Bharati Vidyapeeth Deemed University

College of Engineering, Pune- 411043

The Structure of the Curriculum: 2014 Course

Choice Based Credit System (CBCS)

B. TECH. MECHANICAL: SEMESTER- III & IV

Bharati Vidyapeeth University

College of Engineering, Pune

Department of Mechanical Engineering

Vision: To provide mechanical engineers capable of dealing with global challenges

Mission: Social transformation through dynamic education

Programme Educational Objectives (PEOs):

Graduates will be able,

- To fulfill need of industry with theoretical and practical knowledge
- To engage in lifelong learning and continued professional development
- To fulfill social responsibilities

Programme Outcomes (POs):

a. To apply knowledge of mathematics, science and engineering fundamentals for solving engineering problems

b. To identify the need, plan and conduct experiments, analyze data for improving the mechanical processes

c. To design and develop mechanical systems considering social and environmental constraints.

d. To design and develop a complex mechanical system using advanced mathematical and statistical tools and techniques

e. Use of information technology (IT) tools for prediction and modeling of routine activities to enhance the work performance

f. To know social responsibilities while doing professional engineering practice.

g. To become familiar with eco-friendly, sustainable and safe work environment.

h. To take into account professional ethics while designing engineering systems.

i. Able to work efficiently as a group leader as well as an individual.

j. To communicate in written and verbal form with subordinates and supervisors

k. To apply project and finance management techniques in multidisciplinary environments.

l. To create interest for higher education and updating the knowledge.

B. TECH. MECHANICAL: SEMESTER- III (2014 Course)

S.N	Course	Teaching Scheme (Contact Hrs./week)			Examination Scheme (Marks)							Total Credits		
		L	P/D	T	End Sem. Exam	Continuous Assessment					Total	TH	TW	Total
						Unit Test	Attendance	Assignments	TW/ OR	TW/ PR				
1.	Solid Mechanics	4	-	-	60	20	10	10	-	-	100	4	-	4
2.	Fluid Mechanics	4	2	-	60	20	10	10	-	50	150	4	1	5
3.	Engineering Thermodynamics	3	2	-	60	20	10	10	50	-	150	3	1	4
4.	Engineering Mathematics III	3	-	-	60	20	10	10	-	-	100	3	-	3
5.	Computer Programming and Simulation	3	2	-	60	20	10	10	-	50	150	3	1	4
6.	Professional skill Development-III	4	-	-	100	-	-	-	-	-	100	4	-	4
7.	Production Practice- II #	-	2	-	-	-	-	-	-	50	50	-	1	1
	Total	21	08	0	400	100	50	50	50	150	800	21	4	25

L: Lectures, P/D: Practical/ drawing, T: Tutorial, TH: Theory, TW: Term work

Practical examination of duration 3 Hours.

B. TECH. (MECHANICAL) SEM.-IV (2014 COURSE)

S.N	Course	Teaching Scheme (Contact Hrs./week)			Examination Scheme (Marks)							Total Credits		
		L	P/D	T	End Sem Exam	Continuous Assessment					Total	TH	TW	Total
						Unit Test	Attendance	Assignments	TW/ OR	TW/ PR				
1.	Mechanisms of Machines*	4	2	-	60	20	10	10	50	-	150	4	1	5
2.	Manufacturing Process	3	-	-	60	20	10	10	-	-	100	3	-	3
3.	Material Science	3	2	-	60	20	10	10	-	50	150	3	1	4
4.	Turbomachinery	3	-	-	60	20	10	10	-	-	100	3	-	3
5.	Numerical. Methods. and Optimization Techniques	3	2	1	60	20	10	10	--	50	150	3	2	5
6.	Professional skill Development -IV	4	-	-	100	-		-	-	-	100	4	-	4
7.	Production Practice – III #	-	2	-	-	-	-	-	-	50	50	-	1	1
	Total	20	8	1	400	100	50	50	50	150	800	20	5	25

L: Lectures, P/D: Practical/ drawing, T: Tutorial, TH: Theory, TW: Term work

* End Semester examination of duration 4 Hours.

Practical examination of duration 3 Hours.

Total Credits Sem. III– 25

Total Credits Sem. IV – 25

Grand Total - 50

Rules for Conducting Tests

Mode of the test

- In each semester for each subject two 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) Average marks obtained in two tests shall be considered as provisional marks obtained by the student in the tests.

  ii) If the candidate appears only for one test 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 test.

  iii) 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.

  iv) 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 both tests conducted in each semester.
- Roll nos. allotted to students shall be the examination nos. for the tests.

Department of Mechanical Engineering
Syllabus: Semester III

SOLID MECHANICS

Designation of Course	Solid Mechanics		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 04 Hours/ Week	End Semester Examination	60 Marks	
Practical:- 02 Hours/Week	Unit Test	20 Marks	Theory:- 04
	Assignments	10 Marks	Practical:- 01
	Internal Evaluation	10 Marks	
	Term Work/ Oral	00 Marks	
	Total	100 Marks	05

Course Prerequisites:-	1. Engineering Mathematics 2. Engineering Mechanics 3. Engineering Science
Course Outcomes:-	1. Stresses and strains in different materials. 2. Shear force and bending movement of loading elements. 3. Principal stresses and strain. 4. Torsional, bending and axial force on the shaft. 5. Bending stresses and shear stresses in the machine elements. 6. Design of simple machine components.

Course Contents

Unit 1	**Simple stresses & strains**	**(08 Hrs.)**
Revision of Concept of stresses & strains (linear, lateral, shear, thermal & volumetric). Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Stress-strain diagrams for ductile & brittle materials. Various strengths of material- Yield strength, Ultimate tensile strength etc, Concept of 3D stress state. Interrelation between elastic constants, Proof stress & True stress & strain. Axial force diagrams, stresses and strains in determinate & indeterminate homogeneous & composite bars under concentrated loads & self- weight. Temperature stresses in simple & composite members. Strain energy due to axial load (gradual, sudden & impact), strain energy due to self-weight.		
Unit 2	**Principal stresses & strains**	**(08 Hrs.)**
Normal & shear stresses on any oblique plane. Concept of principal planes derivation of expression for principal stresses & maximum shear stress, position of principal planes & planes of maximum shear, graphical solution using Mohr's circle of stresses, combined effect of axial force, bending moment & torsional moment on circular shafts (solid as well as hollow) **Theories of elastic failure:** Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory, maximum strain theory – their applications & limitations.		
Unit 3	**Shear Force & Bending Moment Diagrams**	**(08 Hrs.)**
Shear forces & bending moments of determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads & couples, relation between SF & BM diagrams for cantilevers, Simply supported beam. Maximum bending movement & positions of points of contra flexure, construction of loading diagrams & BMD from SFD & construction of loading Diagram & SFD from BMD. Slope & deflection of beams - relation between		

BM & slope, slope & deflection of determinate beams, double integration method (Macaulay's method), derivation of formula for slope & deflection for standard cases		
Unit 4	**Torsion and Buckling of columns**	**(08 Hrs.)**
Stresses, strain & deformations in determinate shafts of solid & hollow, homogeneous & composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending & axial force on shafts .Concept of buckling of columns, derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions. Limitations of Euler's formula, Rankine's formula, safe load on columns		
Unit 5	**Stresses in Machine Elements**	**(08 Hrs.)**
Bending stresses : Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections(rectangular, I,T,C) with respective centroidal & parallel axes, bending stress distribution diagrams, moment of resistance & section modulus calculations. Shear stresses : Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange & web		
Unit 6	**Design Process**	**(08 Hrs.)**
Machine Design, Traditional design methods, Basic procedure of Machine Design, Forming Design specifications, Design for: 1) functional requirement, 2) customer orientation 3) Safety requirement & 4) Analysis for use. Requisites of design engineer, Design of machine elements, Sources of Design data, Use of Design data book, Use of standards in design, Selection of preferred sizes, Design Synthesis, Creativity in design. Use of internet for gathering information & Consideration of energy requirement, product life cycle & design for environment. **Design of Simple Machine parts**: Factor of safety, Service factor, Design of simple machine parts - Cotter joint, Knuckle joint and Levers, Eccentric loading , Stresses in curved beams (for circular cross-section only).		

Text Books/ Reference Books

1. Timoshenko & Young, Engineering Mechanics, Tata McGraw Hill Book Publishing co. Ltd. 1981.
2. James Gere, Mechanics of Materials, Thomson Learning
3. S Ramamrutham, Strength of Materials
4. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publication
5. J. E. Shigley, Mechanical Engineering Design, McGraw Hill

Unit Tests

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

FLUID MECHANICS

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

Course Prerequisites:-	Student should have knowledge of 1. Fundamentals of Mechanical engineering. 2. Analysis of forces and moments. 3. Laws of motion, kinetics and kinematics.
Course Outcomes:-	Able to understand- 1. Behaviour of fluids. 2. Use of appropriate pressure measuring devices. 3. Application of Bernoulli's energy equation. 4. Difference between laminar and turbulent flow. 5. Calculate losses in the piping system. 6. Dimensional analysis results and boundary layer theory.

Course Contents

Unit 1	**Fluid Kinematics:**	**(06 Hrs.)**
Types of flow- steady, unsteady, uniform, non-uniform, laminar, turbulent, One, Two and Three dimensional, compressible, incompressible, rotational, Irrotational. Stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates, flow net.		
Unit 2	**Fluid Statics:**	**(06 Hrs.)**
H Hydrostatic law, Pascal's law, Pressure at a point, Total Pressure, Centre of pressure, Liquid pressure on a plane(Horizontal, Vertical, Inclined) & Curved surfaces, Archimedes Principle, Buoyancy and stability of floating and submerged bodies, Metacentric height.		
Unit 3	**Fluid Dynamics:**	**(06 Hrs.)**
Introduction to Navier-Stoke's Equation, Euler equation of motion along a stream line, Bernoulli's equation, application of Bernoulli's equation to Pitot tube, Venturimeter, Orifices, Orifice meter, Triangular Notch & Rectangular Notch .(Without considering Velocity of Approach)		
Unit 4	**Laminar Flow & Flow around Immersed Bodies:**	**(06 Hrs.)**
Definition, relation between pressure and shear stresses, laminar flow through round pipe, fixed parallel plates. Introduction to CFD Methodology (Elementary Treatment).Lift and Drag, Classification of Drag, Flow around circular cylinder and Aerofoil, Development of lift on Aerofoil.		
Unit 5	**Flow Through Pipes:**	**(06 Hrs.)**
TEL, HGL , Energy losses through pipe, Darcy-Weisbach equation, Moody diagram, Minor losses in pipes, pipes in series and parallel, Syphon, Transmission of power, Water hammer in pipes ,		
Unit 6	**Turbulent Flow, Boundary Layer** & Dimensional Analysis**:**	**(06 Hrs.)**

Turbulent Flow, Velocity Distribution, Development of Boundary Layer on a flat plate, Laminar and Turbulent Boundary Layers, Laminar sub layer, Separation of Boundary Layer and Methods of Controlling. Dimensions of physical quantities, dimensional homogeneity, Buckingham pi Theorem, Important dimensionless numbers, Model analysis (Reynolds, Froude and Mach).

Text Books/ Reference Books

1. Dr. P.N. Modi and Dr. S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard
2. Book House.
3. Dr. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines – l", Laxmi Publication Pvt. Ltd., New Delhi.
4. Streeter V. L. and Wylie E. B. Fluid Mechanics McGraw Hill International Book Co.
5. Garde R. J. and Mirajgaonkar, Engineering Fluid Mechanics, Nem Chand & Bros, Roorkee, SCITECH, Publication
6. (India) Pvt. Ltd.
7. Cengel & Cimbla Fluid Mechanics, TATA McGraw-Hill.
8. Irving Shames, "Mechanics of Fluid", McGraw Hill Publication.

Unit Tests-

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

ENGINEERING THERMODYNAMICS

Designation of Course	**Engineering Thermodynamics**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 03 Hours/ Week	End Semester Examination	60 Marks	Theory:03 Practicals: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 thermodynamics 2. Knowledge of basic gas laws 3. Knowledge of pumps and compressors
Course Outcomes:-	Able to understand- 1. The concepts of Carnot theorem to applications such as heat pump and refrigerator. 2. The important phenomenon of heat and work. 3. Various performance parameters and their estimations in respect to trials on Boiler. 4. The knowledge about the phenomenon of steam generation and properties of steam. 5. Basic concepts of thermodynamics and their application to energy conversion device like Compressors. 6. Knowledge of fuels and combustion and availability.

Course Contents

Unit 1	**Second Law of Thermodynamic and Entropy:**	**(06 Hrs.)**
Second Law of Thermodynamics: Limitations of first law of thermodynamics, heat engine, refrigerator and heat pump, Kelvin-Planck's statement & Clausius statement, equivalence of Kelvin-Planck's and Clausius statements, perpetual motion machine of second kind, Carnot cycle & Carnot heat engine. Entropy: Entropy as a property, second law analysis for entropy, Clausius inequality, principle of increase of entropy, irreversibility		
Unit 2	**Steam Generators:**	**(06 Hrs.)**
Classification, constructional details of process and power boiler, boiler mountings and accessories, equivalent evaporation, boiler efficiency, energy balance, boiler controls, boiler draught.		
Unit 3	**Ideal Gas and Properties of Steam and Vapour Power Cycle:**	**(06 Hrs.)**
Ideal Gas definition, Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Specific Gas constant and Universal Gas constant, Ideal gas processes- on P-V and T-S diagrams, Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-V, T-S and Mollier diagram for steam,. Non flow and steady flow vapor processes, work transfer & heat transfer, use of P-V, T-S, H-S diagrams for steam, determination of dryness fraction, and study of calorimeters. Vapour Power Cycle: Carnot cycle using steam, ideal Rankine cycle, calculation of thermal efficiency, specific steam consumption, work ratio, comparison of Carnot and Rankine cycle, and effect of superheat.		
Unit 4	**Single Stage and Multi stage Reciprocating Air Compressor:**	**(06 Hrs.)**

Uses of compressed air, classification, constructional details of single stage compressor, computation of work done, isothermal work done, isothermal efficiency, effect of clearance, volumetric efficiency, FAD, theoretical and actual indicator diagrams, method of improving volumetric efficiency. Need of multi staging, multi stage compressor, work done, volumetric efficiency, condition for maximum efficiency, intercooling, actual indicator diagram.		
Unit 5	**Rotary Compressor:**	**(06 Hrs.)**
Introduction, classification and working principles of different types of compressors, comparison between reciprocating and rotary compressors, positive displacement and rotodynamic compressors, static and total head, work done efficiencies, surging, and choking, stalling, characteristics curves for rotodynamic compressors. Selection of compressors for various applications.		
Unit 6	**Fuels and Combustion and Availability:**	**(06 Hrs.)**
Mass fraction, mole fraction, combustion equation, theoretical air , excess and deficient air, stoichiometric and actual air to fuel ratio, analysis of products of combustion, gravimetric and volumetric analysis and their conversions, method to determine flue gas analysis - CO, CO_2, O_2, HC, NOx, smoke. Availability: High and low grade energy, available and unavailable energy, loss of available energy due to heat transfer through a finite temperature difference.		

Term work

1. Determination of calorific value using bomb calorimeter.
2. Demonstration of exhaust gas analysis by using any commercially available test rig.
3. Test on reciprocating air compressor to determine volumetric efficiency, isothermal efficiency and FAD.
4. Determination of dryness fraction using any commercial available test rig.
5. Study of boiler mounting and accessories
6. Study of package boiler / modern boiler
7. Report on visit to any process industry, which uses boiler.
8. Performance test on rotary air compressor/ blower.
9. Trial on boiler to determine boiler efficiency, equivalent evaporation and energy balance sheet.
10. Study of rotary type positive displacement compressor.

Assignments

Assignment based on each unit

Text Books

1. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications
2. P. L. Ballany, Thermal Engineering, Khanna Publications
3. V. P. Vasandani and D. S. Kumar, Heat Engineering Metropolitan book Company, New Delhi
4. R.K.Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications
5. Y. Cengel & Boles, Thermodynamics -An engineering approach, Tata McGraw Hill Publications
6. Kothandarman & Domkundwar, Thermodynamics & Heat Engines
7. Rayner Joel, Engineering Thermodynamics, ELBS Longman
8. Hawkins G. A., "Engineering Thermodynamics", John Wiley and Sons.

Unit Tests-

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

ENGINEERING MATHEMATICS –III

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

Course Prerequisites:-	Students should have basic knowledge of: 1. Differential calculus 2. Integral calculus 3. Basics of statistics 4. Basics of Probability
Course Outcomes:-	Able to understand- 1. Form mathematical modeling of systems using differential equations and ability to solve linear differential equations with constant coefficient. 2. Apply theorems to compute the Laplace transform, inverse Laplace transforms. Form mathematical modeling of systems using PDE. 3. Apply statistical methods to numerical data. 4. Calculate Correlation and Regression coefficient. 5. Use basics of probability to solve problems.

Course Contents

Unit 1	**Linear Differential Equations (LDE)**	**(06 Hrs.)**
LDE with constant coefficients, Method of variation of parameters, Homogeneous Equations, Cauchy's and Legendre's DE. Simultaneous & Symmetric Simultaneous DE. Application to mechanical systems		
Unit 2	**Laplace Transform (LT)**	**(06 Hrs.)**
LT of standard functions, properties and theorems, Inverse LT, method of finding Inverse LT , Application of LT to solve LDE. Fourier Transform (FT): Fourier Integral theorem, Fourier transform Fourier Sine & Cosine transform, Inverse Fourier Transform		
Unit 3	**Partial Differential Equations (PDE)**	**(06 Hrs.)**
Basic concepts, modeling: Vibrating String, Wave equation. Method of separation of variables, Use of Fourier series, Heat equation: one and two dimensional heat flow equations, Solution by Fourier Transforms, modeling Membrane two dimensional wave equation		
Unit 4	**Measures of central value**	**(06 Hrs.)**
Arithmetic mean, median and mode, geometric mean and harmonic mean. Measure of central tendency, dispersion, mean deviation, standard deviation, skeweness, Moments and qurtosis.		
Unit 5	**Correlation and Regression**	**(06 Hrs.)**
Significance of the study of correlation, types of correlation, coefficient of correlation, difference between correlation and regression. Regression equations, standard error of estimate.		

Unit 6	Probability and Distribution	(06 Hrs.)
Basics of probability, conditional probability, bayes theorem, mathematical expectations, random variable and probability distribution, Poisson, normal distribution. Testing of hypothesis- Z test, chi square test and goodness of fit, F test.		

Term work-

1. Linear Differential Equations
2. Transforms
3. Partial Differential Equations
4. Measures of central value
5. Correlation and Regression
6. Probability and Distribution

Assignments

Assignment based on each unit

Text Books

1. Advanced Engineering Mathematics by Peter V. O'Neil (Cengage Learning).
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).

Unit Tests-

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

COMPUTER PROGRAMMING & SIMULATION

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

Course Prerequisites:-	Basic knowledge of statistics and probability MATLAB basics
Course Outcomes:-	Able to understand- 1. Concept of model 2. Simulation basics 3. Probability concepts 4. Simulation of mechanical engineering problems 5. Discrete Simulation 6. Simulation Experimentation.

Course Contents

Unit 1	**(06 Hrs.)**
Physical model, Mathematical model, Types of mathematical model, Dynamic Versus Static Models, Continuous-Time Versus Discrete-Time, Dynamic Models, Quantitative Versus Qualitative Models, Mechanical system modeling examples.	
Unit 2	**(06 Hrs.)**
Simulation Basics, When Simulation Is the Appropriate Tool, when Simulation Is Not Appropriate, Advantages and Disadvantages of Simulation, Areas of Application, Steps in a Simulation Study Simulation and analytical methods, Basic nature of simulation, The simulation process, Types of system simulation, Generation of random numbers .Monte Carlo Simulation.	
Unit 3	**(06 Hrs.)**
Basic Probability Concepts, Discrete Random Variable, Expected Value and Variance of a Discrete Random Variable, Measure of Probability Function, Continuous Random Variable, Exponential Distribution, Mean and Variance of Continuous Distribution, Normal Distribution.	
Unit 4	**(06 Hrs.)**
Introduction, Simulation of Pure pursuit problem, exponential growth model, simulation of water reservoir system, Trajectory simulation, suspension system, simulation of pendulum.	
Unit 5	**(06 Hrs.)**
Discrete Simulation, Continuous System Simulation. Simulation of Queuing Systems, Inventory Control Models	
Unit 6	**(06 Hrs.)**
Introduction, development of simulation experiments, principles of verification, validation and accreditation, Simulation experimentation, classical experimental design, validation of simulation experiments, evaluation of simulation experiments.	

Simulation Languages

Term work

Following assignment using MATLAB
1. Creating a One-Dimensional Array (Row / Column Vector) Creating a Two-Dimensional Array
2. Performing matrix manipulations – Concatenating, Indexing, and Sorting Normal Distribution
3. Simulation of water reservoir system
4. Trajectory simulation
5. Suspension system
6. Simulation of pendulum
7. Simulation of any one Discrete Simulation, Continuous System Simulation, Simulation of Queuing Systems, Inventory Control Models.

Assignments
Assignment based on each unit

Text Books/ Reference Books

1. Robert E. Shannon, "System Simulation The art and science", Prentice Hall, New Jersey, 1995.
2. D.S. Hira, "System Simulation", S. Chand and company Ltd, New Delhi, 2001.
3. Geoffrey Gordon, System Simulation; Prentice Hall.
4. Robert E. Shannon ; System Simulation: The Art and Science ;Prentice Hall
5. J. Schwarzenbach and K.F. Gill Edward Arnold; System Modelling and Control
6. M Close and Dean K. Frederick; Modeling and Analysis of Dynamic Systems ;Houghton Mifflin

Unit Tests-

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

PROFESSIONAL SKILLS DEVELOPMENT-III

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 math's and reasoning, the rules of English and comprehensive ability
2.	Basic awareness of phrasal verbs used in spoken communication and knowledge of verbs and other words used in professional life.
3.	Basic writing techniques taught to them in the first semester.
4.	The strengths and achievements analyzed during self-awareness session taught in the second semester. They should also be able to identify their long term and short term goals.
5.	Basic knowledge and idea about leaders and leadership qualities.
6.	Basic awareness of PowerPoint presentation and paper presentation and also should be fluent in English.
Course Objectives	
	The Professional Skills Development course which is a combination of aptitude and soft skills aims to augment students to face the campus recruitment test and train them on applying short techniques/ tricks to solve questions of Maths, reasoning and English in very less amount of time. The English and soft skills section focuses on the higher aspects of soft skills such as grooming them on leadership, presentation, business communication which would enable them to project themselves as professionals in the corporate sector and/or otherwise.
Course Outcomes	
The student should be able to	
1.	Solve the aptitude test in the recruitment exam and competitive exam by applying short techniques and solve the question in less amount of time. They would be able to handle around 15-20 topics of math's and reasoning and 50 rules of parts of speech.
2.	Present themselves with finesse by using around 25-20 idioms and phrases relevant to corporate communication as well as spoken English. They will also learn 50-60 words and other words that are specifically used in meetings, group discussions, presentation and other corporate events.
3.	Process their ideas and thoughts (verbal communication) into written communication in an effective, coherent and logical manner within a stipulated time and specific word limit of 500-750 words for essay writing along with limited words for technical writing and report writing.
4.	Identify themselves in terms of their strengths. Weaknesses and opportunities available to them for the career growth. They would also learn to overcome their weakness and convert into strengths and also make utilization of the opportunity vis-à-vis their strength. They would also learn to set realistic short/long term goals relevant to them through the SMART goal mnemonic.
5.	Differentiate between the different types of leaders and groom themselves to be potential leaders. Based on their qualities and strengths they would learn 5 types of leadership styles and mould themselves according to that. They would also learn 10-15 leadership traits.

6.	Prepare PowerPoint presentation and paper presentation effectively by focusing on body language, tone of communication and audiences' needs. They would also learn to handle the questions in an effective and smart way.	
Course Contents		
Unit I	**Aptitude (Maths, Logical Reasoning, English)**	**(18 Hours)**
	• Maths ▪ Enjoy maths + Number system ▪ Number system ▪ Percentage, profit and loss • Logical Reasoning ▪ Coding, Decoding, Number series, ▪ Blood relation Directions, cubes & dices • English ▪ Vocabulary-1 ▪ Confusing words-1(Homonyms)	
Unit II	**Essential Grammar - III**	**(6 Hours)**
	• Idioms and phrases • Usage of Idioms & phrases in daily conversation • Activities • Academic word list- Words to be used in business communication	
Unit III	**Written Communication- II**	**(4 Hours)**
	• Essay writing • Mnemonics to develop ideas and write essays • Structure of essays • Technical writing • Report writing	
Unit IV	**SWOT Analysis**	**(6 Hours)**
	• Introduction to SWOT • Importance to SWOT • Individual & Organizational SWOT Analysis • Identifying strengths, weaknesses, threats & opportunities • Short term goals& Long term goals, Career planning	
Unit V	**Interpersonal Skills - III**	**(4 Hours)**
	• Introduction to leadership skills • Importance of leadership skills • Types of leadership skills • Are leaders born or made?	
Unit VI	**Presentation Skills**	**(4 Hours)**
	• Introduction to PowerPoint presentation • Structure & flow of presentation • Importance of body language • Presentation by students-evaluation& feedback by trainers	
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-II

Designation of Course	**Production Practice-II**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- -- Hours/ Week	End Semester Examination	-- Marks	Practical:- 01
	Unit Test Assignments Internal Evaluation	-- Marks -- Marks -- Marks	
Practical:- 4 Hours/ Week	Term Work	50 Marks	
	Total	50 Marks	01

Course Prerequisites:-	Should have knowledge Production Practice-I
Course Outcomes:-	Students should able to understand 1) Welding Techniques, 2) Pattern Making 3) Mould Making

Course Contents

Each candidate shall be required to complete and submit the following jobs:

1. Welding-TIG / MIG OR Arc Welding (One Job)
2. Pattern making:
   A solid pattern consisting of wood turning or a core box. (One Job)
   It should follow the colour code in pattern making
3. Sand Testing.(Any Two)
3. Sand Moulding (One Job)

Note

Practical examination of 3 hours duration based on above term work will be Conducted at the end of semester.

Department of Mechanical Engineering

Syllabus: Semester IV

MECHANISMS OF MACHINES

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

Course Prerequisites:-	1. Engineering Mathematics 2. Engineering Mechanics
Course Outcomes:-	Learners can - Define various components of mechanisms. 1. Construct/Compose mechanisms to provide specific motion. 2. Draw velocity and acceleration diagrams of various mechanisms 3. Carry out force analysis of engine mechanism. 4. Synthesize the mechanism. 5. Analyze engine mechanism for static and dynamic force analysis.

Course Contents

Unit 1	**Basic Kinematics:**	**(08 Hrs.)**

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**	**(08 Hrs.)**

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**	**(08 Hrs.)**

Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. Klein's construction

Unit 4	**Kinematic Analysis of Mechanisms : Analytical Methods**	**(08 Hrs.)**

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	(08 Hrs.)
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**	**(08 Hrs.)**
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 s u s p e n s i o n 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

The following two assignments shall be completed and record to be submitted in the form of journal.

1. Computer programming for velocity and acceleration analysis of slider cranks mechanism.
2. One problem on velocity and acceleration analysis using:
3. Vector algebra and Complex algebra and comparison of results

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

Designation of Course	**Manufacturing Processes**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 03 Hours/ Week	End Semester Examination	60Marks	Theory: 03
	Unit Test	20 Marks	
	Assignments	10 Marks	
	Internal Evaluation	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 Outcomes:-	1. Understand the pattern, mould, and casting and choose the best casting process for a specific product. 2.Understand the different Hot and Cold working process 3. Choose the proper process for different joining cases. 4.Perform different operations on turning and boring machines 5. Understand and Perform different operations on the drilling and milling machines. 6.Specify and select suitable grinding process for required application

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 permeant 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-

i) 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

Text Books/ Reference Books

1. Chapman W.A.J.: "Workshop Technology" volume I, II, III. ELBS.
2. Hajara Choudhary 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

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	20 Marks	
	Assignments	10 Marks	
	Internal Evaluation	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 Outcomes:-	1. basics of crystal structure, Mechanism of plastic deformation and Annealing and re- crystallization 2.how to measure different types of mechanical properties 3. Use of equilibrium diagrams in selections of alloys for different applications. 4.details about steels and cast irons its properties and applications 5.how to select nonferrous materials for different components 6.basics of corrosion and Prevention of corrosion by different methods

Course Contents

Unit 1	**Study of Engineering materials and Plastic Deformation:**	**(08 Hrs.)**
classification of Engineering materials , Introduction to Nonmetallic 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.		

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 and Practical 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. D Kodgere, 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

Designation of Course	**Turbo Machinery**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 03 Hours/ Week	End Semester Examination	60 Marks	Theory: 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.Basic knowledge of pumps 2.Basic knowledge of Turbines 3.Knowledge of energy conversion devices
Course Outcomes:-	Able to understand- 1 Introduction of Turbo Machinery and Impulse Water Turbines 2 Reaction Water Turbines 3 Steam Turbines 4 Centrifugal Pumps 5 Centrifugal Compressor 6 Axial Compressor

Course Contents

Unit 1	**Introduction of Turbo Machinery**	**(08 Hrs.)**
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	**Reaction Water Turbines**	**(08 Hrs.)**
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	**Steam Turbines**	**(08 Hrs.)**
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	**Centrifugal Pumps**	**(08 Hrs.)**
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	**Centrifugal Compressor**	**(08 Hrs.)**
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	**Axial Compressor**	**(08 Hrs.)**
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		

Term Work

1. Study and trial on a Pelton wheel and plotting of main / operating characteristics.
2. Study and trial on a Francis turbine and plotting of main / operating characteristics.
3. Study and trial on a Kaplan turbine and plotting of main / operating characteristics
4. Study and trial on a Centrifugal pump and plotting of operating / and variable speed characteristics.
5. Study of different types of nozzles
6. Study of axial flow compressors/ centrifugal air blower
7. Study of multi-staging of steam turbines
8. Trial on centrifugal air compressor
9. Design of a complete pumping system installation using standard tables, charts supplied by pump manufacturers.
10. Visit to Hydroelectric power stations and writing a report based on the visit.
11. Visit to water pumping station and writing a report based on visit.

Assignments

Assignments Six Assignments based on above syllabus

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

Designation of Course	**Numerical Methods and Optimization Techniques**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 03 Hours/ Week	End Semester Examination	60 Marks	Theory: 03 Practical:01 Tutorial:01
Practical:- 02 Hours/ Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
Tutorials:- 01 Hours/ Week	Term Work/ Oral	50 Marks	
	Total	150 Marks	05

Course Prerequisites:-	Students should have basic knowledge of: 1. Basics of statistics 2. Basics of Probability
Course Outcomes:-	Able to understand- 1. Form mathematical modeling of systems using differential equations 2. Ability to solve linear differential equations with constant coefficient. 3. Apply statistical methods to numerical data. 4. Calculate Correlation and Regression coefficient. 5. Able to do optimization of engineering problems. 6. Able to complete Multivariate Variable Optimization for any problem

Course Contents

Unit 1	**Roots of Equations:**	**(08 Hrs.)**
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	**Linear Algebraic Equation:**	**(08 Hrs.)**
Navie Gauss elimination, pitfalls of Gauss Elimination, techniques of improving solutions, complex numbers.		
Unit 3	**Curve Fitting and Interpolation:**	**(08 Hrs.)**
Least-Square Regression-Linear regression,. Interpolation-Newton's divided difference interpolating polynomial. Lagrange's interpolating polynomial		
Unit 4	**Numerical differentiation and Integration:**	**(08 Hrs.)**
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	**Single Variable Optimization**	**(08 Hrs.)**
Optimum problem formulation, Engineering optimization problem, Optimality Criteria, Bracketing methods, region-Elimination method, Point Estimate Method, Gradient Based method		
Unit 6	**Multivariate Variable Optimization**	**(08 Hrs.)**
Optimality criteria, Unidirectional search, Direct search method- Evolutionary optimization, simplex search, Gradient Based Methods- Steepest Descent method, Newton's 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

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 concepts of Maths, Logical reasoning and English Grammar taught in the last semester.
2.	An overall idea about the difference in personal and professional communication in terms of vocabulary used.
3.	Knowledge of writing skills, importance of professionalism in emails and letters.
4.	They should be aware of concepts of self-esteem, self-assessment and its importance in setting long term and short term goals.
5.	Awareness of the interpersonal skills like team work and introduction to Leadership taught during the last semester.
6.	Body language and importance of non-verbal communication to maintain professionalism.
Course Objectives	
	The Professional Skills Development 4 is an extension of PSD- 3 with focus on the remaining topics of Maths and Logical reasoning. The further complex concepts of Aptitude and Grammar aims to acquaint them with the level of complexity presented in recruitment tests and also provide them techniques to solve such question with tricks/methods in a very short period. The English communication and soft skills section of PSD-4 focuses on the higher aspects of soft skills such as grooming them on corporate etiquettes and various formats of email/ letter writing so that can present themselves as professionals further both in oral and written communication.
Course Outcomes	
The student should be able to	
1.	Learn further concepts of Maths, Logical reasoning and English grammar and apply short cuts/ tricks to solve questions in less time. Learn remaining 25-30 rules of grammar relevant from the recruitment point of view.
2.	Use appropriate words in the right context both academically and professionally. Students would have approximately around 80-100 words from the academic word list prescribed in the syllabus.
3.	Understand the importance of email etiquettes and distinguish between the format of formal and informal emails/letters. They would be able to draft professional mails and letters like job application letters, cover letters, and apology emails with proper structure and words which are necessary in the corporate life.
4.	Apply various strategies of conflict resolution through amicable way to settle team conflicts/disputes. They would learn to handle criticism and feedback in a positive way as an individual as well as a team.
5.	Understand the major concepts of leadership like coaching, mentoring. They would learn effective time management strategies- Pareto principle (the 80-20 rule of time management) and apply them in the corporate life.
6.	Understand the importance of grooming, body language and etiquettes in the corporate sector. They would be able to conduct themselves in a professional and impressive way by conducting themselves according to situations in the professional sector. They would also learn various strategies and conversational techniques to handle telephonic interviews confidently.

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

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

Course Prerequisites:-	Student should have basic knowledge of welding, soldering, Lathe Machine.
Course Outcomes:-	1. Able to perform different Gear Cutting operations 2. Able to perform different operations on automatic lathe machine. 3. Able to do machining of components covering all operations on Lathe 4. Able to perform CNC Turning

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.

Rules regarding ATKT, Continuous Assessment and award of Class

Standards for Passing

- For all courses, both in UE (University Evaluation) and IA (Internal Assessment) there are constitute separate heads-of-passing (HoP).
  - The student must obtain a minimum grade point of 5.0 (40% marks) at UE as well as at IA.

    OR
  - The student failed in IA can also pass in the course provided he/ she obtains minimum of 25% marks in IA, and GPA (Grade Point Average) for the course is at least 6.0 (50% aggregate). The GPA for the course will be calculated only if the student passes in UE.
- The student who fails at UE in a course has to reapply only at UE as a backlog candidate and clear the HoP. Similarly, a student who fails in a course at IA has to reappear only at IA as backlog candidate and clear the HoP.

Rules of ATKT

- A student is allowed to carry backlog of courses prescribed for B. Tech. Sem. I, III, V, VII to B. Tech. Sem. II, IV, VI, VIII respectively.
- A student is allowed to keep term of Sem. III, if he/ she has failed in any number of courses in B. Tech. Sem. I and II.
- A student is allowed to keep term of Sem. V, if he/ she has failed in any number of courses in B. Tech. Sem. III and IV but passed in all courses in Sem. I and II.
- A student is allowed to keep term of Sem. VII, if he/ she has failed in any number of courses in B. Tech. Sem. V and VI but passed in all courses in Sem. III and IV.

Award of Class for the Degree Considering CGPA

A student who has completed the minimum credits specified for the program shall be declared to have passed in the program. The final result will be in terms of letter grade only and is based on the CGPA of all courses studied and passed. The criteria for the award of the honors at the end of the program are as given below:

Range of the CGPA	Final Grade	Performance Descriptor	Equivalent range of marks (%)
$9.50 \leq 10.00$	O	Outstanding	$80 \leq 100$
$9.00 \leq 9.49$	A^+	Excellent	$70 \leq 79$
$8.00 \leq 8.99$	A	Very Good	$60 \leq 69$
$7.00 \leq 7.99$	B^+	Good	$55 \leq 59$
$6.00 \leq 6.99$	B	Average	$50 \leq 54$
$5.00 \leq 5.99$	C	Satisfactory	$40 \leq 49$
Below 5.00	F	Fail	Below 40