Bharati Vidyapeeth Deemed University

College of Engineering, Pune- 411043

The Syllabus of the Curriculum: 2014 Course

Choice Based Credit System (CBCS)

B. TECH. MECHANICAL: SEMESTER- IV

Bharati Vidyapeeth University

College of Engineering, Pune

Department of Mechanical Engineering

Vision of the Bharati Vidyapeeth (Deemed to be University) College of Engineering is:

To be a World Class Institute for Social Transformation through Dynamic Education

Missions of the Bharati Vidyapeeth (Deemed to be University) College of Engineering are:

- *To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession & society.*
- *To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.*
- *To practice and promote professional ethics, transparency and accountability for social community, economic & environmental conditions.*

Goals of the Bharati Vidyapeeth (Deemed to be) University College of Engineering are:

- *Recruiting experienced faculty.*
- *Organizing faculty development programs.*
- *Identifying socio-economically relevant areas & emerging technologies.*
- *Constant review &up gradation of curricula.*
- *Up gradation of laboratories, library & communication facilities.*
- *Collaboration with industry and research & development organizations.*
- *Sharing of knowledge, infra-structure and resources.*
- *Training, extension, testing and consultancy services.*
- *Promoting interdisciplinary research.*

Vision of the Mechanical Engineering Department is:

To develop, high quality Mechanical Engineers through dynamic education to meet social and global challenges.

Mission Statements of the Mechanical Engineering Department are:

- *To provide extensive theoretical and practical knowledge to the students with well-equipped laboratories and ICT tools through motivated faculty members.*
- *To inculcate aptitude for research, innovation and entrepreneurial qualities in students.*
- *To acquaint students with ethical, social and professional responsibilities to adapt to the demands of working environment.*

Program Educational Objectives (PEOs) of the B. Tech. Mechanical are:

Graduates will be able,

- *To fulfill need of industry and society with theoretical and practical knowledge.*
- *To engage in research, innovation, lifelong learning and continued professional development.*
- *To fulfill professional ethics and social responsibilities.*

PROGRAM OUTCOMES

Engineering Graduates will be able to:

*1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.*

*2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.*

*3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.*

*4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.*

*5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.*

*6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.*

*7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable*

development.

8. ***Ethics****: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.*

9. ***Individual and team work****: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.*

10. ***Communication****: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.*

11. ***Project management and finance****: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.*

12. Life-long learning*: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.*

Statements of Programme Specific Outcomes (PSOs)

PSO1: Apply the knowledge of thermal, design, manufacturing engineering and computational sciences to solve Mechanical Engineering problems.

PSO2: Apply Mechanical Engineering principles for research, innovation and develop entrepreneurial skills.

PSO3: Apply concepts of mechanical engineering to asses' societal, environmental, health and safety issues with professional ethics.

Department of Mechanical Engineering

MECHANISMS OF MACHINES

(Course No.208)

Designation of Course	**Mechanisms OF Machines**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 04Hours/ Week	End Semester Examination	60 Marks	Theory: 04 Practical: 01
Practical:- 02 Hours/Week	Unit Test	20 Marks	
	Assignments	10 Marks	
	Internal Evaluation	10 Marks	
	Term Work / Oral	50 Marks	
	Total	150 Marks	05

Course Prerequisites:-	1. Engineering Mathematics 2. Engineering Mechanics
	1. To make the students conversant with kinematic analysis of mechanisms applied to real life an applications. 2. To give basic knowledge on kinematic, kinetic and dynamic design of machinery. 3. To develop the competency to analyze the velocity and acceleration in mechanisms using ana graphical approach. 4. To develop the skill to propose and synthesize the mechanisms using graphical and analytical techniq
Course Outcomes:-	Students able to 1. Understand the concept of kinematics, Kinematic pair, kinematic chains, mechanism and inversions and Evaluate DOF. 2. Understand the concept velocity and acceleration of any planar mechanism and Anal velocity or acceleration method and ICR method. 3. Understand the concept of velocity and acceleration and analyze it by using Coriolis construction. 4. Understand the concept kinematic analysis of mechanisms and evaluate it by using a 5. Understand the fundamental concept of synthesis of linkages and Analyze by using t techniques. 6. Understand the basic concept of static and dynamic force analysis and Evaluate force engine.

Course Contents

Unit 1	**Basic Kinematics:**	**(08Hrs)**
Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Pantograph, Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism.		
Unit 2	**Velocity and Acceleration Analysis of Mechanisms: Graphical Methods-I**	**(08Hrs)**
Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms. Relative acceleration method: Relative acceleration of a point on a link, Angular acceleration of a link, Acceleration polygons for simple mechanisms. Instantaneous center of rotation (ICR) method: Definition of ICR, Types of ICRs, Methods of locating ICRs,		

Kennedy's Theorem, Body and space centrode.		
Unit 3	**Velocity and Acceleration Analysis of Mechanisms: Graphical Methods-II**	**(08Hrs)**
Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. Klein's construction		
Unit 4	**Kinematic Analysis of Mechanisms : Analytical Methods**	**(08Hrs)**
Analytical method for displacement, velocity and acceleration analysis of slider cranks mechanism. Position analysis of links with vector and complex algebra methods, Loop closure equation, Chace solution, Velocity and acceleration analysis of four bar and slider crank mechanisms using vector and complex algebra methods. Hooke's joint, Double Hooke's joint.		
Unit 5	**Introduction to Synthesis of Linkages**	**(08Hrs)**
Steps in synthesis process: Type, number and dimensional synthesis.Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors, Branch defect and order defect, Crank Rocker mechanisms. Graphical synthesis: Two and three position synthesis using relative pole method and inversion method for single slider crank and four bar mechanism, three position motion synthesis of four bar Mechanism. Analytical synthesis: Derivation of Freudenstein's equation, three position function generation using Freudenstein's equation.		
Unit 6	**Static and Dynamic Force Analysis**	**(08Hrs)**
Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, bifilar suspension, Trifilar suspension. Dynamics of reciprocating engines: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T-θ diagram.		

Term work

Any two of the following experiments shall be performed

1. To determine the mass moment of inertia of a connecting rod using a compound pendulum method.
2. To determine the mass moment of inertia of a flat bar using bifilar suspension method.
3. To determine the angular displacements of input and output shafts of single Hooke's joint for different shaft angles and verification of the results using computer programme.

Drawing Assignments (4 sheets of ½ imperial size)

1. To study and draw (any four) mechanisms for practical applications such as: Straight line mechanisms like Peaucellier Mechanism, Hart's Mechanism, Watt's Mechanism and Grasshopper Mechanism etc., for various link positions.
2. Two problems on velocity and acceleration analysis using Graphical methods i.e., polygons or ICR (Based on Unit 2).
3. Two problems on velocity and acceleration analysis using Graphical methods i.e., polygons involving Coriolis component or Klein's construction (Based on Unit 3).
4. Two problems based on graphical three position function generation, using either relative pole method or inversion method.

Assignments

1. At least five theory questions on Basic Kinematics.
2. At least five theory questions on Steering gear mechanism.
3. At least five problems on velocity and Acceleration analysis of Mechanism: Graphical Method –I.
4. At least five problems based on Instantaneous center of rotation (ICR) method.
5. At least five problems based on velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration
6. At least five problems on velocity and Acceleration analysis of Mechanism: Graphical Method –II.
7. At least five problems onVelocity and acceleration analysis of four bar and slider crank mechanisms using vector and complex algebra methods

8. At least five problems on kinematic analysis of mechanisms: - Analytical Method.
9. At least five problems on introduction to synthesis of linkages.
10. At least five theory questions on introduction to synthesis of linkages.
11. At least five problems on static force analysis.
12. At least five problems on dynamic force analysis.
13. At least five theory questions based on T-θ diagram.

Text Books/ Reference Books

1. Rattan S. S., "Theory of Machines", Tata McGraw Hill.
2. Ballaney P. L., "Theory of Machines", Khanna Publishers, Delhi.
3. Thomas Bevan, "Theory of Machines", CBS Publishers & Distributors, Delhi.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill, Inc.
5. Ghosh Amitabh and Malik A.K., "Theory of Machines and Mechanisms", East-west Press.
6. Groover M.P., "Industrial Robotics", McGraw Hill International.
7. Hall A.S., "Kinematics and Linkages Design", Prentice-Hall.
8. Hartenberg and Denavit, " Kinematic Analysis and Synthesis of Mechanisms".
9. Erdman, A. G. & Sandor, G.N., "Mechanism design, Analysis and synthesis", Vol 1, Prentice –Hall of India.
10. Erdman, A. G. & Sandor, G.N., "Advance Mechanism design", Vol 2, Prentice –Hall of India.

Unit Tests-

Unit Test-I	Unit-I,II, III
Unit Test-II	Unit-IV, V, VI

MANUFACTURING PROCESSES
(Course No.209)

Designation of Course	**Manufacturing Processes**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- -03- Hours/ Week	End Semester Examination	60Marks	Theory:-03
	Unit Test Assignments Internal Evaluation	20- Marks 10- Marks 10 Marks	
	Term Work / Oral	- Marks	
	Total	100 Marks	03

Course Prerequisites:-	1.Basic knowledge of manufacturing Processes 2.Basic Knowledge of Joining and Castings 3.Basic knowledge of Materials
Course Objective:-	1. To acquire knowledge of sheet metal working processes and introduce to use of jigs and fixtures 2. To introduce Various non-conventional machining processes and concepts of CNC programming and robotic applications. 3. To acquire knowledge of heat treatment of steels, alloys and introduce to the procedure of processing composites
Course Outcomes:-	**Students able to** 1. **Understand** the different press working operations, Dies and **evaluate** process parameters in manufacturing of sheet metal components 2. **Understand** the design concepts of Jigs and Fixtures and **apply** for the manufacturing processes . 3. **Understand** the different non-conventional machining processes and **apply** in manufacturing of components. 4. **Understand** the Concepts of CNC programming and robotic applications in manufacturing industries and **apply** for multidisciplinary applications. 5. **Understand** the different heat treatment processes and **apply** it for engineering applications 6. **Understand** the stages of powder manufacturing techniques, composite materials and **apply** for manufacturing components.

Course Contents

Unit 1	**Expendable mould and permanent mould casting processes:**	**(--08)Hrs)**
Sand casting, Types of pattern materials, pattern making allowances, core prints,Moulding sand- properties and testing, Hand and machine moulding, core, core making melting and pouring, Melting furnaces- Cupola, fuel fired, electric arc, Induction furnaces, Defects in casting, lost foam process, Shell moulding , Investment casting. Die casting low pressure perment mould castings hot and cold chamber processes, Centrifugal casting, Semi-centrifugal casting. Centrifuging, Continuous casting		
Unit 2	**Hot working processes, Cold working processes**	**(--08)Hrs)**
A) Hot working processes: Principle, rolling, forging - drops, press, upset. Rolling, forging- extrusion, drawing, spinning, effect of hot working. **B) Cold working processes** Cold rolling, swaging, forging extrusion- forward backward impact. Roll forging, tube drawing, wire drawing, spinning, shot peening, high energy rate forming, sheet metal, working- types of press, drives, different operations, and types of dies.		

Unit 3	Joining process:	(-08)-Hrs)

a) welding process-

Arc welding – theory SMAW, GTAW, GMAW, FCAW, Submerged arc welding stud welding.

ii) Resistance welding- Theory, spot, seam, projection welding processes.

iii) Gas welding

iv) Friction welding, ultrasonic welding, thermit welding, electron beam and laser welding.

b) Use of adhesives for joining.

Classification of adhesives, types of adhesives and their applications, surface preparation and various joints

Unit 4	Turning , boring related process	(08)--Hrs)

Introduction, function, types, construction accessories operations, thread cutting, single and multi start thread cutting, different tools, tool materials, Tool Geometry, concept of speed, feed, depth of cut, Introduction to boring machines general arrangement and nature of work done.

Unit 5	Drilling ,milling machines	(-08)-Hrs)

A) Drilling :

Fundamentals of drilling process, twist drill geometry, tool holders, Types of drilling machines, drilling operations. Types of drills, reaming process.

B) milling machines:

Fundamentals of milling process, cutters-types and geometry, Operations performed on milling machines. Dividing head, methods of indexing. Gear train calculations for helical and cam milling

Unit 6	Abrasive machining processes, Plastics & Plastic Moulding	(-08)-Hrs)

A) Abrasive machining processes:

Abrasive machining, abrasives -types, size and geometry, Grinding, grinding wheels, wheel marking, wheel selection. Wheel mounting. Types of grinding machines, Grinding faults, Honing, lapping, super finishing, buffing, burnishing process.

B) Plastics & Plastic Moulding:

Moulding characteristics of plastic, Moulding process- compression, transfer, and injection blow moulding. Mould design- Materials and construction, bulk factor, shrinkage, moulding parameters, moulding machines, extruders

Assignment:

1. At least five questions on expendable mould casting processes.
2. At least five questions on Permanent mould casting processes.
3. At least five questions on hot working Processes
4. At least five questions on cold working Processes.
5. At least five questions on different joining processes.
6. At least five questions on turning and related processes.
7. At least five questions on boring and related processes.
8. At least five questions on drilling machines and operations of drilling machines
9. At least five questions on milling machines and operations of milling machines
10. At least five questions on abrasive machining processes.
11. At least five questions on Plastics and Plastic molding process.
12. At least five questions on powder metallurgy.
13. At least five questions on ceramics & composite manufacturing.

TextBooks/ ReferenceBooks

1) Chapman W.A.J.: “workshop technology” volume I, II, III. ELBS.
2) Hajarachoudhary S. K., Bose S. K.: “Elements of Workshop technology” – Volume I, II.
3) Begman: Manufacturing processes.
4) HMT: production technology. TMH Publishing Co. New Delhi.
5) Roy A. Lindberg: processes and metables of manufacturing fourth edition practice Hall of India New Delhi.
6) Manufacturing process, P C Pandey

Unit Tests-

Unit Test-I	Unit-I,II ,III
Unit Test-II	Unit-IV,V, VI

MATERIAL SCIENCE
(Course No.210)

Designation of Course	**Material Science**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- -03- Hours/ Week	End Semester Examination	-60- Marks	Theory:-03 Practical:-01
Practical:- 02- Hours/Week	Unit Test Assignments Internal Evaluation	-20- Marks -10- Marks -10- Marks	
	Term Work / Oral	-50- Marks	
	Total	150-- Marks	04

Course Prerequisites:-	1.Knowledge of basic concept of Physics and chemistry 2. Basic information of engineering materials. 3. Basic knowledge of manufacturing processes.
Course Objectives:-	To explain basic concepts in plastic deformations of metals. To calculate the mechanical properties of engineering materials. To explain applications of equilibrium phase diagrams in the manufacturing processes. To acquire knowledge of elements of steels, cast irons , non ferrous materials and its multidisciplinary applications.
Course Outcomes:-	**Understand** the concept of basics of crystal structure, mechanism of plastic deformation, and **remember** in annealing and re- crystallization **Understand** mechanical testing of materials and **evaluate** the properties of materials to obtain an engineering system. **Understand** the equilibrium phase diagram and **analyse** the properties of materials from phases . **Understand** the steels ,cast irons properties and **apply** in multidisciplinary applications. **Understand** different nonferrous materials for different components and **apply** in engineering applications **Understand** basics of corrosion and **apply** Prevention of corrosion by different methods for industrial applications

Course Contents

Unit 1	**Study of Engineering materials and Plastic Deformation:**	**(-08-Hrs)**
classification of Engineering materials , Introduction to Non metallic materials, Study of crystal structure, Indexing of planes and directions, Imperfections in crystals, Mechanism of plastic deformation, Polycrystalline metals, , Work Hardening ,Cold and hot working, Annealing and re -crystallization.		
Unit 2	**Mechanical Testing of Metals:**	**(-08-Hrs)**
Study of destructive testing, Tensile test , Engineering stress and true stress strain, Numerical based on Evolution of properties, Hardness testing such as Brinell, Rockwell, Vickers and Micro hardness test, Impact test, Fatigue test, Creep test, Cupping test, Non Destructive testing such as Liquid dye penetrate test, Magnaflux test, Eddy current test , Ultrasonic testing and Radiography testing		
Unit 3	**Study of Equilibrium Diagrams**	**(-08-Hrs)**
Related terms and their definitions, Hume Ruther's rule of solid solubility, Allotropy and polymorphism, Solidification, Dendritic growth, Cooling curves, Plotting of Equilibrium diagrams, Lever rule, Coring, Eutectic system, Partial eutectic and eutectoid system, Non Equilibrium cooling and its effects		

Unit 4	Study of Steel and Cast Irons.	(08--Hrs)
Production of steel and cast Irons, Allotropy of Iron, Iron and Iron Carbide Equilibrium Diagram, Classification of Steels, Specifications of steels, Plain Carbon steel, Applications and microstructure of steels, Study of cast iron, Classification and applications of cast irons, Properties and manufacturing methods, Effect of alloying elements, Alloy cast irons etc.		
Unit 5	**Study of Non Ferrous Materials**	**(08--Hrs)**
Introduction, Copper and it's alloy, Alpha and alpha beta brasses, Zinc Equivalent , Copper Nickel alloy, Bronzes, Aluminum and it's alloy, Precipitation and age hardening ,Dispersion strengthening , Nickel and it's alloy, Metals at High and Low Temperature, Bearing Materials etc.		
Unit 6	**Corrosion and Prevention:**	**(08--Hrs)**
Introduction, Types of corrosion, Oxide film growth laws, Action of hydrogen, Polarization, Stress corrosion, Season Cracking, Prevention of corrosion, Design of component, Modification of environment, Cathodic Protection, Deposition and coating, Ion Implantation, PVD, CVD, Powder coating etc.		

Assignment:

1. At least five theory questions on classification of engineering materials.
2. At least five theory questions on Study of crystal structure.
3. At least five theory questions on plastic deformation
4. At least five theory questions on mechanical testing of methods
5. At least five theory questions on non-destructive testing
6. At least five theory questions on Plotting of Equilibrium diagrams.
7. At least five theory questions on study of equilibrium diagrams
8. At least five theory questions on study of steel and cast irons.
9. At least five theory questions on Iron and Iron Carbide Equilibrium Diagram.
10. At least five theory questions on study of non-ferrous materials
11. At least five theory questions on corrosion and methods of its prevention.
12. At least five theory questions on Powder coating.

Term work

List of Experiments: (Any Eight)

1. Tensile test to determine strength and other mechanical properties.
2. .Hardness test Brinell and Vickers.
3. Rockwell and Poldi hardness test.
4. .Study of Microstructure of plane carbon steel.
5. Study of Microstructure of cast irons.
6. 6 .Magnetic Particle test.
7. Liquid penetrate test.
8. 8 .Utrasonic Test.
9. Eddy Current test
10. Visual inspection of casting and welded components.
11. Study of nonferrous material and alloys.

Practical Examinations:

Term work andPractical Examinations will be based on above syllabus.

Assignments

1. Density calculations on crystal structure and miller indices for crystal structure.
2. Draw different types of curves such as , Tensile stress strain , S N curves , Creep curves , brittle transient temperature curves.
3. Draw the equilibrium diagram from given data .find out the different types of phases.

4. Draw the Fe. Fe3 C equilibrium diagram and microstructure of steels specimens.
5. Draw the microstructures of brasses and bronzes. Give list of some applications of non ferrous materials .
6. Collect different type of old components and study the corrosion on it also study the prevision processes also.

Text Books

1 "Material Science and Physical Metallurgy",Dr.V.DKodgere, Everest Publication, Pune.
2 "Physical Metallurgy", S H Avner , McGraw Hill Publication.
3 "Material science and metallurgy", O P Khanna, Khanna Publication, Delhi.
4 "Material Science and Engineering", R K Rajput S K Kataria and Sons Publication, Delhi.

Unit Tests-

Unit Test-I	Unit-I,II III
Unit Test-II	Unit-IV ,V, VI

Turbo Machinery

(Course No211)

Designation of Course	**Turbo Machinery**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 03 Hours/ Week	End Semester Examination	60 Marks	03
	Unit Test	20 Marks	
	Assignments	10 Marks	
	Internal Evaluation	10 Marks	
	Term Work / Oral	-- Marks	
	Total	100 Marks	03

Course Prerequisites:-	The Students should have 1. Fundamentals of Mechanical Engineering 2. Fluid Mechanics 3. Engineering Mathematics
Course Objective:-	1. To impart students with knowledge of impulse momentum principle and its applications, velocity triangles and their analysis. 2. To inculcate concepts of impulse and reaction water turbines. 3. To provide knowledge of flow through steam nozzles and steam turbines 4. To provide knowledge of pumps and compressors
Course Outcomes:-	**Students able to** 1. **Understand** the concepts of impulse momentum principle and impulse turbine; and **apply** the principle to various cases. 2. **Understand** concepts of reaction turbines and **analyze** their overall performance 3. **Understand** concepts of steam turbines and steam nozzles; and **analyze** their overall performance. 4. **Understand** concepts of centrifugal pump; and **analyze** its overall performance. 5. **Understand** concepts of centrifugal compressor; and **analyze** its overall performance. 6. **Understand** concepts of axial flow compressor; and **analyze** its overall performance.

Course Contents

Unit 1	**(08 Hrs)**
Introduction of Turbo Machinery 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 ri angles and their analysis, work done and efficiency calculations **Impulse Water 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 2	**(08 Hrs)**
Reaction Water Turbines Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, DOR, draft tubes- types and analysis, cavitations causes and remedies, specific speed, performance characteristics and governing of reaction turbines, selection of turbines.	

Unit 3		(08 Hrs)
Steam Turbines Steam nozzles: types and applications, Equation for velocity and mass flow rate [Elementary treatment only] Steam Turbines: Classifications (Axial and Radial), construction details, compounding of steam turbines, velocity diagrams and analysis of Impulse and reaction turbines (single & multi stage), governing, performance characteristics, selection of turbines.		
Unit 4		**(08 Hrs)**
Centrifugal Pumps Classification, components of centrifugal pump, various terms associated with centrifugal pump, various heads, velocity triangle and their analysis, effect of outlet blade angle, capitation, NPSH, Thomas Cavitations 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, selection of pumps.		
Unit 5		**(08 Hrs)**
Centrifugal Compressor Classification of rotodynamic compressors, blowers, fans. Centrifugal compressor: Construction, flow process on T-S Diagram, velocity diagram and Euler's work, slip factor and its effect on work input, actual work input, dimension parameters, pre-whirl losses, surging, choking, stalling characteristics		
Unit 6		**(08 Hrs)**
Axial Compressor Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, dimensionless parameters, flow through the blade rows, pressure rise across the stage, stage losses and efficiencies, performance characteristics		

Assignments

1. At least Five theory questions on Impulse turbine.
2. At least Five numerical questions on Impulse turbine.
3. At least Five theory questions on Reaction water turbine.
4. At least Five numerical questions on Reaction water turbine.
5. At least Five theory questions on steam turbines.
6. At least Five numerical questions on steam turbines.
7. At least Five numerical questions on centrifugal pumps.
8. At least Five theory questions on centrifugal pumps.
9. At least Five theory questions on centrifugal compressor.
10. At least Five numerical questions on centrifugal compressor.
11. At least Five theory questions on axial compressor.
12. At least Five numerical questions on axial compressor.

Text Books

1 P. N. Modi and Dr. S. M. Seth, “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi.
2 R. K. Rajput, “Hydraulic Machines”, S.Chand Publishers, New Delhi.
3 Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill.
4 Turbomachines, B. U. Pai, Wiley India.
5 Fluid Mechanics & Hydraulic Machines S.C. Gupta 1e Pearson Education.
6 Thermal Turbo machines, Dr. Onkar Singh, Wiley India.
7 Fluid Mechanics and Hydraulic Machines by R.K.Bansal.
8 Basic concepts in Turbo machinery by Grant Ingram.

Unit Tests-

Unit Test-I	Unit-I,II,III
Unit Test-II	Unit-IV,V, VI

NUMERICAL METHODS AND OPTIMIZATION TECHNIQUES
(Course No.212)

Designation of Course	**Numerical Methods and Optimization Techniques**	
Teaching Scheme:	**Examination Scheme:**	
Theory:- 03 Hours/ Week	**Theory**	60 Marks
Practical:- 02 Hours / Week	**Duration**	03 Hours
Tutorials:- 01 Hours / Week	**Unit Test**	20 Marks
	T. W. & Or.	50 Marks

Course Prerequisites:-	Students should have basic knowledge of: 1.Basics of statistics 2.Basics of Probability
Course Objective:-	1. To provide the knowledge to find roots of any equation by iterative method 2. To provide the knowledge to solve simultaneous linear equation by iterative and matrix method 3. To provide knowledge of curve fitting and interpolation 4. To provide knowledge of numerical differentiation, numerical integration, ordinary differential equation 5. To provide knowledge of single variable and multi variable optimization
Course Outcomes:-	Students able to 1. Understand iterative methods to find the roots of any equation and apply them in engineering problems 2. Understand matrix and iterative methods to solve simultaneous linear equations and apply them in engineering problems 3. Understand methods of curve fitting and interpolation and apply them in engineering problems 4. Understand methods to solve numerical differentiation, numerical integration, ordinary differential equation and apply them in engineering problems 5. Understand classical and numerical methods to optimize a single variable equation and apply these methods in engineering problems 6. Understand classical and numerical methods to optimize a multi-variable equation and apply these methods in engineering problems

Course Contents

Unit 1	**(08 Hrs)**
Roots of Equations: Significant figures, Accuracy and Precision, Error definition, Round-Off errors, Truncation error, Total numerical error. Bracketing methods-Bisection and False position method. Open methods, Newton Raphson method	
Unit 2	**(08 Hrs)**
Linear Algebraic Equation: Navie Gauss elimination, pitfalls of Gauss Elimination, techniques of improving solutions, complex numbers.	
Unit 3	**(08 Hrs)**
Curve Fitting and Interpolation: Least-Square Regression-Linear regression,. Interpolation-Newton's divided difference interpolating polynomial. Lagrange's interpolating polynomial	
Unit 4	**(08 Hrs)**
Numerical differentiation and Integration: Trapezoidal rule, Simson's rules, integration with unequal segment, multiple integral, derivatives of unequally spaced data. Engineering Applications.	

Ordinary Differential Equations: Euler's method, improvement of Euler's method, Runge-Kutta method, system of equations		
Unit 5		**(08 Hrs)**
Single Variable Optimization Optimum problem formulation, Engineering optimization problem, Optimality Criteria, Bracketing methods, region-Elimination method, Point Estimate Method, Gradient Based method		
Unit 6		**(08 Hrs)**
Multivariate Variable Optimization Optimality criteria, Unidirectional search, Direct search method- Evolutionary optimization, simplex search, Gradient Based Methods- Steepest Descent method, Newton's method.		

Assignment

1. At least five MATLAB codes based on Bisection Method
2. At least five MATLAB codes based on Gauss elimination method.
3. At least five MATLAB codes based on Trapezoidal Method.
4. At least five MATLAB codes based on Laplace interpolation.
5. At least five MATLAB codes based on Euler's method.
6. At least five MATLAB codes based on Least square method
7. At least five numerical questions based on Bisection Method
8. At least five numerical questions based on Gauss elimination method.
9. At least five numerical questions based on Trapezoidal Method.
10. At least five numerical questions based on Laplace interpolation.
11. At least five numerical questions based on Euler's method.
12. At least five numerical questions based on Least square method

Term work

Minimum six program on from each unit using Matlab.

Text Books/ Reference Books

1. Optimization for Engineering Design: Algorithms and Examples By Kalyanmoy Deb, Prentice-Hall of India Private Limited, New Delhi.
2. Introduction to Optimum Design, Jasbir S Arora, Elsevier Academic Press.
3. Numerical Methods for Engineers, Steven Chaptra and Raymond Canale, McGraw Hill.
4. Numerical Methods for Scientific and Engineering Computations, M. K. Jain, S.R.K. Ayengar and R. K. Jain.

Unit Tests-

Unit Test-I	Unit-I,II ,III
Unit Test-II	Unit-III,IV ,VI

PROFESSIONAL SKILLS DEVELOPMENT-IV
(Course No 213)

Designation of Course	**Workshop Technology**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 4 Hours/ Week	End Semester Examination	100 Marks	Theory: 04 Practical: 00
Practical:- -- Hours/ Week	Unit Test Assignments Internal Evaluation	-- Marks -- Marks -- Marks	
	Term Work	-- Marks	
	Total	100 Marks	04

Course Pre-requisites	
The Students should have knowledge of	
1.	Basic knowledge of Production practice I and Production practice II
2.	Basic knowledge of Material science
3.	Basic Knowledge of Manufacturing processes
Course Objectives	
1	To acquire skills for different turning operations and its calculations
2	To acquaint the skills for indexing and gear cutting operation on milling machine
3	To understand the CNC lathe machine opretions
4	To acquire the knowledge of single spindle automated lathe operations
5	To acquire skills for grinding operations
Course Outcomes	
The student should be able to	
1.	**Understand** various operations to be carried out on lathe machine to **create** jobs as per given drawing.
2.	**Understand** the indexing mechanisms on milling machine.
3.	**Apply** the knowledge of indexing mechanism to **create** a gear cutting job on milling machine.
4.	Understand CNC lathe machine, CNC programming and **apply** it to **create** job as per given specification.
5.	Understand different operations on single spindle automated lathe machine to **creat** a job.
6.	Understand the different operations to be carried out on the grinding machines and **apply** to **create** a job.

Course Contents

Unit I	**Aptitude (Maths, Logical Reasoning, English)**	**(18 Hours)**
	• Maths ▪ Simple Interest and Compound Interest ▪ Ratio, Proportion and Average ▪ Mixture and Allegation • Logical Reasoning ▪ Data Interpretation ▪ Data Sufficiency • English ▪ Grammar I ▪ Vocabulary - Analogies	
Unit II	**Essential Grammar - IV**	**(4 Hours)**
	• Vocabulary – Academic word List	
Unit III	**Written Communication- III**	**(6 Hours)**

	• Email writing and etiquettes – formal and informal email writing, format of various types of email, do's and don'ts of email writing • Letter writing – formal letters, job application letter, and cover letter. • Essay writing – mnemonics top develop ideas and write essays, structure of essays	
Unit IV	**Self-Awareness and Conflict Resolution**	**(4 Hours)**
	• Self-assessment & Perception & attitudes. • Analyzing skills & weaknesses and habits. • Developing positive attitude & handling criticism positively • Handling conflicts in the personal and corporate sector • Causes of conflicts in work scenario. • Ways and methods for conflict resolution	
Unit V	**Interpersonal Skills - III**	**(6 Hours)**
	• Mentoring, Difference between Leadership and Management • Leading with examples • Time management -The Time Management Matrix, Pareto Principle	
Unit VI	**Aptitude (Maths, Logical Reasoning, English)**	**(4 Hours)**
	• Maths ▪ Simple Interest and Compound Interest ▪ Ratio, Proportion and Average ▪ Mixture and Allegation • Logical Reasoning ▪ Data Interpretation ▪ Data Sufficiency • English ▪ Grammar I ▪ Vocabulary - Analogies	
Text Books		
1. APAART: Verbal Ability		
2. APAART: Logical Reasoning		
3. APAART: Quantitative Aptitude		
4. APAART: Speak Well 1 (English Language and Communication)		
5. APAART: Speak Well 2 (Soft Skills)		
1. APAART: Verbal Ability		

PRODUCTION PRACTICE-III
(Course No 214)

Designation of Course	**Production Practice-III**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- -- Hours/ Week	End Semester Examination	-- Marks	01
	Unit Test Assignments Internal Evaluation	-- Marks -- Marks -- Marks	
Practical:- 2 Hours/ Week	Term Work	50 Marks	
	Total	50 Marks	01

Course Prerequisites:-	Student should have basic knowledge of 1. Basic knowledge of Production practice I and Production practice II 2. Basic knowledge of Material science 3. Basic Knowledge of Manufacturing processes
Course Objectives:-	1. To acquire skills for different turning operations and its calculations 2. To acquaint the skills for indexing and gear cutting operation on milling machine 3. To understand the CNC lathe machine operations 4. To acquire the knowledge of single spindle automated lathe operations 5. To acquire skills for grinding operations
Course Outcomes:-	**Students able to** 1. Understand various operations to be carried out on lathe machine to create jobs as per given drawing. 2. Understand the indexing mechanisms on milling machine. 3. Apply the knowledge of indexing mechanism to create a gear cutting job on milling machine. 4. Understand CNC lathe machine, CNC programming and apply it to create job as per given specification. 5. Understand different operations on single spindle automated lathe machine to create a job. 6. Understand the different operations to be carried out on the grinding machines and apply to create a job.

Course Contents

Each Candidate shall be required to complete and submit the following jobs (Any Two)

1. One Composite job consisting of 3 to 4 pieces as below

Machining of components covering all operations on Lathe

(Including Internal and external threading, Taper Matching, Knurling)One Job

Grinding operation on Above (Turning) Job

2. Gear Cutting One Job
3. One job on CNC Machine. (Turning).
4. One job on Single Spindle Automate Lathe

Note

Write a journal/term book based on above syllabus.