FIFTH SEMESTER

Course Title	L	P	M
THEORY			
Dynamics of Machinery *	4	0	100
Design of Machine Elements	4	0	100
Compressible flow and Propulsion Systems	4	0	100
Hydraulic and Pneumatic Systems *	4	0	100
Engineering Metrology & Measurements *	4	0	100
Process Planning and Cost Estimation	4	0	100
PRACTICAL			
1. Manufacturing Technology Lab –I	0	3	100
2. a) Instrumentation and Dynamics Lab	0	3	100
b) Metrology Lab			

DYNAMICS OF MACHINERY

1. FORCE ANALYSIS

10

Rigid Body dynamics in general plane motion – Equations of motion - Dynamic force analysis - Inertia force and Inertia torque – D'Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels – Engine shaking Forces - Cam dynamics - Unbalance, Spring, Surge and Windup.

2. BALANCING

9

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines

3. FREE VIBRATION

10

Basic features of vibratory systems - idealized models - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration critical speeds of simple shaft - Torsional systems; Natural frequency of two and three rotor systems.

4. FORCED VIBRATION

6

Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation.

5. MECHANISMS FOR CONTROL

10

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms.

Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes

Total: 45

TEXT BOOKS

1. Rattan S.S., "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994.
2. Sadhu Singh “Theory of Machines” Pearson Education, 2002.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.
5. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.

DESIGN OF MACHINE ELEMENTS

1. STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

2. DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings - design of knuckle joints.

3. DESIGN OF FASTNERS AND WELDED JOINTS 9

Threaded fastners - Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures - theory of bonded joints.

4. DESIGN OF SPRINGS AND LEVERS 9

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs – Design of Levers.

5. DESIGN OF BEARINGS AND FLYWHEELS 9

Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

Total: 45

Note: ***(Use of P S G Design Data Book is permitted in the University examination)***

TEXT BOOKS

1. Juvinall R.C, and Marshek K.M, "Fundamentals of Machine Component Design", John Wiley & Sons, Third Edition, 2002.

2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 2003.

REFERENCES

1. Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co, 2004.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.

COMPRESSIBLE FLOW AND PROPULSION SYSTEMS

1. COMPRESSIBLE FLOW – FUNDAMENTALS

8

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility

2. FLOW THROUGH VARIABLE AREA DUCTS

8

Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

3. FLOW THROUGH CONSTANT AREA DUCTS

9

Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length.
Isothermal flow with friction in constant area ducts
Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.

4. NORMAL SHOCK

10

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl - Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock, normal shock in Fanno and Rayleigh flows, flow with oblique shock (elementary treatment only).

5. PROPULSION

10

JET PROPULSION: Aircraft propulsion – types of jet engines – energy flow through jet engines, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines

SPACE PROPULSION: Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

Total: 45

Note: *(Use of approved gas tables is permitted in the University examination)*

TEXT BOOKS

1. Yahya. S.M., “Fundamental of compressible flow”, New Age International (p) Ltd., New Delhi, 1996.
2. Patrich.H. Oosthvizen, William E.Carscallen, “Compressible fluid flow”, McGraw-Hill, 1997

REFERENCES

1. Cohen. H., Rogers R.E.C and Sravanamutoo, “Gas turbine theory”, Addison Wesley Ltd., 1987.
2. Ganesan. V., “Gas Turbines”, Tata McGraw-Hill, New Delhi, 1999
3. Rathakrishnan.E, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2001
4. A.H.Shapiro, " Dynamics and Thermodynamics of Compressible Fluid Flow Vol.kl ", John Wiley , 1953, New York.
5. N.J. Zucrow, " Aircraft and Missile Propulsion, Vol. I & II ", John Wiley , 1975.
6. G.P.Sutton, " Rocket Propulsion Elements ", John Wiley, 1986, New York.

HYDRAULICS AND PNEUMATIC CONTROLS

1. BASICS OF FLUID POWER
9

Introduction of fluid power, Advantages of fluid power, Applications of fluid power system.
A brief comparison - Electrical system – Hydraulic system – Pneumatic system. Pascal's law - Boyle's law. Types of fluid power system - Properties of hydraulic fluids -
Properties of air.- Hydraulic and Pneumatic symbols.

2. HYDRAULIC SYSTEMS
9

Hydraulic pumps: Pump classification – Gear pump, Vane pump, Piston pump, construction and working of pumps – Variable displacement pumps. Hydraulic actuators: Classification – Linear hydraulic actuators – Types of hydraulic cylinders – single acting, Double acting and telescopic – Cushioning mechanism. Rotary actuators-Fluid motors, Gear, Vane and Piston motors. Hydraulic valves: Classification – Pressure – Flow – Direction controls.

3. HYDRAULIC CIRCUITS
9

Hydraulic circuits – Reciprocating - Quick return – Sequencing – Synchronizing – Intensifier circuit - Accumulator circuits – Safety circuits –Milling Machine circuits - Press – Planner – Fork lift. Electro hydraulic circuits.

4. PNEUMATIC SYSTEMS
9

Fundamentals of Pneumatics - Control Elements - Logic Circuits - Position - Pressure Sensing - Switching – Electro Pneumatic Circuits - Robotic Circuits.

5. PNEUMATIC CIRCUITS
9

Design of Pneumatic circuits - Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors - Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation - Case studies

Total: 45

TEXT BOOKS:

1. Andrew Parr, " Hydraulics and Pneumatics (HB) ", Jaico Publishing House, 1999.
2. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.

REFERENCES:

1. Dudleyt, A. Pease and John J. Pippenger, " Basic Fluid Power ", Prentice Hall, 1987.

2. Anthony Esposite, " Fluid Power with Applications ", Prentice Hall, 1980.
3. Majumdar S.R., “Oil Hydraulics”, Tata McGraw-Hill, 2000.
4. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 1995
5. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
6. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

ENGINEERING METROLOGY AND MEASUREMENTS

1. CONCEPT OF MEASUREMENT

9

General concept – Measurement system-Units and standards-measuring instruments-sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration, interchangeability.

2. LINEAR AND ANGULAR MEASUREMENT

9

Definition of metrology-Linear measuring instruments: Vernier, micrometer, interval measurement, Slip gauges and classification, interferometery, optical flats, limit gauges-Comparators: Mechanical, pneumatic and electrical types, applications.
Angular measurements: -Sine bar, optical bevel protractor, angle Decker – Taper measurements.

3. FORM MEASUREMENT

9

Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish, straightness, flatness and roundness measurements.

4. LASER AND ADVANCES IN METROLOGY

9

Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology
Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection.

5. MEASUREMENT OF POWER, FLOW AND TEMPERATURE RELATED PROPERTIES 9

Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Flow measurement: Venturi, orifice, rotameter, Pitot tube –Temperature: bimetallic strip, pressure thermometers, thermocouples, thermister.

Total : 45

TEXT BOOKS

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 1994
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997

REFERENCES

1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 1984
2. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000
3. Beckwith T.G, and N. Lewis Buck, "Mechanical Measurements", Addison Wesley, 1991
4. Donald D Eckman, "Industrial Instrumentation", Wiley Eastern, 1985.

PROCESS PLANNING AND COST ESTIMATION

1. PROCESS PLANNING

9

Types of Production - Standardization, Simplification - Production design and selection - Process planning, selection and analysis - Steps involved in manual experience based planning and computer aided process planning - Retrieval, generative - Selection of processes analysis - Breakeven analysis.

2. ESTIMATING AND COSTING

9

Importance and aims of Cost estimation - Functions of estimation - Costing - Importance and aims of Costing - Difference between costing and estimation - Importance of realistic estimates - Estimation procedure.

3. ELEMENT OF COST

9

Introduction - Material Cost - Determination of Material Cost Labour Cost - Determination of Direct Labour Cost - Analysis of overhead expenses - Factory expenses - Depreciation - Causes of depreciation - Methods of depreciation - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses – Ladder of cost.

4. PRODUCT COST ESTIMATION

9

Estimation in forging shop - Losses in forging - Forging cost - Illustrative examples. Estimation in welding shop - Gas cutting - Electric welding - illustrative examples. Estimation in foundry shop - Estimation of pattern cost and casting cost - Illustrative examples.

5. ESTIMATION OF MACHINING TIME

9

Estimation of machining time for Lathe operations - Estimation of machining time for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples.

Total:45

TEXT BOOKS:

1. M.Adithan and B.S. Pabla, " Estimating and Costing ", Konark Publishers Pvt. Ltd., 1989.
2. A.K. Chitale and R.C. Gupta, " Product Design and Manufacturing ", Prentice Hall Pvt. Ltd., 1997.

REFERENCES:

1. Nanua Singh, " System approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, Inc., 1996.
2. Joseph G. Monks, " Operations Management, Theory & Problems ", McGraw Hill Book Company, 1982.
3. G.B.S. Narang and V.Kumar, " Production and Costing ", Khanna Publishers, 1995.
4. T.R. Banga and S.C. Sharma, " Estimating and Costing ", Khanna Publishers, 1986.

MANUFACTURING TECHNOLOGY LAB –I

LIST OF EXPERIMENTS

1. Study of different types of lathes-centre, capstan turret and automatic and accessories.
2. Exercises on plain, step and taper turning.
3. Screw cutting – external and internal threads.
4. Exercises on tool angles on performance of lathe.

TOTAL : 45

2. a) INSTRUMENTATION AND DYNAMICS LAB

LIST OF EXPERIMENTS

Instrumentation Lab

1. Measurements of pressure
2. Measurements of Temperature
3. Measurements of Flow
4. Measurements of Speed
5. Measurements of Force.

Dynamics Lab

1. Governors – Determination of sensitivity, effort.
2. Cam – study of jump phenomenanon and drawing profile of the cam
3. Motorised Gyroscope – Verification of laws – Determination of gyroscopic couple.
4. Whirling of shapt – Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Vibrating system – Spring mass system – Determination of dumping co-efficient of single degree of freedom system.

b) METROLOGY LAB

LIST OF EXPERIMENTS

1. Use of precision measuring instruments like micrometer vernier, height, height and depth gauge, surface plate, etc.
2. Checking dimensions of a part using slip gauge.

3. Use of sine bar for measuring angles and taper.
4. Taper and bore measurement using spheres.
5. Fundamental dimension of a gear using contour projector.
6. Testing square ness of a try square using slip gauge.
7. Checking straightness of a surface plate using autocollimeter.

TOTAL : 45