3	-	50	--	50
7	Workshop Practice-VI	-	-	2	-	2	-	25	50#	75
	Total	**16**	**-**	**14**	**-**	**30**	**500**	**200**	**100**	**800**

'*' indicates Practical & Oral Examination
'#' indicates Practical Examination only

Note : 1.Vacational Training (to be evaluated at B.E. Part 1) of minimum 15days should be completed in any vacation after SE Part-II but before BE Part-I & the report should be submitted in BE Part-I.
2. The Practical batch be of 15 students (to the extent possible). After formation of batches, if the number of students remaining is 50% or more than batch size, a new batch be formed.
3. Practical / Tutorial load indicates the load per batch.

T.E. (Mech.) Part-I
Theory of Machines-II

Teaching Scheme :
Lectures : 3 Hrs. /Week
Practical : 2 Hrs./Alternate Week

Exam Scheme :
Theory Paper : 100 Marks
Term Work : 25 Marks
Oral : 25 Marks

Section – I

1. Toothed Gearing :
Geometry of motion, Gear geometry, Types of gear profile- involute & cycloidal, Theory of Spur, Helical & Spiral gears, Interference in involute tooth gears and methods for its prevention, Contact ratio, Path of contact, Efficiency and center distance of spiral gears. **(05)**

2. Gear Trains :
Types of Gear trains- Simple, Compound, Epicyclic, Reverted gear train, Tabular methodfor finding the speeds of elements in simple and compound epicyclic gear train, Differential gear box.Equivalent mass and Moment of Inertia applied to gear trains. **(05)**

3. Turning Moment diagram and Flywheel:
Function of flywheel and study of turning moment diagrams. Coefficient of fluctuation of speed energy. Determination of size of the flywheel for various application. Stresses in flywheel rim & spokes. **(04)**

4. Gyroscope :
Gyroscopic couple,Spinning and Precessional motion, Gyroscopic couple and its effect on i) Aero plane ii) Ship iii) Four-Wheeler iv) Two –Wheeler **(04)**

Section – II

5. Balancing :
Static and Dynamic balancing of rotary and reciprocating masses. Primary and Secondary forces and couples. Direct and Reverse cranks. Balancing of Single cylinder, Multi cylinder-In-line and V-Engines. Study of various balancing machines. **(06)**

6. Vibrations :
Basic concepts and definitions, vibration measuring parameters- Displacement, Velocity and acceleration, Free and forced vibrations. Types of damping , Equivalent Springs. **(03)**

7. Single degree of freedom systems :
Free vibrations with and without damping (Rectilinear, Torsional & Transverse), degree of damping. Logarithmic decrement, equivalent viscous damping, Coulomb damping. **(05)**

8. Forced vibrations with viscous damping, magnification factor, frequency response curves, vibration isolation and transmissibility. Whirling of Shafts and Critical speeds (No numerical treatment) **(04)**

9. Introduction to natural frequency of torsional vibrations,single rotor, two rotor and three rotor system, torsionally equivalent shafts, free torsional vibrations of geared system. **(04)**

Note: For topic 1 to 7 both Numerical & Therotical treatment & Topic 8 only theoretical.

Term Work

1. Experiment on Gyroscope.
2. Generation of involute gear tooth profile.
3. Two Problems on each type of Epicyclic gear train using tabular method.
4. Determination of M.I.by Bi-filar suspension, Trifilar suspension or Compound pendulum.
5. Balancing of rotary masses (Static and Dynamic)
6. Determination of logarithmic decrement (Free Damped Vibrations) .
7. Forced vibration characteristics (Undamped and Damped vibrations)

Books Recommended

1. Theory of Machines by Rattan S.S.
2. Theory of Machines by Thomas Bevan.
3. Theory of Machines & Mechanisms by Shigley
4. Mechanism and Machine Theory by Rao, Dukkipati.
5. Theory of Machines by Dr. V.P.Singh
6. Mechanical Vibrations by Grover
7. Theory of Machines by Ballaney
8. Theory of Machines by Jagdishlal
9. The complete Automotive Technology by William Crouse Angline
10. Mechanical Vibrations by Dr. V.P.Singh
11. Theory Machines and Mechanisms by Sayyad F.B. and Singhal

T.E. (Mech.) Part-I

FLUID MACHINERY & FLUID POWER

Teaching Scheme
Lectures : 3 Hrs/Week
Practicals : 2 Hrs/Week

Examination Scheme
Theory : 100 Marks
Term Work: 25 Marks

SECTION – I

1. **Water Turbines :** Euler's equation for rotodynamic machines, classification of Hydraulic turbines, pelton wheel, Work done and efficiencies pelton wheel, Working proportions of pelton wheel, Design of pelton Turbine runner, Working and construction of Francis, Kaplan turbine. Work done and efficiencies of Francis & Kaplan turbine, Working Proportions of Francis & Kaplan turbine, draft tube, types and function, Governing of turbines. **(6)**

2. **Centrifugal Pumps :** Working principles, construction, types, various Heads, multistage pumps, ,velocity triangles, Minimum starting speed, cavitation, MPSH & NPSH,. Methods of priming, Calculations of efficiencies, Discharge, blade angles, Heads, Power required, impeller dimensions. (**5)**

3. **Similarity Principles :**Model testing, unit quantities, specific speed of turbine(Pelton, francis, Kaplan turbine), specific speed of pumps,. Prediction of performance at other operating conditions. Performance characteristics of turbines & pumps. **(3)**

4. **Steam Turbines :** Principle of operation, classification, impulse & reaction steam turbines, compounding of steam turbines. Flow through impulse turbine blades, velocity diagrams, work done efficiencies, End thrust, blade friction, influence of ratio of blade speed to steam speed on efficiency of single stage turbine and its condition curve & reheat factors. Flow through impulse reaction blades, velocity diagram, degree of reaction, parsoni reaction turbine, back pressure and pass out turbine. Governing of steam turbines. Losses in steam turbines. **(6)**

SECTION – II

5. **Introduction to Fluid Power and Hydraulic System elements :**Types, advantages, applications of fluid power Pumps- Types, working, Characteristics, Applications. Seals & Packing- Types, materials, Applications. Hydraulic Actuators- Linear & Rotary, Types, Working, Cushioning effects, Calculation of force & velocity of piston. System components: Accumulators, Intensifiers, their types, working, applications. Symbols used in hydraulic and pneumatic circuits. **(7)**

6. **Pneumatic System Elements :**Piping, materials and pressure ratings, piping layout, air compressors, types, working, selection criteria, FRL unit, construction and working, pneumatic cylinders and air motors, construction and working, types. **(4)**

7. **Hydraulic and Pneumatic Control Elements :**Hydraulic - Pressure control valves- Direct acting type, pilot operated, sequence, counter balancing , unloading, pressure reducing, Construction & Working. Direction control valves- Types, construction & working, Spool actuation methods, spool centre positions, Flow control valves- Compensated & Non-Compensated, Construction & Working. Pneumatic - Direction control valves, Flow control valves and pressure control valves – types and working. **(5)**

8. **Hydraulic and Pneumatic Circuits & their applications :** Speed control circuits, Regenerative, Sequencing, Counter balancing, Synchronizing, Interlocking Circuits with accumulator & intensifier, Hydraulic and pneumatic clamping & braking systems, Pneumatic power tools, time delay circuits, **(4)**

Term-Work

List of Experiments

A) Fluid Machinery-

Minimum 3 experiments of the following.

1. Trial on a Pelton wheel .
2. Trial on a Francis/ Kaplan turbine .
3. Study & trial on a centrifugal pump.
4. Study / trial on a Steam power plant.

B) Fluid Power

Minimum of 3 assignments from serial no. 1 to 6,

1. Study of pressure control valves and circuits using pressure control valves.
2. Study of flow control valves and circuits using flow control valves
3. Study of direction control valves and pilot operated check valves and circuits
4. Study of hydraulic power units and accessories.
5. Study of filters and determination of filtration ratings.
6. Study of compressed air generation and distribution systems.

7. Testing of Gear pump and determination of performance characteristics
8. Demonstration of **Minimum of Three** hydraulic circuits such as : Simple reciprocating, Regenerative, Speed control(Meter in, meter out & bleed off), Sequencing, Synchronization, transverse & feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit, motor breaking circuit.
9. Demonstration on Pneumatic Trainer of **Minimum of Three** Pneumatic circuits (based on syllabus of UNIT 8 above).

C) One industrial visit of the following.

- Visit to Hydro-electric power station & writing a report based on the visit.
- Visit to pumping station & writing a report based on the visit.

Text and Reference Books

1. " Hydraulics, Fluid Mechanics and Machinery " ,Modi P N & Seth S N, Standard Book House ,New Delhi.
2. "Theory of Hydraulic Machinary", V.P. Vasandani, Khanna Publishers, Delhi.
3. "A text book of fluid Mechanics & hydraulic Machines", Dr.R.K. Bansal, Laxmi Publications Ltd.
4. "Hydraulic Machines", Dr. J. Lal, Metropolitan Book Co. Pvt. Ltd., Delhi.
5. Treaties on Heat Engineering , Vasandani Kumar , Khanna Publishers, Delhi
6. Steam and Gas Turbines , R. Yadav,
7. 'Industrial Fluid Power', Pinches – Prentice hall
8. 'Basic Fluid Power',D.A.Pease – Prentice hall
9. 'Industrial Hydraulics',J.J.Pipenger –, McGraw Hill
10. 'Hydraulics and Pneumatics'H.L.Stewart –, Industrial Press
11. 'Fluid Power with application',A. Esposito –, Prentice hall
12. 'Oil Hydraulics',B. Lall –, International Literature Association
13. 'Fluid Power Design Handbook'Yeaple
14. Vickers Manual on Industrial Hydraulics

15. Festo's Manual on Pneumatic Principle, applications
16. ISO – 1219, Fluid Systems and components, Graphic Symbols
17. "Oil Hydraulics- Principle & Maintenance", Majumadar, Tata McGraw Hill
18. "Pneumatics- Principle & Maintenance", Majumadar, Tata McGraw Hill
19. "ABC's of Hydraulic Circuits", H L Stewart, (Taraporwala Press)
20. "ABC's of Pneumatic Circuits", H L Stewart, (Taraporwala Press)

T.E. (Mech.) Part-I
METALLURGY

Teaching Scheme :
Lectures : 3 / week
Practicals : 2 hrs./ week/ batch

Examination Scheme :
Theory : 3 hrs. 100marks
Practical : Term work -25
Oral -25

SECTION - I

1. a) Classification of metallic materials. **(1)**

b) Concept of alloying, classification of cooling curves, equilibrium diagram. Introduction to solid solution, types (in brief) **(3)**

2. Study of Ferrous materials & alloys.

a) Iron-Iron carbide equilibrium diagram **(3)**

b) Plain carbon steels, composition, applications & properties **(1)**

c) Effect of alloying elements on steels **(1)**

d) Study of some important alloy steels. (Application) **(3)**
i) Nickel-chromium steel ii) Hadfield manganese steel
iii) Hadfield silicon steel iv) Free cutting steel v) HSLA steel
vi) High speed steel vii) HCHC steel viii) Maraging steel
ix) Water, oil, air hardening steel x) Hot & cold working tool steel, die steel
xi) Stainless steel xii) Dual phase steel xiii) Invar Spring Steel

e) Cast irons: composition, properties applications & comparisons of various types of cast irons. i.e. white iron, gray iron, SG iron, malleable iron, alloy cast irons, patented CI like mehanite. **(2)**

3. Study of nonferrous metals & alloys

a) Copper alloys, brasses, bronzes: typical composition, properties, applications **(2)**

b) Aluminium alloys: wraught & cast aluminium alloys **(2)**
Aluminium- silicon, aluminium-copper equilibrium diagram
composition, properties, applications of aluminium alloys

c) Study of solder materials, babbits & miscellaneous nonferrous alloys **(1)**

d) Standards and specifications of Ferrous and Non-ferrous alloys **(1)**

SECTION -II

4. Heat treatment of steel

a) Heat treatment, definition, concept, objectives **(3)**
Introduction to isothermal transformation & TTT diagram for eutectoid Steel. Transformation on continuous cooling, critical cooling rate

b) Annealing & normalizing- purposes, types, application, comparison **(2)**

c) Hardening & tempering:- concept, process, applications property changes, quenching media, methods of hardening- austempering, martempering, hardening with self tempering, concept of harden ability in brief, objectives & types of tempering, Sub zero treatment. **(3)**

d) Surface hardening treatment, carburising, nitriding, cyaniding, & Carbonitriding. Processes, purposes, applications and comparison Induction & flame hardening, processes, applications, comparison **(3)**

5. Powder metallurgy

a) Significance, methods of powder manufacture, mixing / blending, compaction methods, sintering processes & its significance, advantages & limitations **(4)**

b) Typical powder metallurgy applications and their flow chart:- Self lubricated bearings, cemented carbide cutting tools, friction materials, etc

6. a) Destructive testing methods, test procedure in brief, significance of i) Hardness testing ii) Tensile testing iii) Impact testing iv) Creep v) Fatigue testing **(3)**

b) Study of non destructive methods such as i) dye penetrant test ii) magnetic particle test iii) ultrasonic test iv) radiography v) Eddy current test Significance & comparison of these tests. **(2)**

Term work
(Any Eight of the following)

1	Study of Metallurgical Microscope	**1 turn**
2	Specimen preparation and Mounting process	**2 turns**
3	Macro examination and Spark test	**1 turn**
4	Study of microstructures of Steels	**1 turn**
5	Study of microstructures of Cast irons	**1 turn**
6	Study of microstructures of Non ferrous alloys	**1 turn**
7	Study and demonstration of Heat treatment processes Annealing, Normalising, Hardening, Hardening and Tempering	**3 turns**
8	Study of Microstructures of Annealed, Normalisied, Hardened, Hardened & Tempered samples	**1 turn**
9	Study of microstructures of Surface hardened samples	**1 turn**
10	Study and demonstration of Tensile, Impact, and Hardness tests, Creep test.	**2 turns**
11	Study and demonstration of any of the NDT processes	**1 turn**

Note: Journal based on above.

Recommended Books:

1. Heat treatment principles and technique - Rajan Sharma & Sharma
2. Introduction to Physical metallurgy – Avner, TMH.
3. Engineering Metallurgy Vol. I & II – R. A. Higgins (ELBS).
4. Engineering Metallurgy – E. C. Rollason (ELBS)
5. Introduction to Engg. Materials – B. K. Agarwal (TMH).
6. Engineering Metallurgy - Lakthin (MIR Publishers).
7. Material Science and Metallurgy – Dr. Kodgire (Everest , Pune).
8. Engineering Metallurgy I & II – A. S. Gholap & M. S. Kulkarni

T.E. (Mech.) Part-I
Metrology & Mechanical Measurements

Teaching Scheme :
Lectures-3 hours per week
Practical- 2 hours per week

Examination Scheme :
Theory Paper: 100 Marks
Term Work: 25Marks

SECTION I: ENGINEERING METROLOGY

1. Introduction & Standards of Measurement: Need of carrying out measurement, Definition and elements of measurement, Definition of metrology, Precision and accuracy. Classification of standards, International standards of length, Line, End & Wavelength standards, Slip gauges: Slip-gauge set specification, Selection of slip Gauges including numerical problems. **(3)**

2. Limits, Fits & Tolerances and Limit Ganges & Gauge Design: Terminology, Types of tolerances, Representation of tolerances, Addition & subtraction of tolerances, Accumulation of tolerances, Types of fits, Hole & shaft base systems of limits, fits and tolerances, Use of Tolerance charts, Numerical problems based on fundamental deviations & fundamental tolerance grades. Taylor's Principal of gauge design, types of gauges, Design of limit gauges, Disposition of gauge tolerances & wear allowances, numerical problems on gauge design. **(6)**

3. Measurement of Angles: Precision polygons as angle standards, Protractors, Spirit levels, Clinometers, Angle dekkor, Autocollimator, Angle gauges, Sine instruments, Constant Deviation prism, Dowell Prism, Simple numerical problems. **(3)**

4. Interferometry: Principle of interference of light, Principle & uses of optical flats, Principle of interferometer, Types of interferometers: Michelson's interferometer, NPL Flatness and Gauge Length interferometer, Simple numerical problems. **(3)**

5. Principles of Measuring Instruments / Machines: Measuring Principles of Vernier Caliper, Micrometer & Pneumatic comparator, Co-ordinate Measuring Machine, Profile projector, Introduction to laser Measurement, Metroscope & Automatic inspection system.**(2)**

6. Screw-Thread and Gear Metrology: Basic elements of screw-thread measurement, Methods of measurement of effective diameter, floating carriage micrometer Basic elements of spur-gear measurement, Methods of measurement of gear tooth thickness, Simple numerical problems. **(3)**

SECTION-II-MECHANICAL MEASUREMENTS

7. Mechanical Measurement: Need of Mechanical Measurement, Instruments, Measurement methods, Generalized measurement system & its functional elements, Instrument characteristics-Static & Dynamic characteristics, Calibration, Classification of transducers. **(3)**

8. Measurement of temperature: Importance of temperature measurement, Thermometer, Thermocouple- Principle, Types, Calibration, RTD, Thermistor, Numerical Problems. **(2)**

9. Measurement of Pressure & Vacuum: Importance of pressure & Vacuum measurement, Range of high pressure & vacuum Bourdon tubes, Dead weight pressure- gauge tester, Diaphragm gauge, LVDT, Piezo-electrical pressure gauge, Low vacuum gauges-McLeod gauge, Thermal conductivity gauge, Pirani gauge, Ionization gauge. **(3)**

10. Measurement of angular speed: Importance of angular speed measurement, Mechanical tachometers, Electrical tachometers-Drag cup, Inductive, Photoelectric pick up, Stroboscope, Numerical problems. **(3)**

11. Measurement of Flow: Importance of Flow measurement, Water meter, Turbine meter, Rotameter, Gas flow meter, Hot wire anemometer, Numerical problems. **(2)**

12. Measurement of strain: Classification of strain gauges, Principle of electrical strain gauge, Gauge factor (Analytical treatment), Analysis of Wheatstone's network using strain gauges, Types of electrical strain gauges, Mounting, Application to measure load/force, torque, Simple Numerical problems. **(4)**

13. Measurement of Vibration & Sound: Importance of vibration measurement, Classification of vibration measuring instruments, Seismic instrument, piezo-electric accelerometers, Importance of acoustic measurements, Sound pressure & power levels, Sound level meter. **(3)**

TERM - WORK

A) Metrology Laboratory

Any five of the following experiments (Experiment 1 is compulsory)

1. Uses of various measuring instruments (at least five of each type): Vernier instruments, Micrometer instruments, Dial instruments and Auxiliary instruments for carrying out measurements.
2. Calibration of Vernier caliper / Micrometer using slip gauges.
3. Use of at least one type of each class of comparator such as mechanical, optical, pneumatic, etc.
4. Measurement of angle using Bevel protractor and sine bar / sine centre.
5. Use of Clinometer and Angle gauges.
6. Determination of effective diameter of a screw thread using two/ three wire method.

7. Measurement of gear- tooth thickness.
8. Use of advanced measuring equipment such as Co-ordinate Measuring Machine / Metroscope / Profile projector.
9. Use of optical flat / optical parallels.

B) Mechanical Measurements Laboratory

Any five out of eight experiments from the following:

1. Temperature Measurement using thermocouples, RTD, Thermistor.
2. Testing of mechanical pressure gauge using Dead Weight pressure tester.
3. Vacuum measurement using U tube manometer & Mechanical Vacuum Gauge.
4. Angular speed measurement using stroboscope, photoelectric pick up, Tachometer or inductive pick-up tachometer.
5. Flow measurement using Rotameter / Water meter.
6. Measurement of bending strain or load using strain gauges.
7. Vibration measurement using seismic instrument or accelerometer.
8. Acoustic measurement using a sound level meter.

Reference Books:

1. Engineering Metrology: I C Gupta
2. Practical Engineering Metrology: Sharp K W B, Pitman, London.
3. Engineering Metrology: R K Jain, Khanna Publishers.
4. Metrology -Taher.
5. IS:2709/1964 & IS:919-1993
6. Mechanical Measurement & Control: Dr D S Kumar
7. Mechanical Measurement: Sohni & Dr Radhakrikshan.
8. Mechanical Measurement: Beckwith, Buck, Roy D. Marragoni, Narosa Publishing House New Delhi.

T.E. (Mech.) Part-I
INDUSTRIAL ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs./ Week
Practical : 1 Hr./Week/batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

To acquire knowledge of work measurement techniques for improving overall productivity and performance.

SECTION – I

1. Introduction to Productivity and Work Study:
Definition and scope, Productivity and quality of life, factors affecting productivity. Evolution of work study, contribution of Taylor and Gilberth, Work Study – techniques and basic procedure, Definition, functions and scope of industrial engineering, Human factor in application of work study. (**4)**

2. Method Study:
a) Definition, objectives and basic procedure, steps of method study
b) Select, Record, Examine, Develop – Process chart symbols, Outline and flow process charts, Flow diagrams,.
c) Movement of workers and material – String diagram, Flow process charts, Multiple activity chart, Travel charts.
d) Methods and movements at workplace – Principles of Motion Economy, Classification of movements, Two handed process chart, SIMO chart, Micro Motion study, Therbligs
e) Critically Examine Techniques, Evaluate, Define, Install and Maintain the improved method. (**11)**

3. Working conditions and Environment:
Occupational Hazards, Health and Safety, Lighting, Noise and Vibrations, Climatic conditions, ILO Norms, **(2)**

4. Ergonomic considerations at work place (for machine shop work) (2)

SECTION – II

5. Work Measurement:
Definition, objectives, basic procedure, Techniques of work measurement, Time study – Equipments and forms, selection of a job, steps in time study,breaking the job into elements, different types of elements, timing the elements, Rating in time study – standard rating and standard performance, factors affecting rate of Working, allowances, standard time determination, use of time standards, Work sampling – Need, procedure of work sampling,

determining time standard by work sampling. Predetermined time standards (PTS) – Definition, Methods Time Measurement (MTM), standard data from PTS, applications of PTS. Introduction to MOST (Introductory treatment) **(10)**

6. Location Layout:

a) Factors affecting site selection, factors affecting layout design, types of layout, systematic layout planning procedure, flow space requirement and availability, designing of layout, templates. 2-D and 3-D models,

b) Material Handling – Principles, functions and equipments (**5)**

7. Job Evaluation and Merit Rating

a) Job Analysis, Job evaluation, Objectives, Methods – Ranking System, Grade Description system, Factor Comparison System, Point rate System,.

b)Merit rating – Objectives, Methods of Merit Rating. (**3)**

8. Types of Incentive schemes (Introductory treatment) (1)

9. Concept of performance improvement like PDCA cycle (1)

Term Work

Any Six Assignments based on above Syllabus, including minimum two case Studies.

Reference Books

1. Work Study- I L O
2. Work Study, Curie & Faraday (ELBS)
3. Job Evaluation, I L O
4. Payment by results, I L O
5. Time & Motion Study Design, Bames (John Wiley)
6. Industrial Engineering Handbook, Maynard (McGraw Hill)
7. Facility Layout and Location – An Analytical Approach, Francis et al (PHI)
8. Work Study & Ergonomics, L.C. Jhamb (Everest)
9. Work Study by O.P. Khanna (Dhanapat Rai and Sons)
10. MOST, Zandin
11. Industrial Engineering, by O.P.Khannna.

T.E. (Mech.) Part-I
Machine Design-I

Teaching Scheme :
Lectures: 3 Hrs. / Week
Practical: 1 Hrs. / Week

Examination Scheme
Theory Paper: 100 Marks.
Term Work: 25 Marks.

SECTION-I

1. **Fundamentals of machine design.**
   Basic procedure of machine design, types of loads, factor of safety, theories of failure, service factor, material selection, preferred series, standardization. **(4)**

2. **Design of simple machine parts.**
   Cotter joint, knuckle joint, turn buckle, levers. **(6)**

3. **Design against fluctuating loads.**
   Stress concentration causes and remedies, fatigue failure, endurance limit, notch sensitivity, Goodman & soderberg diagram, modified Goodman diagram, design under combined stress, design for finite & infinite life under reversed stresses. **(6)**

4. **Selection of flat, V belt & rope drives from standard manufacturers' catalogue/ Design data book.** **(4)**

SECTION-II

5. **Design Considerations for:**
   a) Design for manufacture, Design for casting, Design for forging, machining, assembly, design with non-metals.
   b) Aesthetic & Ergonomic. (**4)**

6. **Design of shafts, keys and couplings.**
   ASME code, types of shafts – solid, hollow, line, transmission & splined shafts. Types of couplings-Muff, rigid flange & flexible bush pin type coupling. Design of keys. **(6)**

7. **Design of springs.**
   Types of springs and their applications, stresses induced in helical spring, design of helical (compression and tension) springs subjected to static loading, series & parallel springs. Introduction to leaf springs. **(5)**

8. **Design of Joints.**
   Types: Welded joints, bolted joints, riveted joints, design for transverse & eccentric loading. **(5)**

Term work

Minimum five assignments on above topics.

Reference Books

1) Design of Machine Elements by V.B.Bhandari.

2) Machine Design by R.K.Jain.

3) Machine Design by Pandya Shah.

4) Machine Design Integrated approach by Robert L. Norton.

5) Design of Machine Element by J.F. Shigley.

6) Design of Machine Element by M.F.Spotts.

7) PSG Design data Book.

TE (Mech.) Part – I & II
Workshop Practice – V & VI

Practical: 2 Hrs/Week

Term Work: 25 Marks
(To be given at the end of Part-II)
Practical Exam : 50 Marks
(at the end of Part-II)
Practical Exam.duration : 8 Hours

A composite job consisting of more than three components (excluding commercial components) requiring minimum five operations listed below:

1. Turning
2. Drilling
3. Boring
4. Hand tapping
5. Milling
6. Internal & External V-threading
7. Grinding

The components of the composite job shall carry at least one specified close tolerance.
In addition, following operations to be demonstrated during the term work. (These are not to be included in the job operations for term work & exams.)

1. Shaping
2. Slotting
3. Grinding
4. Form Turning
5. Planing
6. Honing

The composite job incomplete in T.E. (Mech.) Part I should be completed during T.E. (Mech.) Part II.
Assessment of Workshop Practice V & VI term work shall be done at the end of T.E. (Mech.) Part II.
Practical examination of EIGHT hours duration having 2-3 parts on the operations mentioned in syllabus of Workshop Practice – V & VI. (The operations meant for demonstration are not to be included for examination job)

T.E. (Mech.)Part -II
Machine Design-II

Teaching Scheme :
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week

Examination Scheme
Theory Paper: 100 Marks.
Term Work: 25 Marks.
Oral :25 Marks

SECTION-I

1. **Spur Gear**
   Design considerations of gears, gear materials, types of gear tooth failures, hunting tooth, gear tooth loads, minimum number of teeth, face width, Lewis equation, Spott's equation, Buckinghams' Equation, gear design for maximum power transmission. **(6)**

2. **Helical Gears**
   Virtual number of teeth, force analysis, beam and wear strength, effective load on gear tooth, introduction to herring bone gears. **(4)**

3. **Pressure vessel**
   Types of pressure vessels- horizontal and vertical, thick & thin cylinders, failure criteria of vessels – Lame's equation, Clavarino's equation, Birnies equation, Autofrettage and compound cylinders, classification of pressure vessels as per IS:2825,1969.Types of supports, introduction to design of pressure vessels as per codes, shell & end closures. Effect of opening & nozzle in shell and covers. **(7)**

4. **Optimum Design:**
   Introduction to optimum design for mechanical elements, adequate and optimum design, Johnson's method of optimum design- simple problems on shafts subjected to torsional and bending moments. **(3)**

SECTION- II

1. **Bevel Gear:**
   Terminology and geometrical relation. Guidelines for selection of dimensions and minimum number of teeth force analysis, mounting of bevel gears, beam strength and wear strength, dynamic tooth load. Introduction to design of spiral bevel gear and hypoid gears. **(6)**

2. **Worm Gear**
   Terminology and geometrical relations, materials, types of failures, standard dimensions and recommendations of worm gearing, force analysis of worm drive, friction in worm gear, efficiency and design criteria of worm drive as per IS7443-1974, load rating of worm drive, strength and wear rating of worm gear, thermal considerations in worm drive. **(5)**

3) Bearing design & selection: Tribological aspects

i) Rolling Contact Bearing: Types, static and dynamic load capacities, Stribeck's equation. equivalent bearing load, load-life relationship, bearing life, load factor selection of bearing from manufactures catalogue. Ball and Roller bearing,Design for variable load and speed, Bearings with probability of survival other than 90 %. Lubrication and mountings, dismounting and preloading of bearings. **(5)**

ii) Sliding contact bearing : Bearing material and their properties, bearing types and their construction details. **(2)**

iii) Hydro-dynamic lubrication : basic theory, thick and thin film lubrication, Reynolds's equation, Sommerfield Number,Design considerations in Hydrodynamic bearings. Introduction to hydro static bearings. **(2)**

Term Work

a) Design & drawing of (any one)

1) Gear box
2) Pressure vessel

b) Minimum four design assignments on remaining topics.

Reference Books:

1) Design of Machine Elements by J.E. Shigely

2) Engg. Design Material and processing approach by George Dieter.

3) Design of Machine Elements by V.B.Bhandari.

4) Design of Pressure Vessel by Harvey.

5) Process Equipment Design by Sen Bhattacharya.

6) PSG Design data Book.

7) Machine Tool Design Data Book. C.M..T.I., Bangalore.

08) Machine Design by Hall, Holowenko, Schaum's outline series.

09) Process Equipment Design by M.V. Joshi.

10) Machine Design by Robert L. Norton.

11) Introduction to Tribology by Mujumdar.

12) Machine Design by R.K.Jain.

13) Machine Tool Design by N.K.Mehta.

TE (Mech) Part- II
Tool Engineering

Teaching Scheme :
Lectures : 3 / week
Practicals : 2 hrs./ week/ batch

Examination Scheme
Theory : 4 hrs. 100 marks
Practical : Term work -2

SECTION - I

1. Theory of Metal cutting

a) Orthogonal cutting & Oblique cutting, Force analysis for orthogonal cutting **(1)**

b) Chip formation, types of chips, wedge action, shear plane angle, cutting ratio, shear stress & strain, velocity relationship, Merchant's theory, Merchant's circle & force relationship **(3)**

c) Tool dynamometers- types, applications. **(1)**

d) Machinability Index, factors affecting machinability **(1)**

e) Tool life- Flank & crater wear, effect of variables on tool life, Taylor's equation of tool life **(2)**

f) Coolants- Heat generation, types of coolants. **(1)**

g) Tool Materials **(1)**

2. Press Tools

a) Elements of press tools, types of dies, types of operations. **(2)**

b) Design of die for cutting operation, mechanics of shearing, cutting force estimation, punch & die clearance, stock strip lay out, design of punches & die block functioning & place of other elements. Centre of pressure, selection of die set & press **(5)**

c) Design of drawing dies, determination of blank size, no. of draws, stage wise component drawing, drawing radii, clearance, estimation of drawing force, time & power **(2)**

d) Types of Bending dies, related estimates. **(1)**

SECTION -II

3. Geometry & Nomenclature of cutting tools

a) Single point cutting tools- Geometry & Tool signature as per ASA system & ORS system, effect of geometry on tool life, cutting force, surface finish. **(2)**

b) Types of Multipoint cutting tools like Milling cutters, Drills, Broaches, Reamers **(2)**

4. Design of Jigs & Fixtures

a) Introduction, necessity & applications, basic concepts **(1)**

b) Location & clamping systems- Principle, types, applications **(2)**

c) Design of Jigs- Principles of Jig design, types & applications, types of bushes & selection, use of standard parts, design procedure & drawing. **(4)**

d) Design of Fixtures- Principles of Fixture design, standard elements & types of fixtures, design of milling fixtures. **(4)**

5. Economics of Tooling

a) Elements of cost: methods of depreciation **(1)**
b) Estimation of total cost & sales price **(1)**
c) Break- even analysis for equipment selection **(1)**
d) Economics of small tool selection, equipment replacement **(1)**
e) Economic Order Quantity for Batch production **(1)**

TERM WORK
(Minimum Six of the following)

1. Study of cutting tools : Classification, Nomenclature, Geometry
2. Exercise on Theory of metal cutting.
3. Demonstration of Lathe tool & Drill tool dynamometer & calculation of cutting forces.
4. Exercises on Mechanics & Economics of Machining & Tooling
5. Sheet on Press tool design- Cutting & drawing operation, necessary calculation
6. Sheet on Jig design- Exercise & drawing
7. Sheet on Fixture design- Exercise & drawing
8. Industrial visit

RECOMMENDED BOOKS

1. Metal cutting Theory & tool design- Mr. Arshinnov (MIR Publication)
2. Fundamentals of Tool design- ASTME Publication
3. Tool design – Donaldson (TMH Publication)
4. Text Book of Production Engineering – P.C.Sharma (S.Chand Publication)
5. Machine Tool Engineering – G.R. Nagpal (khanna Publication)
6. Press Tools – P.H.Joshi (S.Chand Publication)
7. Jigs & Fixtures - P.H.Joshi (S.Chand Publication)
8. Jig & Fixture Design – Kempster (ELBS Publication)

T.E. (MECH) Part - II
Heat and Mass Transfer

Teaching Scheme :
Lectures – 3 Hrs/week
Practical – 2 Hrs/week

Examination Scheme
Theory Paper- 100 marks
Pract. & Oral Exam – 25 marks
Term Work- 25 marks

Section I

1. Introduction

Aims of studying heat transfer, applications of heat transfer, basic modes of heat transfer and laws governing various modes, Thermal conductivity, effect of temperature on thermal conductivity of various materials. **(2)**

2. Conduction

Fourier's law of heat conduction and electrical analogy of thermal circuits, General heat conduction equation in Cartesian coordinate system. Deduction of one dimensional steady state conduction equation. Application of above (one dimensional case) equation to the system of plane wall (including composite structure) as well as to the system with radial heat conduction i.e. cylinders and sphere (including composite structures) , overall heat transfer coeff., critical radius of insulation, one dimensional steady state heat conduction with uniform heat generation (plane wall and solid cylinder).

Heat transfer through uniform cross section fins and evaluation of fin performance, Thermowell, Thermal contact resistance.

Unsteady State heat conduction - Systems with unsteady state heat conduction – systems with negligible internal resistance i.e. lumped heat capacity analysis **(13)**

3. Radiation

Nature of thermal radiation, properties of surface as receiver of energy and as an emitter of energy, laws governing radiation heat transfer – Planck's law, derivation of Wien's law and Stefan Boltzmann law from Planck's law of radiation, Kirchhoff's law. solid angle, intensity of radiation ,Lambert's cosine rule.

Heat transfer between two black surfaces, shape factor, Electrical analogy of radiation heat transfer between two grey surfaces, Application of electrical analogy method for two parallel infinite surfaces, concentric cylinders and spheres etc. radiation shield. **(5)**

Section II

4. Convection

Nature of convection, free and forced convection, convective heat transfer coefficient (h) and Nusselt number. Knowledge of the methods of evaluation of 'h', dimensional analysis, exact and approximate boundary layer analysis by analogical method (knowledge of boundary layer analysis be only descriptive in nature and must not include derivations or solutions of mathematical equations for any particular case). Concept of reference temp., Empirical correlations for forced and free convention as applied to some simple cases of tubes, plates (in different positions).

Boiling and condensation
Nucleate and film boiling phenomenon , drop wise and film wise condensation.

(8)

5 Heat Exchangers

Types of Heat exchangers direct transfer type, Storage types, Direct contact types heat exchangers.

Classification according to flow arrangement. Fouling factor, mean temp. diff., LMTD for parallel flow, counter flow, cross flow, correction factor, special cases. The effectiveness by NTU method, effectiveness of parallel, counter flow heat exchangers, design considerations. Heat pipe component and working principle. (Elementary treatment only), compact Heat exchanger. **(7)**

6 Mass Transfer

Introduction, definitions of concentrations, velocity, and mass fluxes, Fick's law of diffusion and analogy between heat and mass transfer. **(2)**

7 Finite Difference applications in heat conduction and convection

Introduction to finite difference , Finite difference methods for solving conduction and convection problems .
One dimensional steady state heat conduction-boundary conditions, Finite difference applications in convective heat transfer (Introduction only). **(3)**

TERM WORK

Any Eight experiments based on the following + 2 computer application assignments.

1. Thermal conductivity of insulating powder
2. Thermal conductivity of composite wall
3. Thermal conductivity of metal rod
4. Heat transfer by natural convection
5. Heat transfer by forced convection
6. Emissivity measurement
7. Stefan Boltzmann experiment

8. Critical heat flux
9. Heat pipe
10. Parallel flow-Counter flow heat exchanger

Instruction for Practical exam:

1. Four to Five experiments shall be selected for practical examination.
2. The no. of student for each practical set up should not be more than 04/05 students.
3. Oral will be based on the practical performed in the examination and the experiments included in the journal

References

1. Heat Transfer – A Practical approach – Ynus – A – Cengel (Tata McGraw Hill)
2. A Text Book on Heat Transfer by Dr. S.P.Sukhatme
3. Heat Transfer by J.P.Holman, McGraw Hill Book Company, New York.
4. Heat Transfer by Chapman A.J,McGraw Hill Book Company, New York.
5. Heat and Mass Transfer, S.C.Arora and S.Domkundwar, Dhanpatrai and Sons, Delhi.
6. Fundamentals of Heat and Mass Transfer by R.C.Sachdev, Willey Eastern Ltd.,
7. Heat and Mass Transfer by Dr. D.S.Kumara S.K.Kataria & Sons, Delhi.
8. Heat and Mass Transfer R.K.Rajput, S. Chand and Company Ltd., New Delhi. 110055
9. Heat Transfer by P.K.Nag, Tata McGraw Hill Publishing company Ltd., New Delhi.
10. Heat Transfer – P.S.Ghoshdastidar, Oxford University Press, Delhi.
11. Engineering Heat & Mass – M.M.Rathod, Laxi Publication, Delhi
12. Computational Fluid flow & Heat transfer- K.Muralidhar,T. Sundarrajan, Narosa Pub. House, New Delhi

T.E (Mech) Part - II
Automatic Control Engineering

Teaching Scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination scheme:
Theory Paper:100 marks
Term work: 25 marks

Section - I

UNIT (1) Need for control, manual and automatic control, Open loop and closed loop (feedback) control systems, modern control systems. **(3)**

UNIT (2) Representation of control components:
Mechanical – helical spring, viscous damper, torsional spring and damper,
Electrical – resistor, inductor, capacitor, series and parallel electric circuit and mech. System, grounded chair representation.
Analogs – direct and inverse analogs for mechanical, thermal and fluid systems. **(5)**

UNIT (3) Representation of control systems: Linearization of non-linear functions, linearization of operating curves, hydraulic amplifier, servomotor, jet pipe amplifier, speed control of AC and DC motors. **(4)**

UNIT (4) Block diagram algebra: general representation of a feedback control system, transfer functions, rules of block dia. algebra, reduction of block dis. to obtain closed loop transfer function. **(4)**

UNIT (5) Steady state operation: Steady state analysis for general block dia. for a control system, steady state characteristics, equilibrium in a system. **(4)**

Section - II

UNIT (6) Transient Response: general operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros, general form of transient response, Routh's stability criterion for a control system. **(3)**

UNIT (7) Modes of control: ON/OFF, proportional (P), Integral (I), Derivative (D) and P+I, P+D, P+I+D controllers, graphical representation of these controllers. **(3)**

UNIT (8) Root locus method: Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps. **(6)**

UNIT (9) Bode Plots: Magnitude and Phase angle plots, standard form of open loop T.F. $G(j\omega)$ $H(j\omega)$, Bode plots for standard factors of $G(j\omega)$ $H(j\omega)$,steps to sketch Bode plots for following factors :System gain K, Poles & zeroes at the origin, simple poles & zeroes, frequency response specifications, calculation of Gain Margin and Phase margin from Bode plots. **(5)**

UNIT (10) State space methods: State space representation for control system by direct, parallel, series and general programming, matrix from representation, computer diagrams. **(3)**

TERM WORK

1. An experiment on DC/AC motor speed control
2. An experiment to demonstrate ON/OFF control action
3. An experiment to demonstrate various modes of control: P, P+I, P+D & P+I+D.
4. Assignment on linearization of nonlinear functions and operating curves.
5. Assignment on reduction of block diagrams of control systems using block diagram algebra.
6. Assignment on 'Root Locus method'
7. Assignment on 'Bode Plots.
8. Assignment on 'State space methods'

- Every assignment must include a few theory questions and a variety of problems
- Software 'MATLAB' must be used to solve some problems in assignment numbers No.5 to No. 8

TEXT BOOKS

1. Automatic control Engineering: F.H.Raven., McGraw Hill International editions, New Delhi, Fifth edition.
2. Control Systems: U.A. Bakshi and V.U. Bakshi, Technical Publications, Pune, Fifth revised edition – 2007.

REFERENCE BOOKS

1. Modern Control Engineering: K.Ogata, Prentice Hall of India Pvt. Ltd., NewDelhi., Fourth edition.
2. Process Control: C. Johnson, Prentice Hall of India Pvt. Ltd., 1996.
3. Closed loop control systems: S.C.Goyal and U.A.Bakshi, Technical Publications, Pune, 2002.
4. Feedback Control systems: Bhide, Satyanarayana and Jalgoankar, Technova Publishers, Pune
5. Automatic control systems, B.C. Kuo, Prentice Hall of India Ltd.

T.E. (Mech) Part –II
Computer Aided Design & Computer Aided Manufacturing
(CAD/CAM)

Teaching Scheme :
Lectures: 3Hrs/Week
Paper: 100 Marks

Examination Scheme
Practical: 2 Hrs/Week
Term Work: 25Marks

Section-I

1) **Introduction to CAD / CAM**: Product Design Concept, Product Cycle and CAD / CAM, Advantages of CAD / CAM, Hardware in CAD, Graphics Workstation, Types of Input Devices, CPU and Output Devices, Software for CAD / CAM, Functions of a Graphics Software, Selection of CAD / CAM Software **(4)**

2) **Computer Graphics**: Geometric Transformations, Homogeneous Coordinates, Inverse Transformations, Coordinate Transformations, Three Dimensional Transformations, Standardization in Graphics Software, CAD / CAM Data Exchange, Shape Based Format, Product Data Based Format. **(5)**

3) **Geometrical Modeling**: Introduction, Model Structure Organization, Database Creation, Wire Frame Modeling, Wire Frame Representation, Real Objects and Wire Frame Models, Surface Modeling, Parametric representation of Hermite, Beizer, B-Spline, NURBS. Kinds of Surfaces, Solid Modeling, Representation Schemes for Solid Models, Applications of Solid Modeling. **(6)**

4) **Automation** (Introductory treatment only)Concepts in Manufacturing Systems, Definition of Automation, Types, Advantages and Limitations of Automation, Group Technology, Merits and Demerits of Group Technology, Concept of a Machine Cell, CAPP, Flexible Manufacturing System (FMS), Elements of FMS, Applications of FMS, Merits and Demerits in FMS, Computer Integrated Manufacturing (CIM). **(5)**

Section-II

5) **NC – CNC – DNC Machine Tools** :Numerical Control of Machine Tools, Elements of NC Manufacturing System, Coordinate System and Machine Motions, Types of NC Systems, Position and Motion Control in an NC System, Structure, Drives and other Devices, Steps in NC Manufacturing, Applications of NC Machine Tool, Advantages and Disadvantages of NC Technology, Limitations of Conventional NC **(5)**

6) **CNC Technology**: CNC controllers, Features and Advantages of CNC, Adaptive Control, Advantages of Adaptive Control, Direct Numerical Control (DNC), Types of DNC, Advantages and Disadvantages of DNC. **(4)**

7) **Tooling for CNC Machines**: Tool holders, Adapters, Tool magazines, Automatic tool changers, Pallets, Tool setting, Modular tooling. **(3)**

8) **Manual Part Programming:** Principles of an NC Program, Word Address Format (WAF), Machining Formulas, Tool Length and Cutter Diameter Compensation, Canned Cycles for Lathe, Milling and Drilling, Subprogram or Subroutines, DO Loop, Macros, Diameter Versus Radius Programming, CAD / CAM Systems for Part Programming**. (8)**

List of Experiments

1. One assignment on CAD/CAM definitions, Computer hardware devices, Various software used in CAD, functions of graphics packages, Hardware requirement for CAD system.
2. Assignment on Solid Modelling & Drafting of any two mechanical components.
3. Assignment on Modelling of Assembly of machine components like coupling, Knuckle joint, Cotter joint, Vice, Bearing block, Valve, Pulley support, Machine tool parts etc.
4. Assignment on fundamentals of NC--Structure of CNC, Actuating systems, Feedback systems, Axes & Standards, Machine control units.
5. Part programming of one job using CAM software. Programming and manufacturing of one job on CNC lathe or CNC Milling machine.
6. Assignment based on Industrial visit and report based on at least one of followingNC, CNC, Automation, Robots, and AGV.

Reference Books

1. Theory and Practice , Ibrahim Zeid – CAD/CAM - Tata McGraw Hill Publishing Co.
2. CAD/CAM - Mastering , Ibrahim Zeid –-Tata McGraw Hill Publishing Co.
3. Introduction to CAD/CAM ,Rao P.N., -Tata McGraw Hill Publishing Co.
4. Automation, Production Systems and Computer Integrated Manufacturing, Grover M.P.- Prentice Hall of India.

5. Computer Integrated Design and Manufacturing , D.D. Bedworth, M.R Henderson & P.M. Wolfe- -Tata McGraw Hill Pub. Co.
6. Numerical Control -Computer Aided Manufacturing ,Kundra, Rao, Tiwari- - Tata McGraw Hill Pub.Co.
7. CAD/CAM Theory and Concepts ,Kuldeep Sareen, C.Grewal, -S.Chand & Co.Ltd.
8. CAD/CAM/CAE ,Chougule N.K.- SCITECH Publications (I) Pvt. Ltd.

T. E. (Mech) Part – II
General Proficiency & Seminar

Teaching Scheme:-1 Hour/week. **Term work: - 50 Marks**
Practical :- 2 Hours/week

Purpose :- To develop presentation skills, Communication skill & to become familiar with the present environment to help him/her in deciding the career.

1. Resume writing – Definition of resume, Types of resumes, Purpose or function of resume, Basic hints for writing resume. **(2)**
2. Letter writing – Job query letter, application letter, recommendation letter, job offer letter, acceptance letter, job refusal letter, appreciation letter & resignation letter. **(2)**
3. Group discussion- Introduction to group discussion, Ways to carry out group discussion, Parameters— Contact, body language, analytical and logical thinking, decision making, evaluation, Topics – Technical, Non-technical, Social, Current affairs. **(2)**
4. Interview techniques- Definition of interview, Purpose of interview, Guidelines for interviews, Self evaluation/analysis for interviews. **(2)**
5. SWOT analysis **(1)**
6. Study of Various instruments & hand tools, techniques used for presentation e.g. charts, displays, models, Overhead projector, LCD projector etc. **(2)**
7. Information about various opportunities in technical & non-technical postgraduate courses, entrance examinations etc. e.g. GATE, CET/CAT, GRE-TOEFL, M.E/M.TECH, IES, UPSC, MPSC. **(2)**
8. Information about job opportunities (technical/administration) & nature of work and its importance in different sectors like Government jobs, Private jobs, Various departments in any company, jobs in IT/Software sector, private consultancy entrepreneur. **(2)**
9. Introduction to various techniques like Speed mathematics / Vedic mathematics for use in competitive examinations, optimse utilization of internet (search, data collection) **(1)**
10. Report writing & technical paper presentation, project report, seminar- report writing and presentation. **(1)**

Practicals

1. Resume writing.
2. One application letter & one resignation letter.
3. Group discussion -- should be conducted by making different groups considering the recent issues & evaluation should be done by the teacher, writing minutes of group discussion.
4. Mock Interviews and analysis report.
5. Student should analyze himself/herself with respect to his/her strength & weaknesses, opportunities & threats. Use of things like past experience, achievements, failures, feedback from others for SWOT analysis should be made, evaluation report.
6. Demonstration of working of LCD projector, OHP & other presentation tools
   Using Microsoft power-point presentation software and other for preparation and presenting seminars / projects etc.
7. Report on one of the career opportunities (based on topic 7 & 8)
8. Review of one technical reference book
9. Technical, research, online journal – different titles available, referral review
10. Student should prepare one report of 10 to 12 pages about any recent technological changes/ recent products & should submit and present seminar on the same

Books

1. 'How to write first class letters', Lee Sue Baugh, Viva Books Pvt.Ltd, NTC Publishing group.
2. 'Strengthen your writing', V.R.Narayanaswami, Orient Longman Pvt. Ltd.
3. 'Business Communications', M. Balasubrahmanian, Kalyani Publishers, New Delhi-Ludhiyana.
4. 'Communicative Competence in Business English', Brian Robinson, Vidya S. Netrakanti, Dr. Hari V. Shintre, Orient Longman Ltd.
5. 'A Guide to Technical Communication', James Sherlock, Allyn & Bacon Inc.
6. 'Effective Letters in Business', Robert L. Shurter, Tata McGraw Hill Pub., New Delhi.
7. 'Vikas Book of General English' Chaudhri Harish Chandra, Dalip Singh, Vani Educational Books.
8. First things first by Stephan Covey
9. Vedic Mathematics by Swami Saraswati
10. Vedic Mathematics by Grover
11. Every ones guide to effective writing by Jayakaran, Apple Publishing

Internet, Technical, Business Magazines, News papers should be other sources for references.