



BHARATI VIDYAPEETH UNIVERSITY,
Pune.

(Established under Section 3 of UGC ACT 1956)



COURSE STRUCTURE AND SYLLABUS

B. Tech. (MECHANICAL) (Sem. V & VI)



COURSE STRUCTURE & SYLLABUS

BHARATI VIDYAPEETH UNIVERSITY, PUNE

B. Tech. (MECHANICAL) (Sem. V & VI)



Bharati Vidyapeeth University College of Engineering (BVUCOE) is the largest Engineering College in Maharashtra with an intake of 700 students in each academic year. Imparting quality technical education from Under Graduate to Doctorate Level, BVUCOE is probably the only Engineering College in India with an accreditation from both NAAC as well as NBA. The faculty at BVUCOE boasts of highly qualified academicians, a quality that is further emphasized by the fact that 15 of them are presently pursuing their Ph.D. degree.

BVUCOE has been ranked 29th amongst the Top 50 Technical Schools of India in survey conducted by DATAQUEST-IDC. We have enjoyed a ranking in this list for the last 4 years. Research is of utmost importance in all our programs. A total of 113 research papers were published in the academic year 2007-2008.

Currently we have 12 ongoing research projects. The infrastructure of BVUCOE is state-of-the-art with 62 classrooms, 59 laboratories and a well-stocked library that currently holds 27,130 titles. The college has an international presence with MoUs signed with the North Carolina A&T State University (Greensboro, USA), University of Venice (Italy), Actel Corporation (USA). Corporate interaction is also inculcated in our programs through our association with Oracle India Ltd., Infosys Ltd. and Tata Consultancy Services.

SALIENT FEATURES

The Mechanical Engineering Department has dedicated and enthusiastic staff and most of them are well qualified and experienced. The faculty is focused towards inculcating technical creativity in the students along with theoretical as well as practical knowledge. The excellent facilities are available to achieve this aim. The department has well equipped laboratories, and has modern equipment related to Mechanical Engineering.

In view to keep pace with the times, department has started the postgraduate course in CAD/CAM, which is unique in Pune region.

The Mechanical Engineering Student Association Organizes "RENAISSANCE" which is annual state level event. It is symposium comprising of paper presentation, Robotic competition, Quiz and Design competition.

MAJOR GROUPS/AREAS

Design Engineering , CAD/CAM (Computer Aided Design/Computer Aided Manufacturing , Heat Power Engineering, Manufacturing Engineering

EXPERTISE IN RESEARCH AND CONSULTANCY

Manufacturing, Electrochemical Machining, Design and FEM, Gear Dynamics, Tribology, Conical Air Bearing, Manufacturing, Solid Lubricants in Grinding, Mechanical Engineering department also conducts practicals for the students of engineering colleges in and around Pune.

MAJOR EQUIPMENTS

Steam Boiler, Steam Turbine, Advanced Pneumatic Trainer kit Hydraulics Trainer Kit, Hydraulic Power Pack, Emissivity Measurement Apparatus, Stephens, Boltzmann Apparatus, Clutch lining Testing Machine, Epicyclic gear train, Governor, Gyroscope, Vibration Setup, Refrigerator Tutor, Multi Cylinder Petrol Engine, Diesel Engine Test Rigs

SOFTWARE

IDEAS Nx10, MATLAB, ANSYS, AUTOCAD, Windows NT

LABORATORIES

Steam Power Laboratory, Industrial Fluid Power Laboratory, Computer Graphics and Laboratory, Heat Transfer Laboratory, Theory of Machines Laboratory, Dynamics of

Machinery Laboratory, Elements of Mechanical Engineering Laboratory, Refrigeration and Air conditioning Laboratory, I.C. Engine Laboratory.





STRUCTURE & EXAMINATION PATTERN

B. Tech. - Mechanical Engineering

Semester V									Total Duration : 32 Hrs/Week Total Marks : 750
Subject Code	Subject	Teaching Scheme (Hrs.)			Examination Scheme (Marks)				Total (Marks)
		L	P	D	Theory	Unit Test	TW & Pr	TW & Or	
K60301	Theory of Machine - II	04	02	-	80	20	-	50	150
K60302	Machine Design -I*	04	-	02	80	20	-	50	150
K60303	Heat Transfer	04	02	-	80	20	50	-	150
K60345	Advance Manufacturing Processes	04	02	-	80	20	-	50	150
K60304	Numerical Methods in Mechanical Engineering	04	02	-	80	20	50	-	150
	Total	20	08	02	400	100	100	150	750

Teaching Scheme			Examination Scheme				Total
Lectures	Practical	Drawing	Theory	Test	T. W. & Pr	T. W. & Or.	
20	08	02	400	100	100	150	750

Semester VI									Total Duration : 32 Hrs/Week Total Marks : 750
Subject Code	Subject	Teaching Scheme (Hrs)			Examination Scheme (Marks)				Total (Marks)
		L	P	D	Theory	Unit Test	TW & Pr	TW & Or	
K60305	Refrigeration & Air-conditioning	04	02	-	80	20	-	50	150
K60306	Machine Design-II*	04	-	02	80	20	-	50	150
K60329	Metrology & Quality Control #	04	02	-	80	20	50	-	150
K60307	Fluid Machinery	04	02	-	80	20	50	-	150
K60308	Computer Aided Design	04	02	-	80	20	-	50	150
	Total	20	08	02	400	100	100	150	750

Teaching Scheme			Examination Scheme				Total
Lectures	Practical	Drawing	Theory	Test	T. W. & Pr	T. W. & Or.	
20	08	02	400	100	100	150	750

*Time duration 4 hours for theory paper.

Subject common to Mechanical Engineering and Production Engineering.



RULES FOR CONDUCTING TESTS

Mode of the test

- In each semester for each subject three tests shall be conducted. The schedule for the same will be declared at the commencement of academic year in the academic calendar.
- Each test shall carry 20 marks.
- University examination pattern has given weightage of 20 marks for the tests.
- To calculate these marks following procedure is followed:
 - i) Out of the three tests conducted during the semester, the marks of only two tests in which the candidate has shown his/her best performance shall be considered, to decide the provisional marks in each subject.
 - ii) Average marks obtained in two tests in which students have performed well, shall be considered as provisional marks obtained by the student in the tests.
 - iii) If the candidate appears only for two tests conducted during the semester, he/ she will not be given benefit of the best performance in the tests.
 - iv) If the candidate appears only for one test conducted during the semester, to calculate the marks obtained in the tests it will be considered that the candidate has got 0 (zero) marks in other tests.
 - v) The provisional marks obtained by the candidate in class tests should reflect as proportional to theory marks. In cases of disparity of more than 15% it will be scaled down accordingly; These marks will be final marks obtained by the student. No scaling up is permitted.
 - vi) If the candidate is absent for theory examination or fails in theory examination his final marks for tests of that subject will not be declared. After the candidate clears the theory, the provisional marks will be finalized as above.
- Paper Pattern for Tests
 - i) All questions will be compulsory with weightage as following

Question 1	-	7 marks
Question 2	-	7 marks
Question 3	-	6 Marks
 - ii) There will not be any sub-questions.
- For granting the term it is mandatory to appear for all the three tests conducted in each semester.
- Roll numbers allotted to the students shall be the examination numbers for the tests.



SEMESTER - V



TEACHING SCHEME

Lectures : 04 Hrs/week

Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Or. : 50 Marks

Unit-I

(08 Hours)

Friction:

Types of friction, Laws of friction, friction between screw and nut, friction in mechanism, friction in turning pairs, friction circle and friction axis, Greasy friction, film friction.

Belt, rope and Chain drives:

Flat and V-belt, rope, limiting tension ratio, power transmitted, centrifugal effect, maximum power transmitted by belt, slip, creep, initial tension, friction due to rope on surface of cylinder and V groove, chain drive – classification of chain, chain speed, angular velocity of sprocket, chain length and kinematics of chain drive.

Unit-II

(08 Hours)

Friction Clutches:

Pivot and collar friction, single disc or plate clutch, Multiple disc clutch, cone clutch, centrifugal clutch, Torque transmitting capacity, clutch operating mechanisms.

Brakes and Dynamometer:

Types of brakes, braking torque, Braking of a vehicle, Dynamometer – Types, principle and torque measurement.

Unit-III

(08 Hours)

Toothed Gear, Involutometry:

Spur Gear: Terminology, law of gearing, conjugate action, involute and cycloidal profile, path of contact, arc of contact, contact ratio, interference, undercutting, effect of centre distance variation, friction between gear teeth, internal gear.

Helical Gears: Normal and transverse module, Torque transmitted by helical gears on parallel shaft, virtual no. of teeth.

Unit-IV

(08 Hours)

Spiral Gears:

Spiral angle, shaft angle, efficiency of spiral gear.

Worm and worm gears:

Terminology, velocity ratio, centre distance, Torque transmitted and efficiency of worm gearing.

Bevel Gears:

Terminology, geometrical relationship, tooth forces and torque transmitted.

Gear Train:

Types, velocity ratio, tooth load torque transmitted and holding torque.

Unit-V

(08 Hours)

Cams and Followers:

Cam mechanism and its uses, Types of cam and followers, main considerations affecting choice of cam profiles, Determination of cam profiles for given follower – motion, analysis of cams with specified contours – circular arc cam, tangent cam, cycloidal cam, kinematic equivalent system.

Unit-VI

(08 Hours)

Flywheel:

Turning Moment diagram, fluctuation of energy and speed, Determination of flywheel size for different types of engines and machines.

List of Practical

- Study of various types of gear boxes.
- To draw conjugate profile for any general shape of gear tooth.
- To generate gear tooth profile and to study the effect undercutting and rack shift using models.
- To draw cam profile for various types of follower motion.
- Determine experimentally coefficient of friction of friction lining material and also torque carrying capacity of clutch / brake.

- To study epicyclic gear train and experimentally measure holding torque and torque transmitted.
- Determination of flywheel size for an engine for a given T- ω diagram and using computer program.
- Study of various types of dynamometers and measurement of torque.

Text Books/ References

- Thomas Bevan, "Theory of Machine", CBS Publication
- J. E. Shingley, "Theory of Machine", McGraw Hill
- John Hannah and R. C. Stephens, "Mechanics and Machines", Advanced theory and examples, Edward Arnold
- R. S. Khurmi and J. K. Gupta, "Theory of Machines", Eurasia Publishing House
- S. S. Rattan, "Theory of Machines", McGraw Hill
- Abdulla Shariff, "Theory of Machine", Dhanpat Rai Publication
- P. L. Ballney, "Theory of Machines", Khanna Publications

Syllabus for Unit Test

Unit Test 1	Unit III & IV
Unit Test 2	Unit I & II
Unit Test 3	Unit V & VI



TEACHING SCHEME

Lectures : 04 Hrs/week

Drawing : 02 Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Or. : 50 Marks

Unit-I

(06 Hours)

Basic Concept of Machine Design:

Traditional design methods, Basic procedure of machine design, Use of standards in design, Selection of Preferred sizes, Introduction to aesthetic and ergonomic consideration in design. Design of simple machine parts (levers, curved beams, crane hooks, joints etc).

Unit-II

(10 Hours)

Shaft, Keys & Couplings:

Shaft design on strength basis, Shaft design on Torsional rigidity basis, ASME code of shaft design, Keys – Saddle, Sunk, Feather, Woodruff, Square, Flat, Kennedy key, Key design, Design of splines, Types of couplings, Muff coupling, Flange coupling, Flexible bush pin type coupling.

Unit-III

(08 Hours)

Power Screws:

Forms of threads, Differential & compound screw, Design of square & trapezoidal threads, Self locking screw, Design of power screws, Screw jack, toggle jack, C-clamp, Recirculating ball screw.

Unit-IV

(08 Hours)

Springs:

Types, Materials, Stress & deflection equations for helical, tension & compression spring, Torsional and multi leaf springs, Styles of ends, Nipping of leaf spring, Shot peening, Spring in series & parallel, Concentric springs.

Unit-V

(06 Hours)

Joints:

- 1) Design of welded joint :Advantages, Limitations, Butt & fillet welds, Parallel & transverse fillet welds, Axially loaded unsymmetrical welded joint, Eccentric loading in plane of weld, Welded joint subjected to bending & Torsional moment,
- 2) Design of adhesive joints.

Unit-VI

(10 Hours)

Design of Fluctuating Load:

Stress concentration, Causes & remedies, Fluctuating stresses, Fatigue failure, S-N curve, Endurance limit, Notch sensitivity, Endurance strength modifying factors, Reversed stress, Design for finite & infinite life, Cumulative damage fatigue failure, Soderberg & Goodman diagram, Modified Goodman diagram, Fatigue design of components under combined stresses such as shafts, bolts, springs, Preloaded bolts subjected to fluctuating loads.

Term work:

Term work shall consists of Two design projects. Design projects should be in the form of system design comprising of machine elements studied in syllabus. Design data book should be used extensively.

Four assignments on remaining topics.

Oral :

Oral will be based on above term work

Text Books/References

- Shigle J. E. & Mischke C. R., "Mechanical Engineering Design", McGraw Hill Pub. Co. Ltd.
- Spott M. E. & Shoup T. E., "Design of Machine Elements", Prentice Hall International
- Bhandari V. B., "Design of Machine Elements", Tata McGraw Hill Pub. Co. Ltd.
- Black P. H. & Q Eugene Adams, "Machine Design", McGraw Hill Book Co. Ltd.
- William C. Orthwein, "Machine Components Design", West Pub. Co. Jaico Pub. House

- “Design Data”, P. S. G. College of Technology Coimbatore.
- Juvinal R. C., “ Fundamentals of Machine Components Design”, John Wiley & Sons
- Hall A. S. Holwenko A. R., “Theory & Problems of Machine Design”, Schaum's outline series

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI



TEACHING SCHEME

Lectures : 04 Hrs/week

Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Pr. : 50 Marks

Unit-I

(08 Hours)

Introduction:

Modes of heat transfer, Applications of heat transfer in different fields of engineering, Fourier's law of conduction, Newton's law of cooling, Stefan-Boltzmann's law of radiation, Isotropic and anisotropic materials, three dimensional heat conduction equation in Cartesian coordinate for anisotropic material for steady state condition, and reduction to Fourier equation, Laplace equation and Poisson's equation, three dimensional heat conduction equation in cylindrical and spherical coordinates (no derivation), thermal diffusivity.

One dimensional steady state heat conduction:

One dimensional steady state heat conduction through a plane wall, cylindrical wall and sphere, Analogy between heat flow and electricity, heat conduction through a composite slab, cylinder and sphere, overall heat transfer coefficient, concept of thermal resistance and conductance.

Unit-II

(08 Hours)

Insulation:

Purpose of insulation, critical radius of Insulation, Economic thickness of Insulation, Thermal contact resistance, thermal conductivity and it's variation with temperature for metals, non metallic solids, gases and liquids, one dimensional problems of variable thermal conductivity.

One Dimensional Steady State Heat Conduction with Internal Heat Generation:

Symmetrical and asymmetrical boundary condition in plane wall, conduction in solid and hollow cylinder and sphere, practical problems of heat generation.

Unit-III

(08 Hours)

Extended Surfaces:

Heat transfer through extended surfaces, Classification of fins, Derivation of differential equation for fins with constant cross sectional area with different boundary conditions, Effectiveness and efficiency of a fin, Error in measurement of temperature, thermo well.

Unsteady state heat conduction :

System with negligible internal resistance, Biot & Fourier numbers Criteria for neglecting internal temperature gradient.

Unit-IV

(08 Hours)

Convection:

Introduction to hydrodynamic of thermal boundary layer, Laminar & turbulent flow over & inside a surface, convection heat transfer coefficients & order of magnitude, Dimensional analysis of free & forced convection, physical significance of the dimensionless parameters, Nusselt's number, Reynold's number, Prandtl's number, Grashoff's number, Stanton number, Rayleigh number.

Forced Convection:

Empirical correlations for heat transfer in laminar and turbulent flow over a flat plate and in a circular pipe, Concept of hydraulic diameter.

Natural Convection:

Empirical correlations for free convection, heat transfer over horizontal, vertical plate.

Unit-V

(08 Hours)

Thermal Radiation:

Fundamental concepts, Black body radiation, Kirchoff's law, Planck's distribution law, Wein's displacement law, Stefan Boltzmann's law, Surface emission, relative properties of a surface, Grey, black and real surface, solid angle and intensity of radiation, Lambert's Cosine law, Heat exchange by radiation between two finite black surfaces, Radiation shape factor, use of shape factor charts, Irradiation, radiosity, Electrical network, Heat exchange between two infinitely parallel planes and cylinders, Radiation shields.

Unit-VI

(08 Hours)

Condensation and Boiling:

Film and dropwise condensation, derivation of heat transfer coefficient for laminar film condensation on vertical and inclined plate, Correlations for condensation on and inside tubes, modes of pool boiling, critical heat flux, forced boiling.

Heat Exchanger:

Classification, Applications of heat exchangers, Heat exchanger analysis, Logarithmic Mean Temperature Difference for parallel and counter flow heat exchangers, LMTD correction factors, fouling factor. The effectiveness NTD Method for parallel and counter flow heat exchangers, Design considerations for heat exchanger.

Termwork

Term work shall consist of any eight experiments

- Determination of thermal conductivity of insulating powder.
- Determination of thermal conductivity of metal rod.
- Determination of thermal conductivity of different materials in composite wall.
- Temperature distribution along a length of a fin and determination of fin effectiveness and fin efficiencies.
- Determination of film heat transfer coefficient on a hollow vertical tube heated from inside.
- Determination of film heat transfer coefficient for turbulent flow inside a pipe.
- Determination of emissivity of a metal surface.
- Determination of Stefan-Boltzmann constant.
- Performance of a parallel flow and counter flow heat exchanger.
- Calibration of thermocouple.
- Demonstration of a heat pipe.

Text Books/ References

- J. P. Holman, "Heat Transfer", McGraw Hill Publication
- Sachdeva R.C. (1988), "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Limited
- Frank P Incropera, David P De Witt (1990), "Fundamentals of Heat Transfer", Wiley Eastern Ltd.

- Chapmen A.J. (1989), “Heat Transfer”, IV Edition.
- Sukhatme S.P. (1989), “A text book on Heat Transfer”, IIIrd Edition Orient Longmans Ltd, New Delhi
- Arora S.C. and Domkundwar S. (1994), “A Course in Heat and Mass Transfer”, Dhanpat Rai and sons
- Karlekar and Desmant, “Principles of Heat Transfer”, Prentice hall of India Ltd.

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI



K60345: ADVANCED MANUFACTURING PROCESSES

TEACHING SCHEME

Lectures : 04 Hrs/week

Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Or. : 50 Marks

Unit -I

(06 Hours)

Theory of metal Cutting:

Cutting tools tool geometry, concept of speed, feed, depth of cut, cutting action and effect of these on cutting forces. Merchant's circle of forces, estimation of cutting forces, machinability. Tool life for minimum cost and maximum production. New technology in metal cutting for high productivity. Measurement of cutting forces and power required. Cutting tools- Design of single point, multipoint and form tools.

Unit -II

(08 Hours)

Jigs and Fixtures:

Definitions, elements, Basic principles and guide lines for design. Location, types of locators and their selection. Clamping, basic principles, types and their selection, indexing methods. Design of drilling jigs. Design of milling & Turning fixtures.

Unit-III

(08 Hours)

Non Conventional Machining:

Concept of non conventional machining. Study of processes like, Electrochemical Machining, Electro Discharge Machining, Abrasive Jet Machining, Plasma Machining, LASER Machining, Ion beam Machining, Ultrasonic Machining, Electron Beam Machining with reference to process capabilities, working principle, Material removal rate, Advantages and limitations.

Gear Manufacturing:

Gear cutting processes- forming and generation, Gear cutting on milling, gear hobbing, gear shaping, gear shaving, lapping and grinding.

Unit-IV

(08 Hours)

Sheet Metal Working :

Study of various press tools and presses, Study of various processes like Piercing, Notching forming, Drawing, coining etc. Elements of dies and punches. Types of dies – simple, compound, combination and progressive dies and punches for various press working operations such as punching, blanking, drawing, bending, forming, coining etc. Calculations of clearances, centre of pressure, forces, press tonnage, blank size, number of draws, strip layout, sheet utilization, ratio. Methods of reducing forces. Design of simple blanking die, Progressive die, & Deep Drawing Die.

Unit-V

(08 Hours)

Heat treatment of steels and alloys:

Iron and Iron Carbide Equilibrium Diagram, Transformation product of Austenite, Martensite transformation, Time- Temperature. Transformation curve, Heat treatment of steels, Annealing, Normalising, Hardening and tempering, Hard ability, Jominy End quench test, Surface hardening heat treatments, Carburising, Nitriding, Carbonitriding, Induction and flame hardening, Tool steels, Classification, Properties and application of tool steels, Heat treatment of tool steels.

Unit-VI

(08 Hours)

C. N. C. Machine Tools & Robotics:

Principle of operation of CNC, Types, Features, Direct numerical control (DNC) and its applications.

CNC part programming, axes nomenclature of CNC machines. Manual part programming using. Computer aided part programming using APT.

Types of Robots, construction and operation of robots, robot axes and configuration, robot applications, robot selection and economic justification.

FMS, FMC and Adaptive Control.

List of Practical (Any Eight)

- Heat treatment of plain carbon steels.
- Jominy End Quench test for hardnability test.
- Design and working drawing of any 3 of the following cutting tools, Single point tools, Turning tool, Circular form tool, Broach.

- Design and working drawing of one drilling jig.
- Design and working drawing of one fixture.
- Programming and making of two jobs on CNC or CNC Tutor involving turning, parting, taper turning and other turning operation.
- Design of simple blanking die, Progressive die, & Deep Drawing Die.

Oral

Term work and oral will be based on above syllabus.

Text Books/References

- Dr. V. D. Kodgere, “Material Science and Physical Metallurgy”, Everest Publication, Pune
- Donaldson, Lacain and Goold, “Tool Design”, Tata McGraw Hill
- M. H. A. Kempster, “Introduction to Jigs and Fixtures Design”, Viva Books Ltd.
- ASTME, “Tools Engineering Handbook”,
- P. C. Sharma, “Production Engineering”, Khanna Publication
- Hoffman, “Introduction to Jigs and Fixture”, Galgotia Publishers
- Radhakrishnan P. and Subramanyan CAD/ CAM/CIM Wiley Eastern Ltd.
- Rao P. N., Tewari N. K. and Kundra T. K., “Computer Aided Manufacturing”, Tata McGraw Hill
- Groover M. P., “Automation, Production System and Computer Integrated Manufacturing”, Prentice Hall of India

Syllabus for Unit Test

Unit Test 1	Unit I & IV
Unit Test 2	Unit II & V
Unit Test 3	Unit III & VI



K60304: NUMERICAL METHODS IN MECHANICAL ENGINEERING

TEACHING SCHEME

Lectures : 04Hrs/week

Practical : 02Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Pr. : 50 Marks

Unit -I

(08 Hours)

Error Analysis:

Significant figures, Accuracy and Precision, Error definition, Round-Off errors, Truncation error, Total numerical error, Blunders, Formulation error and Data Uncertainty.

Unit -II

(08 Hours)

Roots of Equations:

Bracketing methods-Bisection and False position method. Open methods-Simple fixed-point iteration, Newton Raphson method and Secant method. Engineering Applications.

Unit-III

(08 Hours)

Linear Algebraic Equation:

Navier Gauss elimination, pitfalls of Gauss Elimination, techniques of improving solutions, complex numbers. Gauss Jordan, Gauss sieedel and LU Decomposition. Engineering application-spring mass system.

Unit-IV

(08 Hours)

Curve Fitting:

Least-Square Regression-Linear regression, polynomial regression and multiple linear regressions.

Interpolation-Newton's divided difference interpolating polynomial. Lagrange's interpolating polynomial, coefficients of interpolating polynomials. Inverse interpolation spline interpolation. Engineering Applications.

Unit-V

(08 Hours)

Numerical differentiation and Integration:

Trapezoidal rule, Simson's rules, integration with unequal segment,

multiple integral, romberg integration, Gauss Quadrature.
Richardson Extrapolation, derivatives of unequally spaced data.
Engineering Applications.

Unit-VI

(08 Hours)

Ordinary Differential Equations:

Euler's method, improvement of Euler's method, Runge-Kutta method, system of equations, Adaptive Runge Kutta method. Stiffness and multistep method. Engineering Applications.

Term work

Eight computer programs using C++ based on above syllabus covering all units.

List of Practical

Practical examination to be conducted on above syllabus.

Text Books/ References

- Steven Chapra and Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw-Hill edition.
- S. S. Sastry, "Introductory Methods of Numerical Analysis", Prentice, Hall of India
- V. Rajaraman, "Computer Oriented Numerical Method", Prentice, Hall of India Pvt. Ltd. New Delhi
- M. K. Jain and Ayengar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations"
- N. Krishna Raju and K. U. Muthu, "Numerical Methods for Engineering Problems", Macmillan India Ltd.
- Gupta Malik, "Calculus of Finite Differences and Numerical Analysis", Krishna Prakashan Mandir, Meerut

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI



SEMESTER - VI





K60305: REFRIGERATION & AIR-CONDITIONING

TEACHING SCHEME

Lectures : 04Hrs/week

Practical : 02Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Or. : 50 Marks

Unit-I

(08 Hours)

Methods of Refrigeration:

Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, vapour refrigeration system, steam jet refrigeration system, refrigeration by using liquid gases, Thermoelectric and ultrasound refrigeration.

Air refrigeration system:

Definition, refrigeration load, unit of refrigeration, Reverse Carnot cycle, Bell Coleman cycle, Methods of air refrigeration systems, simple air cooling system, boot strap system, reduced ambient system, regenerative system.

Unit-II

(08 Hours)

Simple Vapour Compression System:

Limitations of air refrigeration system, development of vapour compressor cycle, effect of operating parameters on VCC, use of P-H charts, actual vapour compression cycle.

Refrigerants:

Desirable properties of refrigerants, classification of refrigerants, secondary refrigerants, alternative refrigerants for CFC's, HCFC'S, ozone depletion potential (ODP), Global warming Potential (GWP).

Unit-III

(08 Hours)

Multi Pressure Systems

Introduction to multistage compression, two stage compression with flash gas removal, with liquid intercooler, complete two stage compression system, Cascade systems.

Vapour Absorption System:

Introduction, Simple Vapour absorption system, practical vapour absorption system, COP of an ideal vapour absorption system, Water ammonia system, Electrolux refrigerator, Lithium-Bromide absorption

system, Comparison between VCC and VAC (no mathematical treatment).

Unit-IV

(08 Hours)

Psychometry:

Introduction, Psychometric terms, Use of Psychometric charts, Psychometric processes, adiabatic saturation temperature, evaporative cooling, by pass factor of coil, efficiency of coil, adiabatic mixing of two air streams, Air washers, Thermodynamics of human body with environment effective temperature, comfort chart, factors influencing human comfort.

Unit-V

(08 Hours)

Air Conditioning Systems:

Definition, factors, equipment used, classification, all air system, all water system, air water system, unitary and central air conditioning, in filtration and ventilation loads, concepts of SHF, RSHF, ERSHF, ADP.

Components of Refrigeration and Air Conditioning System:

Compressors, condensers, evaporators, expansion devices such as capillary tubes, automatic expansion valves, thermostatic expansion valves and controls such as thermostats, humidistat, Solenoid, Installation, charging, testing and maintenance.

Unit-VI

(08 Hours)

Ducts:

Introduction, classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct, friction losses, dynamic losses, air flow through simple duct system, equivalent diameter, for determination of duct size.

Food Preservation:

Cold storage, control and modified atmosphere (CAMA) storages, mobile refrigeration and air conditioning, refrigerant piping selection, pressure drop, valves, fitting, insulating materials.

Termwork

The term work shall consist of record of any eight experiments from the following:

- Test on vapour compression test rig.

- Test on air conditioning test rig.
- Test on ice plant test rig.
- Study on non-conventional refrigeration system.
- Determination of cooling load of air conditioning system (case study).
- Determination of refrigeration load in cold storage (case study / visit).
- Study of installation /operation/maintenance practices for refrigeration system.
- Visit to any refrigeration or air conditioning plant.
- Trial on heat pump test rig
- Test on vapour absorption test rig.

Text Books / References

- C. P. Arora, “Refrigeration and Air Conditioning”, Tata McGraw Hill
- Arora Domkundwar, “Refrigeration and Air Conditioning”, Dhanpat Rai and Company
- Dossat Ray I, “Principal of Refrigeration”, Wiley Eastern Limited
- Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Limited
- Khurmi R. S. and Gupta J. K., “Refrigeration and Air Conditioning”, Eurasia Publication House (P) Ltd. New Delhi
- Stocker W. F. and Jones J. W., “Refrigeration and Air Conditioning”, McGraw Hill International Editions

Syllabus for Unit Test

Unit Test 1	Unit I & IV
Unit Test 2	Unit III & V
Unit Test 3	Unit IV & VI



TEACHING SCHEME

Lectures : 04Hrs/week

Drawing : 02Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Or. : 50 Marks

Unit-I

(06 Hours)

Design For Manufacture:

General principles of design for manufacture & assembly (DFM & DMFA), Principles of design of casting & forging, Design for machining, Design for powder metallurgy, Design for welding.

Unit-II

(10 Hours)

Gears:

Gear drives, Classification of gears, Selection of types of gears, Standard system of gear tooth.

Spur Gears:

Number of teeth & face width, Types of gear tooth failure, Desirable properties & selection of gear materials, Force analysis, Beam strength, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength, Estimation of module based on beam & wear strength, Gear design for maximum power capacity, Estimation of dynamic tooth load by velocity factor, Spott's equation, Buckingham's equation, Methods of gear lubrication.

Unit-III

(06 Hours)

Helical Gears:

Transverse & normal module, virtual number of teeth, Force analysis, Beam & wear strength, Effective load on gear tooth, Estimation of dynamic load by velocity factor, Spott's equation, Buckingham's equation.

Unit-IV

(08 Hours)

Rolling Contact Bearing:

Types, Static & dynamic load carrying capacities, Stribeck's equation,

Equivalent bearing load, Load life relationship, Selection of bearing life, Selection from manufacturers catalog, Taper roller bearing, Design for cyclic load & speed, Bearing with probability of survival other than 90%, Lubrication & mounting construction materials, Selection of oil seals & gaskets, Pre loading, Types of failure of bearings and its remedies.

Unit-V

(10 Hours)

Sliding Contact Bearing:

Basic modes for lubrication, Viscosity. Effect of temperature on viscosity, Viscosity index, Additives, Greases, Selection of lubricants.

Viscous flow through rectangular slot, Load carrying capacity & flow requirement of hydrostatic step bearing, Energy losses, Hydrodynamic lubrication, Reynolds equation, Sommerfeld number, Raimondi & Boyd's method, Temperature rise in hydrodynamic bearings, Parameters of bearing design, Length to diameter ratio, Unit bearing pressure, Radial clearance, Minimum oil film thickness, Constructional details of bearings, Bearing materials & their selection, Sintered metal bearings, Comparison of rolling & sliding contact bearing.

Unit-VI

(08 Hours)

Tribology:

Introduction to tribology, Tribology in design, Tribology in industry.

Friction:

Introduction, Law of friction, Kinds of friction, causes of friction, theory of friction.

Wear:

Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theory of wear.

Termwork

Term work shall consist of one design project. Design project should be in the form of system design comprising of machine elements studied in syllabus. Design data book should be used extensively.

Four assignments on remaining topics.

Oral

Oral will be based on above term work.

Text Books/References

- Shigle J. E. & Mischke C. R., “Mechanical Engineering Design”, McGraw Hill Pub. Co. Ltd.
- Spott M. E. & Shoup T. E., “Design of Machine Elements”, Prentice Hall International
- Bhandari V. B. “Design of Machine Elements”, Tata McGraw Hill Pub. Co. Ltd.
- Black P. H. & Q Eugene Adams “Machine Design”, McGraw Hill Book Co. Ltd.
- William C. Orthwein, “Machine Components Design”, West Pub. Co. Jaico Pub. House
- “Design Data”, P. S. G. College of Technology Coimbatore
- Juvinal R. C. “Fundamentals of Machine Components Design” Jonh Wiely & Sons
- Hall A. S. Holwenko A. R. “Theory & Problems of Machine Design”, Schaum's outline series

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI



K60329: METROLOGY AND QUALITY CONTROL

TEACHING SCHEME

Lectures : 04Hrs/week

Practical : 02Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Pr. : 50 Marks

Unit-I

(08 Hours)

Introduction:

Meaning of metrology, precision, accuracy, errors in measurement, calibration.

Linear Measurement:

Standards - line standard, end standard, wave length standard, classification of standards, precision, and non precision measuring instrument, slip gauges.

Angular Measurement:

Sine bar, Sine center, Uses of sine bar, angle gauge, Auto Collimator, Angle Dekkor, Constant Deviation Prism.

Unit-II

(08 Hours)

Limits, Fits, Tolerances:

Meaning of limit, Fits and Tolerance, Cost-Tolerance relationship, concept of Interchangeability, Indian Standard System (ISS).

Design of limits gauges:

Types, Uses, Taylor's principle, Design of limit gauges. Inspection of geometric parameters: Straightness, Parallelism, Concentricity, Squareness and circularity.

Comparators:

Uses, types, advantages and disadvantages of various types of comparators.

Unit-III

(10 Hours)

Surface finish measurement:

Surface texture, Meaning of RMS and CLA values, Tomlinson's Surface meter, Taylor-hobson surface meter, grades of roughness, specifications.

Screw Thread Metrology:

External screw threads terminologies, floating carriage instruments, pitch and flank measurement of external screw thread, application of Tool Makers Microscope, use of profile projector.

Gear Metrology:

Spur gear parameters, gear tooth thickness measurement, gear tooth vernier caliper, constant chord method, span micrometer, base tangent comparator.

Interferometry:

Introduction, flatness testing by interferometry, NPL flatness interferometer. Study of measuring machines, recent trends in engineering metrology.

Unit-IV

(08 Hours)

Introduction to quality:

Meaning of quality, Approaches-Deming's Approach, Juran's Approach, quality of product, quality of service, cost of quality, value of quality, difference between inspection, quality control and quality assurance, role of quality in present day environment.

Introduction to quality control:

- 1) Meaning of quality control.
- 2) 100% inspection and Sampling inspection.
- 3) Statistics in selective inspection.

Introduction to statistical quality control:

Control chart- Attribute (P, np, C, U) and variable (X, R chart), sampling inspection, OC curves and sampling plan, process capability index (Cp, Cpk) concept, methods of determining cp and cpk.

Unit-V

(08 Hours)

Quality assurance systems:

Total quality management (TQM):

7 tools of problem solving, cause and effect diagram, pareto analysis etc, Q. F. D., quality circles, Kaizen, six sigma, 5S system.

Technical Specification (T.S) TS 16 949 standards:

Reliability Engineering: concept, definitions of MTTF, MTBF, FEMA.

Design of experiment:

Meaning, objective, and types of research, approaches, two factorial experiments, and Taguchi method.

Unit-VI

(08 Hours)

ISO9001- 2000 series of standards:

History and evaluation of ISO9000 series, importance and over view of ISO9000-1998 series standards, structure of ISO9000-2000 series standards, clauses of ISO9000 series standards and their interpretation and implementation, quality system documentation and audit.

ISO14000:

Environmental management concept, and requirement of ISO14001, benefits of environmental management systems.

Termwork

The term work should be in the form of journal consisting of following three sections:

A) Experiments: (any eight of the following)

- Study of Linear and Non Linear Measuring Instruments.
- Measurement of the surface roughness.
- Measurement of angle by sine bar /sine center.
- Measurement of optical surface using Interferometer.
- Measurements of screw tread parameters using Floating Carriage Micrometer.
- Measurement of gear tooth thickness using gear tooth vernier caliper and span micrometer.
- Study and experiment on profile projector /Tool makers microscope
- Alignment test on lathe /drilling /milling machine.
- Experiment to measure Process Capability using Statistical Process Control. Or Minitab Software
- Sampling Inspection .

B) Assignments:

Any three assignment based on Quality Control Syllabus.

At least one industrial visit to Quality Department.

Oral

Term work and oral will be based on above syllabus

Text Books/ References

- R. K. Jain, "Engineering Metrology", Khanna Publication
- K. J. Hume, "Engineering Metrology"
- "Hand Book of Industrial Metrology", A. S. T. M. E. Prentice Hall
- K. W. B. Sharp, "Practical Engineering Metrology", Pitman Publication
- J. M. Juran, "Hand Book of Quality Control", McGraw Hill Publication
- Grant, "Statistical Quality Control", McGraw Hill
- S. S. Kuber, "Metrology and Quality Control", Nirali Prakashan

Syllabus for Unit Test

Unit Test 1	Unit I & II
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TEACHING SCHEME

Lectures : 04 Hrs/week

Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Pr. : 50 Marks

Unit-I

(08 Hours)

Momentum equation and its applications:

Impulse-momentum principle, fixed and moving flat plates, curved vanes with jet striking at the centre of vane and jet striking tangentially on to the vane, Impact of jet on hinged plates, Impact of jets on series of flat plates and vanes, water wheels, velocity triangles and their analysis, work done and efficiency calculations.

Unit-II

(08 Hours)

Impulse Turbines:

Main components and constructional features of Pelton wheel, Concept of centrifugal head, general energy equation for turbine, Velocity diagrams and analysis, Important non-dimensional parameters such as speed ratio, jet ratio, flow ratio, Condition for maximum hydraulic efficiency.

Unit-III

(08 Hours)

Reaction Turbines:

Different types of reaction turbines such as Francis, Kaplan, bulb, propeller turbines. Main components and constructional features, draft tube, types of draft tube, efficiency, limitations for use of draft tube, cavitation in turbines.

Unit-IV

(08 Hours)

Governing, Performances and Selection of Turbines:

Governing Mechanism for Pelton, Francis and Kaplan turbines, safety devices for turbine, Pressure regulators, surge tanks, forebay, Performance of water turbines, types of characteristic curves, unit quantities, specific speed, shape of runner, runaway speed, selection of turbines.

Unit-V

(08 Hours)

Hydrodynamic Pumps:

Classification, components of centrifugal pump, various terms associated with centrifugal pump, various heads, velocity triangle and their analysis, effect of outlet blade angle, cavitation, NPSH, Thomas Cavitation factor, priming of pumps, installation, specific speed, Performance characteristics of centrifugal pump, Axial thrust, maintenance, trouble and remedies, series and parallel operation of pumps, system resistance curve, water hammer problem in pumping system.

Unit-VI

(08 Hours)

Reciprocating and Special Pumps:

Reciprocating pump, Airlift pump, hydraulic ram, deep well pump, submersible pumps, vertical turbine pump, construction, principle of operation, energy analysis, performance characteristics.

Fluid Coupling and Torque Converter:

Construction, working, characteristic curves, applications.

Termwork

Record of minimum eight experiments from the following list shall be submitted in the form of journal (one industrial visit is compulsory)

- Study and trial on a Pelton wheel and plotting of main / operating characteristics.
- Study and trial on a Francis turbine and plotting of main / operating characteristics.
- Study and trial on a Kaplan turbine and plotting of main / operating characteristics.
- Study and trial on a Centrifugal pump and plotting of operating / and variable speed characteristics.
- Study of different non-conventional pumps such as air lift, jet pump, deep well pump, hydraulic ram etc.
- Study of fluid coupling and torque converter
- Study of hydraulic accumulator, intensifier and press.
- Study and trial on reciprocating pump and plotting of operating characteristics.
- Design of a complete pumping system installation using standard tables, charts supplied by pump manufacturers.
- Visit to Hydro electric power stations and writing a report based on the visit.
- Visit to water pumping station and writing a report

based on the visit.

Oral/Practical

Based on above termwork.

Text Books/References

- P. N. Modi and Dr. S. M. Seth, “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi
- Dr. J. Lal, “Hydraulic Machines”, Metropolitan Book Co. Pvt. Ltd. Delhi
- R. K. Rajput, “Hydraulic Machines”, S.Chand Publishers, New Delhi.
- S. Ananthswamy, “Fundamentals on Hydraulic Machinery”, United Book Cooperation, Pune

Syllabus for Unit Test

Unit Test 1	Unit I & II
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TEACHING SCHEME

Lectures : 04 Hrs/week

Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory : 80 Marks

Duration : 03 Hours

Unit Test : 20 Marks

T. W. & Or : 50 Marks

Unit-I

(08 Hours)

Overview of Graphics system:

Video display devices, Refresh cathode ray tube, Raster scan display, Random scan display, and color CRT monitors, Direct-view storage tubes, Flat panel displays, Three-dimensional viewing devices. Input devices. Graphics file formats, Graphics standards.

Unit-II

(08 Hours)

Output Primitives:

Points and lines, Line drawing algorithm-DDA algorithm, Bresenham's line drawing algorithm, Thick line segments. Circle and Ellipse generation algorithm.

Polygon-polygon filling, Flood fill, Boundary fill, Scan line fill.

Unit-III

(08 Hours)

Two-dimensional Transformations:

Basic transformation-Translation, Rotation, Scaling, Reflection, shear. Matrix representation and Homogeneous Coordinates. Composite transformations.

Unit-IV

(08 Hours)

Three-dimensional Transformations:

Introduction, Translation, Rotation, Scaling, Reflection, shear. Affine and Perspective geometry. Orthographic, Axonometric, Oblique projection.

Unit-V

(08 Hours)

Two-dimensional Viewing:

Viewing coordinate reference frame, Window to viewport coordinate

transformation. Clipping operation, Point clipping, Line clipping, Cohen Sutherland line clipping. Polygon clipping, Sutherland-Hodgemon polygon.

Unit-VI

(08 Hours)

Geometrical Modeling:

Type of geometric models. Wireframe modeling, surface modeling, analytic surfaces. Solid modeling-geometry and topology, solid entities, methods of solid modeling, constructive solid geometry, boundary representation, sweeping, parametric solid modeling.

Termwork

Six computer programs using c++ based on above syllabus covering units II, III, IV and V.

One CAD assignment based on unit VI.

Oral

Based on above syllabus.

Text Books/References

- Donald Hearn and H. Pauline Baker, "Computer Graphics", Prentice, Hall of India New Delhi
- David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", Tata McGraw Hill Edition
- William M. Newman and Robert F. Sproull, "Principles of Interactive Computer Graphics", Tata McGraw Hill Edition
- Steven Harrington, "Computer Graphics A Programming Approach", McGraw Hill International Edition
- F. S. Hill Jr., "Computer Graphics Using Open GL", Pearson Education

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RULES REGARDING ATKT, CONTINUOUS ASSESSMENT AND AWARD OF CLASS

A. T. K. T.

- A candidate who is granted term for B.Tech. Semester-I will be allowed to keep term for his/her B.Tech. Semester-II examination even if he/she appears and fails or does not appear at B.Tech. Semester-I examination.
- A candidate who is granted term for B. Tech. Semester - III will be allowed to keep term for his/her B.Tech. Semester-IV examination even if he/she appears and fails or does not appear at B.Tech. Semester-III examination.
- A candidate who is granted term for B.Tech. Semester-V will be allowed to keep term for his/her B.Tech. Semester-VI examination if he/she appear and fails or does not appear at B.Tech. Semester-V examination.
- A candidate who is granted term for B.Tech. Semester-VII will be allowed to keep term for his/her B.Tech. Semester-VIII examination if he/she appears and fails or does not appear at B.Tech. Semester-VII examination.
- A student shall be allowed to keep term for the B.Tech. Semester-III course if he/she has a backlog of not more than 3 Heads of passing out of total number of Heads of passing in theory examination at B.Tch. Semester-I & II taken together.
- A student shall be allowed to keep term for the B.Tech. Semester-V of respective course if he/she has no backlog of B.Tech Semester-I & II and he/she has a backlog of not more than 3 Heads of passing in theory examination and not more than 3 heads of passing in termwork and practical examination or termwork and oral examination.
- A student shall be allowed to keep term for the B.Tech. Semester-VII course if he/she has no backlog of B.Tech. Semester-III & IV and he/she has a backlog of not more than 3 Heads of passing in theory examination and not more than 3 Heads of passing in termwork and practical examination or termwork and oral examination.

CONTINUOUS ASSESSMENT

- In respect of Term work at B.Tech. Semester-I & II, B.Tech. Semester-III & IV and B.Tech. Semester-V & VI, target date shall be fixed for the completion of each job, project experiment or assignment as prescribed in the syllabus and the same shall be collected on the target date and assessed immediately at an affiliated college by at least one pair of the concerned teachers for the subject and the marks shall be submitted at the end of each term to the Principal of the college.

- Termwork and performance of Practical/Oral examination shall be assessed on the basis of the depth of understanding of the principles involved, correctness of results and not on ornamental or colorful presentation.
- For B.Tech. Semester-VII & VIII, termwork assessment will be done by external and internal examiners jointly during the examination schedule declared by the university. The record of continuous assessment shall be made available to the examiners during Term work and practical and Term work and oral examinations. Examiner shall use this record for overall assessment of the performance of the student. Every practical/termwork assignment shall be assessed on the scale of 20 marks and weightage of 20 marks shall be distributed as follows:

Sr. No.	Activity	Marks
1	Timely Submission	04
2	Presentation	06
3	Understanding	10

Marks obtained out of 20 for all assignments together will be converted on scale of marks assigned to term work of respective subject in the structure of the course.

CLASS

- The class should be awarded to the student on the basis of aggregate marks obtained together in both the semesters of the respective year by him. The award of class shall be as follows.

A	Aggregate 66% or more marks	First Class with Distinction
B	Aggregate 60% or more marks but less than 66%	First Class
C	Aggregate 55% or more marks but less than 60%	Higher Second Class
D	Aggregate 50% or more marks but less than 55%	Second Class
E	Aggregate 40% or more marks but less than 50%	Pass Class

