Gurugram University Gurugram

Curriculum for UG Degree Course

in

Mechanical Engineering

Semester 3

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	BSC		Mathematics-III	3	0	0	3	**30**	**70**	**100**
2	PCC		Fluid Mechanics	3	0	0	3	**30**	**70**	**100**
3	HSMC		Thermodynamics	3	0	0	3	**30**	**70**	**100**
4	PCC		Industrial Automation	3	0	0	3	**30**	**70**	**100**
5	PCC		Production Process-I	3	0	0	3	**30**	**70**	**100**
6	PCC		Strength of Materials	3	0	0	3	**30**	**70**	**100**
7	LC		Fluid Mechanics_Lab	0	0	2	1	**50**	**50**	**100**
8	LC		Thermodynamics__Lab	0	0	2	1	**50**	**50**	**100**
9	LC		Strength of Materials _Lab	0	0	2	1	**50**	**50**	**100**
10	MC		**Constitution of India***	0	0	2	0	**30**	**70**	**100***
	Total						**21**			**900**

***Constitution of India : Non-credit mandatory course, students have to attain pass marks (40%)**

NOTE: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree. However, these marks will be shown in the detailed marks certificate of the students.

Semester 4

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	HSMC		Applied Thermodynamics	3	1	0	**3**	**30**	**70**	**100**
2	PCC		Machine Tools and Machining	3	1	0	**3**	**30**	**70**	**100**
3	PCC		Kinematics of Machine	3	1	0	**3**	**30**	**70**	**100**
4	PCC		Instrumentation and Control	3	1	0	**3**	**30**	**70**	**100**
5	PCC		Production Process-II	3	1	0	**3**	**30**	**70**	**100**
6	PCC		Computer Aided Design and Manufacturing	3	1	0	**3**	**30**	**70**	**100**
7	LC		Instrumentation and Control_ Lab	0	0	2	**1**	**50**	**50**	**100**
9	LC		Kinematics of Machine _Lab	0	0	2	**1**	**50**	**50**	**100**
10	LC		Computer Aided Design and Manufacturing _Lab	0	0	2	**1**	**50**	**50**	**100**
11	MC		Scientific and Technical writing Skills	0	0	2	**0**	**30**	**70**	**100***
			Total				**21**			**1000**

NOTE: **Scientific and Technical writing Skills**: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree. At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/Institute/ Professional Organization/Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization and its evaluation shall be carried out in the 5th Semester.

Course code					
Course title	**Mathematics III**				
Category	**Basic Science Course**				
Semester and Credits	L	T	P	**Credits**	Semeter
	3	0	0	3	III
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

(1) To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering

(2) To provide an overview of probability and statistics to engineers

UNIT-I

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation.

UNIT-II

Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

UNIT-III

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential, and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT-IV

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second-degree parabolas and more general curves. Test of significance: Large

sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes.

Course Outcomes:

Upon completion of this course, students will be able to

1. Solve field problems in engineering involving PDEs.
2. Formulate and solve problems involving random variables
3. Apply statistical methods for analysing experimental data.
4. Acquire a solid understanding of linear algebra and its applications in engineering
5. Enhance mathematical reasoning and critical thinking
6. Gain knowledge of Probability and its types

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

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Course code					
Course title	**Fluid Mechanics**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	III
Marks for Sessional	30 Marks				
Marks for End Term Examination	70 Marks				
Total	100 Marks				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1 To learn about the application of mass and momentum conservation laws for fluid flows
2 To understand the importance of dimensional analysis
3 To obtain the velocity and pressure variations in various types of simple flows

UNIT-I

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, and properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium, Problems.

Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Problems.

UNIT-II

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orificemeter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications, Problems. Compressible

Fluid Flow: Introduction, continuity momentum and energy equation, sonic velocity, propagation of elastic waves due to compression of fluid, propagation of elastic waves due to disturbance in fluid, stagnation properties, isentropic flow, effect of area variation on flow properties, isentropic flow through nozzles,diffusers,injectors,Problems..

UNIT-III

Viscous Flow: Flow regimes and Reynolds's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems.

Flow Through Pipes: Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes, Problems.

UNIT-IV

Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, von-karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies lift and drag on a cylinder and an airfoil, Problems.

Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes, Problems.

Course Outcomes: At the end of the course, the student shall be able to:
CO1. Expedite the properties of fluid along with pressure measurement techniques and concept of stability.
CO2. Understand the characteristics of fluid and application of continuity and Bernoulli's equation.
CO3. Conceptualisation of boundary layer, laminar and turbulent flow.
CO4. Analyse flows through pipes and open channels.
CO5. Apply the principles of conservation of mass, momentum, and energy to analyze fluid flow problems
CO6. Comprehend the concept of boundary layers and be able to analyze flow phenomena near solid surfaces

TEXT BOOKS:

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
2. Mechanics of Fluids – I H Shames, Mc Graw Hill

REFERENCES BOOKS:

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi

Course code					
Course title	**Thermodynamics**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	III
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1 To learn about work and heat interactions, and balance of energy between system and its surroundings
2 To learn about application of I law to various energy conversion devices
3 To evaluate the changes in properties of substances in various processes
4 To understand the difference between high grade and low grade energies and II law limitations on energy conversion

UNIT-I

Fundamentals - System and Control volume; Property, State and Process; Exact and Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.
Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic and Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

UNIT-II

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states and determination of properties, Mollier's chart.

UNIT-III

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

UNIT-IV

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and AvaiLability, AvaiLability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis. Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

Course Outcomes:

After completing this course, the students will be able to
CO1. Apply energy balance to systems and control volumes, in situations involving heat and work interactions
CO2. Evaluate changes in thermodynamic properties of substances
CO3. Evaluate the performance of energy conversion devices
CO4. Differentiate between high grade and low grade energies.
CO5. Comprehend thermodynamic principles to analyze and solve problems related to energy transfer and conversion in engineering systems
CO6. Analyze and evaluate the behavior of thermodynamic systems, such as ideal gases, mixtures, and pure substances

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Course code	
Course title	**Industrial Automation**
Category	**Professional Core Course**

Semester and Credits	L	T	P	Credits	Semester
	3	1	0	3	III
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To help students gain essential and basic knowledge of automated systems.
2. To familiarize the students with the design of hydraulic and pneumatic circuits for various automated applications.
3. To make students understand the Programmable Logic Controller to control the systems at industrial premises
4. To enable the students to apply the knowledge of information technology in the field of automation for better enhancement.

Unit:1

Introduction, automation principles and strategies, basic elements of advanced functions, levels modeling of manufacturing systems, Introduction to CNC programming.

Automated material handling systems , AGV, Transfer mechanism , Buffer storage , Analysis of transfer lines, Robots in material handling, Automated storage and Retrieval Systems (AS/RS) - carousel storage, Automatic data capture, bar code technology, Automated assembly systems

Unit:2

Group Technology, Part family, Sensor technologies, Automated inspection and testing, Coordinate measuring machines, Machine vision, Rapid prototyping

PLC Architecture, Modes of operation, Programming methods, Instructions, Instruction addressing, latches, timers and counters

Unit:3

SCADA, DCS, Integration of PLC, SCADA and DCS with manufacturing systems, Man-machine interfaces, Introduction to PLM, Case studies.

Industry 4.0- Standard, Real-time production monitoring techniques with smart sensors, Configuration of smart shop floor, traceability and call back of defective products

Unit 4

Artificial Intelligence based systems, Virtual Business, e-Commerce Technologies, Global Manufacturing Networks, Digital enterprise technologies, IOT in manufacturing

Course Outcome:

Upon successful completion of the course the students will be able to

1. Apply automation principles and strategies and model manufacturing systems
2. Design automated storage and retrieval systems and employ robots in material handling
3. Implement concepts of automation in inspection and testing
4. Apply PLC timers and counters for the control of industrial processes
5. Design of Hydraulic Circuit and pneumatic circuit for manufacturing application
6. Monitor production using smart sensors based on Industry 4.0 techniques
7. Implement artificial intelligence based systems and IOT in manufacturing

Text Book(s)

1. Mikell P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, 2016, Fourth edision, Pearson Education, New Delhi

Reference book:

1. P. Radhakrishnan, S. Subramanyan, V. Raju, CAD/CAM/CIM, New age International, New Delhi.
2. Yusuf Altintas, Manufacturing Autmation, 2012, Cambridge University Press, USA.
3. David Bedworth, Computer Integrated Design and Manufacturing, TMH, New Delhi.
4. Gupta A. K., Arora S. K., Industrial Automation and robotics, 2013, Third Edision, University Science Press, New delhi.
5. Rajesh Mehra, Vikrant Vij, PLSc and SCADA Thory and Practice, 2011, First Edision, University Science Press, New delhi.

Course code					
Course title	**Strength of Materials**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	III
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1 To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads

2 To calculate the elastic deformation occurring in various simple geometries for different types of loading

UNIT-I

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

UNIT-II

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

UNIT-III

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Columns and Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Eulers, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular and circular sections, Numerical.

UNIT-IV

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure. Slope and Deflection: Relationship between bending moment, slope and deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without
overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.

Course Outcomes:

After completing this course, the students should be able to

CO1. Recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

CO2. Evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

CO3. Analyze stress and strain in various structural components, including axial stress and strain, shear stress and strain, and bending stress and strain

CO4. Determine important material properties, such as modulus of elasticity, yield strength, ultimate strength, and toughness

CO5. Analyze the behavior of structural components subjected to axial and torsional loading

CO6. Familiar with energy methods, such as strain energy and virtual work principles.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw-Hill Publishing Co. Ltd., New Delhi 2005.

Course code					
Course title	**Production Process-I**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	III
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

UNIT-I

Metal Casting Process: Introduction, Foundry: Introduction to Casting Processes, Basic Steps in Casting Processes. Pattern: Types of Pattern and Allowances. Sand Casting: Sand Properties, Constituents and Preparation. Mould and Core making with assembly and its Types. Gating System. Melting of Metal, Furnaces and Cupola, Metal Pouring, Fettling. Casting Treatment, Inspection and Quality Control, Sand Casting Defects and Remedies.

Machine tools: Introduction, constructional features, specialization, operations and devices of basic machine tools such as lathe, shaper, planner, drilling machining, and milling machine, indexing in milling operation, working principles of capstan and turret lathes.

UNIT-II

Welding: Introduction to Welding, Classification of Welding Processes, Gas Welding: Oxy-Acetylene Welding, Resistance Welding; Spot and Seam Welding, Arc Welding: Metal Arc, TIG and MIG Welding, Submerged arc welding (SAW), resistance welding principles, electrode types and selection, thermit welding, electro slag welding, electron beam welding, laser beam welding, forge welding, friction welding, Welding Defects and remedies, brazing and soldering.

Forming Processes: Basic Principle of Hot and Cold Working, Hot and Cold Working Processes, Rolling, Extrusion, Forging, Drawing, Wire Drawing and Spinning. Sheet Metal Operations: Measuring, Layout marking, Shearing, Punching, Blanking, Piercing, Forming, Bending and Joining.

UNIT-III

Metal forming Jigs and Fixtures: Introduction, Metal blow condition, theories of plasticity, conditions of plane strains, friction, conditions in metal working, wire drawing, theory of forging, rolling theory, no slip angle, and foreword slip, types of tools, principles of locations, locating and clamping devices, jigs bushes, drilling jigs, milling fixtures, turning fixtures, boring and broaching fixtures, welding fixtures, different materials, for jigs and fixtures, economics of jigs and

fixtures.

UNIT-IV

Machine Tools and Machining Processes: Grinding Machines and selection of grinding wheel (Dressing and Truing), Broaching machines, Lapping/Honing machines (Super Finishing Operations) and planning Machines. Gear Manufacturing Gear milling, standard cutters and limitations,
Polymer Processing: Polymer Moulding Techniques for thermoplastic and thermosetting plastics. Applications of Plastics in engineering field.
Powder Metallurgy: Introduction to PM, Powder making processes, Steps in PM. Compaction and Sintering processes. Secondary and finishing operations in PM

Course Outcome (COs): At the end of the course, the student shall be able to:
CO1 Demonstrate the knowledge about different sand moulding and metal casting processes.
CO2 Understand the plastic deformation of metals under rolling, extrusion, forging and sheet metal working. CO3 Acquire knowledge about basic welding processes and their selection for fabrication of different components.
CO 4 Learn about different gear manufacturing and gear finishing operations.
CO 5 Acquire the basics of powder metallurgy.
CO6 Understand the different measuring instrument for surface finish

Text Book:
1. Manufacturing Engineering Technology, K. Jain, Pearson Education
2. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, TMH.
3. Principles of Manufacturing Materials and Processes, James S.Campbell, TMH.
4. Welding Metallurgy by G.E.Linnert, AWS.
5. Production Engineering Sciences by P.C.Pandey and C.K.Singh, Standard Publishers Ltd.
6. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern

Reference Book:

1. Welding technology by O P Khanna
2. Foundry technology by O P Khanna
3. Elements of workshop technology. Vol. 1 and II by S K Hajra Choudhury
4. Manufacturing Science by Ghosh and Malik
5. Production Technology by WAJ Chapman Vol I, II, III
6. Production Technology by P C Sharma.
7. Production Technology by Raghuvanshi.

Course code					
Course title	**Fluid Mechanics _Lab**				
Category	**Laboratory Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	0	0	2	1	III
Marks for Sessional	50 Marks				
Marks for End term Examination	50 Marks				
Total	100 Marks				

Course Objectives:

1. Understand the techniques and concept of stability.
2. Learning continuity and Bernoulli's equation.
3. Learn discharge measuring devices and hydraulic coefficients.
4. Knowledge of different types of pipe losses and determine the velocity profile in a pipe.

List of Experiments:

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orificemeter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge, contraction and velocity of an orifice.
7. To verify the Bernoullis Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.
12. To verify the momentum equation.

Course Outcomes:

Students will be able to understand:

CO1. Understand the techniques and concept of stability.

CO2. Learning continuity and Bernoulli's equation.

CO3. Analyse discharge measuring devices and hydraulic coefficients.

CO4. Knowledge of different types of pipe losses and determine the velocity profile in a pipe.

Note:

1. At least Ten experiments are to be performed in the semester.

Course code					
Course title	**Strength of Materials_Lab**				
Category	**Laboratory Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	0	0	2	1	III
Marks for Sessional	50 Marks				
Marks for End term Examination	50 Marks				
Total	100 Marks				

Course Objectives

1. To learn the principles of mechanics of solid and various properties of materials.
2. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.

List of Experiments:

1. To study the Brinell hardness testing machine and perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine and perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine and perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine and perform the Erichsensheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod andCharpy).
6. To study the Universal testing machine and perform the tensile test.
7. To perform compression and bending tests on UTM.
8. To perform the sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.

Course Outcomes:

The students will be able to understand

CO1. Learn the principles of mechanics of solids and engineering.

CO2. Preparation of formal Laboratory reports describing the results of experiments.

CO3. Acquire to operate basic instruments in the mechanics of materials Lab.

CO4. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.

Note: 1. At least eight experiments are to be performed in the semester.

Course code					
Course title	**Thermodynamics_Lab**				
Category	**Laboratory Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	0	0	2	1	III
Marks for Sessional	50 Marks				
Marks for End term Examination	50 Marks				
Total	100 Marks				

Course Objectives:

1. To understand Vapour power cycles.
2. To understand steam boilers, their types and components.
3. To learn fundamentals of flow of steam through a nozzle.
4. To understand Steam turbines ,condensers and compressors.

List of Experiments:

1.To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power out putand efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study and find volumetric efficiency of a reciprocating air compressor.
9. To study cooling tower and find its efficiency.
10. To find calorific value of a sample of fuel using Bomb calorimeter.
11. Calibration of Thermometers and pressure gauges.

Course Outcome:

The Students will be able to understand the practical exposure of:
CO1. Vapour power cycles and find and compare different cycles based on their performance parameters and efficiencies.
CO2. Steam boilers, their types and components.
CO3. Fundamentals of flow of steam through a nozzle.
CO4. Steam turbines and can calculate their work done and efficiencies.
CO5. Types and working of condensers and compressors and define their different types of efficiencies

Note:

1. At least eight experiments should be performed from the above list.

Course code					
Course title	**Constitution of India**				
Category	**Mandatory Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	0	0	2	0	III
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

UNIT-I

Introduction to Constitution: Meaning and importance of the Constitution, salient features of Indian Constitution. The preamble of the Constitution**.** Fundamental rights**-** meaning and limitations. Directive principles of state policy and Fundamental duties -their enforcement and their relevance.

UNIT-II

Union Government: Union Executive- President, Vice-president, Prime Minister, Council of Ministers. Union Legislature- Parliament and Parliamentary proceedings. Union Judiciary-Supreme Court of India – composition and powers and functions.

UNIT-III

State and Local Governments: State Executive- Governor, Chief Minister, Council of Ministers. State Legislature-State Legislative Assembly and State Legislative Council. State Judiciary-High court. Local Government-Panchayat Raj system with special reference to 73rd and Urban Local Self Govt. with special reference to 74th Amendment.

UNIT-IV

Election provisions, Emergency provisions, Amendment of the constitution: Election Commission of India-composition, powers and functions, and electoral process. Types of emergency grounds, procedure, duration, and effects. Amendment of the constitution- meaning, procedure, and limitations.

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. 2. To address the growth of Indian opinion regarding modern Indian intellectuals‟ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

CCO1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership

of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4. Discuss the passage of the Hindu Code Bill of 1956. The examination of the regular students will be conducted by the concerned college/Institute internally.

References:

1. M.V.Pylee, “Introduction to the Constitution of India”,4th Edition, Vikas publication,2005.
2. Durga Das Basu(DD Basu) , “Introduction to the constitution of India”,(Student Edition),19th edition,Prentice-Hall EEE, 2008.

Textbooks Reference Book

1. Merunandan, “Multiple Choice Questions on Constitution of India”, 2nd Edition, Meraga publication,2007.

Semester 4

S. No.	Course Code	Category	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Applied Thermodynamics	3	0	0	**3**	**30**	**70**	**100**
2	PCC		Machine Tools and Machining	3	0	0	**3**	**30**	**70**	**100**
3	PCC		Kinematics of Machine	3	0	0	**3**	**30**	**70**	**100**
4	PCC		Instrumentation and Control	3	0	0	**3**	**30**	**70**	**100**
5	PCC		Production Process-II	3	0	0	**3**	**30**	**70**	**100**
6	PCC		Computer Aided Design and Manufacturing	3	0	0	**3**	**30**	**70**	**100**
7	LC		Kinematics of Machine_LAB	0	0	2	**1**	**50**	**50**	**100**
8	LC		Instrumentation and Control_ Lab	0	0	2	**1**	**50**	**50**	**100**
9	LC		Production Process-II_Lab	0	0	0	**1**	**50**	**50**	**100**
10	LC		Computer Aided Design and Manufacturing _Lab	0	0	2	**1**	**50**	**50**	**100**
11	MC		Scientific and Technical writing Skills	0	0	2	**0**	**30**	**70**	**100***
			Total				**22**			**1000**

NOTE:

1. Scientific and Technical writing Skills: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree

2. At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/Institute/ Professional Organization/Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization and its evaluation shall be carried out in the 5th Semester.

Course code					
Course title	**Applied Thermodynamics**				
Category	**Engineerimg Science Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	IV
Marks for Sessional	30 Marks				
Marks for End Term Examination	70 Marks				
Total	100 Marks				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn about of I law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand about the properties of dry and wet air and the principles of psychrometry
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn the about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

UNIT-I

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

UNIT-II

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Supercritical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

UNIT-III

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation compressible flow in diffusers, efficiency of nozzle and diffuser.

UNIT-IV

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines

Course Outcomes: After completing this course, the students will be able to
CO1 Understand various practical power cycles and heat pump cycles.
CO2 Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
CO3 Understand phenomena occurring in high speed compressible flows
CO4

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd

Course code					
Course title	**Machine Tools and Machining**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	IV
Marks for Sessional	30 Marks				
Marks for End Term Examination	70 Marks				
Total	100 Marks				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To provide students with a comprehensive understanding of machine tools, their operations, and the machining processes involved.
2. Knowledge and skills necessary to operate machine tools effectively and efficiently, and to perform various machining operations with precision

Unit I

Basic Kinematic Structure of Centre Lathe- Kinematic analysis of: Speed Gear Box, Feed Gear Box, Apron Mechanism, Thread Cutting. Tool Geometry- Detailed discussions restricted to ASA, ORS and MRS and for single point cutting tool as well as WRS, Introduction to NRS.Introduction to tool geometry of milling cutters and drills.

Unit II

Introduction To Grinding-Need and different methods of grinding, Wheel specifications, Mechanics of grinding, Similarities and differences between grinding and machining.Basic Kinematic systems and operations of Other Machine Tools- Kinematic system and operations of drilling machines.Kinematic system and operations of milling machines.Construction, working principle and applications of shaping, planing and slotting.

Unit III

Screw Thread Measurement- Standard thread profiles, Different Thread Elements, Effective diameter, 2 wire and 3 wire methods as applied to standard and non-standard thread profiles, Best wire size, Virtual Effective Diameter. Surface Roughness-Sources of surface irregularities in manufacturing, Different elements of surface roughness, Definition of center line and related roughness parameters, Measurement Instruments, Profilometers, Analysis of roughness signal in frequency domain

Unit IV

Gear Metrology- Different types of gears, Basic elements of a gear, Involute function, Relations between different gear elements of spur and helical gears, Virtual number of teeth, Use of gear tooth Vernier for chordal and constant chordal measurements,Span measurement using Base Tangent Micrometers. Coordinate Measuring Machines-Introduction to Coordinate Measuring Machines.

Course Outcomes:

Upon completing the Machine Tool and Machining course, students should be able to:

CO1. Demonstrate a clear understanding of different types of machine tools, their components, and

their functions.
CO2. Identify the various types of machine tools commonly used in machining operations. Interpret engineering drawings
CO3. Interpret geometric dimensions and tolerances (GDandT) and select appropriate machining strategies accordingly.
CO4. Understand the principles of cutting tool technology and select appropriate cutting tools for different machining operations.
CO5. Optimize machining processes for improved productivity and quality.
CO6. Analyze and troubleshoot machining issues:

TextBook :

1. Sen, G. C., and Bhattacharyya, A. Principles of Machine Tools: New Central Book Agency
2. Bhattacharyya A, Theory and Practice Of Metal Cutting, New Central Book Agency

Reference Books:

3. Boothroyd, G., and Knight, W. A. Fundamentals of machining and machine tools: Taylor and Francis. 92
4. Trent, E. M. Metal cutting: Butterworth Heinemann
5. Stephenson, D. A., and Agapiou, J. S. Metal cutting theory and practice: CRC Taylor and Francis.
6. Dotson, C. Fundamentals of dimensional metrology: Thomson Delmar.
7. Kelly, P. Metrology: BiblioBazaar.
8. Jain, R.K., Engineering Metrology, Khanna Publisher
9. Smith, G. T. Industrial metrology: surfaces and roundness: Springer.
10. Griffiths, B. Manufacturing surface technology: surface integrity and functional performance:Taylor and Francis.

Course code					
Course title	**Kinematics of Machine**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	IV
Marks for Sessional	30 Marks				
Marks for End Term Examination	70 Marks				
Total	100 Marks				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1 To understand the kinematics and rigid- body dynamics of kinematically driven machine components.\
2 To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.\
3 To be able to design some linkage mechanisms and cam systems to generate specified output motion.\
4 To understand the kinematics of gear trains.

UNIT-I

Introduction: mechanism and machines, kinematics links, kinematics pairs, kinematics chains, degree of freedom, Grubler's rule, kinematics inversion, equivalent linkages, four link planar mechanisms, straight line mechanisms, steering mechanisms, pantograph, problems. Kinematics Analysis of Plane Mechanisms: displacement analysis, velocity diagram, velocity determination, relative velocity method, instantaneous center of velocity, Kennedy's theorem, graphical and analytical methods of velocity and acceleration analysis, problems.

UNIT-II

Cams: Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical methods, cams with specified contours, problems. Gears: fundamental law of gearing, involute spur gears, characteristics of involute and cycloidal action, Interference and undercutting, center distance variation, path of contact, arc of contact, non standard gear teeth, helical, spiral bevel and worm gears, problems.

UNIT-III

Gear Trains: synthesis of simple, compound and reverted gear trains, analysis of epicylic gear trains, problems Kinematics synthesis of Mechanisms: function generation, path generation, Freudenstein's equation, two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, precision positions, structural error; Chebychev spacing, transmission angle, problems.

UNIT-IV

Friction : Types of friction, laws of friction, motion along inclined plane, screw threads, efficiency on inclined plane, friction in journal bearing, friction circle and friction axis, pivots and collar friction, uniform pressure and uniform wear. Belts and pulleys: Open and cross belt drive, velocity ratio, slip,

material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts, ratio of tension, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drives, chain length, classification of chains.

Course Outcomes : Students would be able :

CO1 - To understand about the applications of mechanism and machines.

CO2 - To understand about the basics Cams and Friction

CO3 - Familiarize about power transmitted with Belts and pulleys and also Gears and Gear Trains. CO4 - Students having familiarization with calculate Kinematics Analysis of Plane Mechanisms

CO5 - Students would be able to know the Kinematics synthesis of Mechanisms.

CO6- Perform kinematics synthesis of mechanisms

TEXT BOOKS:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Malik, Third Edition Affiliated East-West Press. 2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.

References:

1. Mechanism and Machine Theory : J.S. Rao and R.V. Dukkipati Second Edition New age International. 2. Theory and Machines: S.S. Rattan, Tata McGraw Hill. 3. Theory of Machines, Beven, Pearson Indian Education Service Pvt. Ltd. India.

Course code					
Course title	**Instrumentation and Control**				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	IV
Marks for Sessional	30 Marks				
Marks for End Term Examination	70 Marks				
Total	100 Marks				

Course Objectives:

1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

UNIT-I

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning; Instruments and Their representation : Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration.

UNIT-II

Transducer Elements : Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric, Inductive Self Generating and Non-Self Generating Types, Electromagnetic, Electrodynamic, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, PiezoElectric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Single Double and Four Active Arm Bridge Arrangements, Temperature Compensation, Balancing and Calibration, Ionisation Transducers, Mechano Electronic Transducers, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Volatic Transducers, Digital Transducers, Frequency Domain Transducer, Vibrating String Transducer, Binary codes, Digital Encoders.

UNIT-III

Motion, Force and Torque Measurement : Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices, Seismic Devices, Spring Mass and Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter. Intermediate, Indicating and Recording Elements : Introduction Amplifiers, Mechanical, Hydraulic, Pneumatic, Optical, Electrical Amplifying elements, Compensators, Differentiating and Integrating Elements.

Temperature Measurement : Introduction, Measurement of Temperature, Non Electrical Methods – Solid Rod Thermometer, Bimetallic Thermometer, Liquid-in-Glass thermometer, Pressure Thermometer, Electrical Methods – Electrical Resistance Thermometers, Semiconductor Resistance Sensors (Thermistors), Thermo–Electric Sensors, Thermocouple Materials, Radiation Methods (Pyrometry), Total Radiation Pyrometer, Selective Radiation Pyrometer.

UNIT-IV

Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use.
Practical group based project utilizing above concepts.
Pressure and Flow Measurement : Pressure and Flow Measurement, Introduction : Moderate Pressure Measurement, Monometers, Elastic Transducer, Dynamic Effects of Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing, Quantity Meters, Positive Displacement Meters, Flow Rate Meters, Variable Head Meters, Variable Area Meters, Rotameters, Pitot-Static Tube Meter, Drag Force Flow Meter, Turbine Flow Meter, Electronic Flow Meter, Electro Magnetic Flow meter. Hot-Wire Anemometer.

Course Outcomes:
Upon completion of this course, the students will be able
CO1. Understand the measurement of various quantities using instruments, their accuracy and range, and the techniques for controlling devices automatically.
CO2. Identify and select appropriate sensors for common engineering measurements, such as temperature, pressure, flow, and displacement
CO3. Design and configure instrumentation systems for specific measurement tasks
CO4. Analyze transducer performance and calibration
CO5. Explore ionization and mechano-electronic transducers
CO6. Design and analyze block diagrams to represent control systems

Text Books:
1.Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2.Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3.Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

Course code					
Course title	Production Process-II				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	IV
Marks for Sessional	30 Marks				
Marks for End term Examination	70 Marks				
Total	100 Marks				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives (COs): At the end of the course, the student shall be able to:

1- Acquire knowledge about mechanics of chip formation and to identify the factors related to tool wear and machinability.
2- Learn about different gear manufacturing and gear finishing operations.
3- Select the proper cutting tool material and components of jigs and fixtures.
4- Understand the basics principles of non-conventional machining processes and their applications.
5- Identify and select different measuring instruments for the inspection of different components.

UNIT-I

Mechanism of Metal Cutting: Deformation of metal during machining, nomenclature of lathe, milling tools, mechanics of chip formation, built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal cutting, factors affecting tool forces. Cutting speed, feed and depth of cut, surface finish. Temperature distribution at tool chip interface. Numerical on cutting forces and Merchant circle. Cutting Tool Materials and Cutting Fluids: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Types of tool wear, tool life, factors governing tool life, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.

UNIT-II

Unconventional Machining Processes: Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electrochemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining: Generation of electron beam, relative merits and demerits. Laser beam machining: Principles and applications. Jigs and Fixtures: Introduction, location and location devices, clamping and clamping devises, Drill Jigs, Milling Fixtures.

UNIT-III

Numerical Control of Machine Tools; Introduction, Numerical Control and its growth, NC Machines tools, Axes of NC Machines, Classification of NC System, CNC, DNC and Machining Centre. Machine Control unit, NC tools and Tool changer.

UNIT-IV

Group Technology; Definition and concept, Group and Family, working of group technology, Stages for Adopting Group Technology, Advantages of Group Technology. Component Classification and Coding,

Personnel and Group Technology, Planning the introduction of Group Technology, Group Technology layout.

Course Outcomes:

At the end of the course, the student shall be able to: CO

CO 1-Acquire knowledge about mechanics of chip formation and to identify the factors related to tool wear and machinability.

CO 2- Learn about different gear manufacturing and gear finishing operations.

CO 3- Select the proper cutting tool material and components of jigs and fixtures.

CO 4- Understand the basics principles of non-conventional machining processes and their applications.

CO 5- Identify and select different measuring instruments for the inspection of different components.

Text Books

1. Manufacturing Technology – Vol. –
2. 2, P.N. Rao, T.M.H, New Delhi 2. Computer Aided Manufacturing: S Kumar and B Kant Khan, Satya Prakashan, New Delhi .

References:

1. Principles of Machine Tools – G.C. Sen and A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg.and Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
3. Modern Machining Processes: P.C. Pandey and H.S. Shan, T.M.H. Company, New Delhi
4. Text Book of Production Engineering: P.C. Sharma, S.Chand and Sons.
5. Production Engineering by KC Jain and AK Chilate, PHI, New Delhi

Course code					
Course title	Computer Aided Design and Manufacturing				
Category	**Professional Core Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	3	1	0	3	IV
Marks for Sessional	30 Marks				
Marks for End term Examination	70 Marks				
Total	100 Marks				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1 Understand the fundamentals of various Computer Aided Design, basics of geometric modeling, curves surfaces, solids and Additive Manufacturing Technologies for application to various industrial needs.
2 Learn what Advanced/Additive manufacturing (AM) is and understand why it has become one of the most important technology trends in decades for product development and innovation.
3 Differentiate between subtractive and Additive manufacturing.

UNIT-I

Introduction: Introduction to CAD/CAM/CAE, Design Process, Importance and Necessity of CAD, Applications of CAD, Hardware and Software requirement of CAD. Fundamentals of Additive Manufacturing (AM), Basic steps to perform AM, Classification of AM, Applications of AM: Aerospace, Biomedical, Automotive, Bio-printing, Tissue and Organ Engineering, Architectural Engineering, Surgical simulation, Art, Health care.

UNIT-II

Basics of geometric and solid modeling, coordinate systems. Transformations: Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations. Curves: Algebraic and geometric forms, reparametrization, Analytical and Synthetic curves, cubic splines, Bezier curves and B-spline curves. Surfaces and Solids: Plane surface, ruled surface, surface of revolution, tabulated cylinder, bicubic surface, Bezier surface, B-spline surface, Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition.

UNIT-III

Finite Element Method: Introduction, Procedure, Finite Element Analysis, Finite Element Modeling, Analysis of 1D, 2D structural problems. Design for Additive Manufacturing, Software issues for AM, Direct Digital Manufacturing. Difference between machining and additive manufacturing. Photo polymerization Processes, Powder bed fusion processes, Extrusion Based systems, Printing Processes, Effects of significant parameters.

UNIT-IV

Flexible Manufacturing Systems and Computer aided process planning: Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications Conventional process planning, types of CAPP, Steps in variant process planning, planning for CAPP.

COURSE OUTCOMES: Upon completion of this course the student will be able to:
CO1. Demonstrate the knowledge of Computer Aided design and Additive Manufacturing.
CO 2. Understand the concept of wireframe modeling, surface modeling and solid modeling.
CO3. Understand the method of manufacturing of liquid based, powder based and solid based techniques
CO4. Apply the FEM to perform structural analysis and solve engineering problems
CO5. Analyze 1D and 2D structural problems
CO6. Evaluate the benefits and challenges of implementing FMS in manufacturing environments.

Text Books

1. CAD/ CAM by Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill

Reference Books

1. Numerical Control and Computer Aided Manufacturing by Kundra, Rao and Tiwari, TMH.
2. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Course code					
Course title	Kinematics of Machine_ Lab				
Category	**Laboratory Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	0	0	2	1	IV
Marks for Sessional	50 Marks				
Marks for End term Examination	50 Marks				
Total	100 Marks				

Course Objectives:

1 To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
2 To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
3 To be able to design some linkage mechanisms and cam systems to generate specified output motion.
4 To understand the kinematics of gear trains.

List of Experiments:

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study various type of cam and follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.
7. To study various types of Steering Mechanism.
8. To study various types of gears – Helical, cross helical worm, bevel gear.
9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
10. To study the working of Screw Jack and determine its efficiency.
11 To study various types of Belt, Rope and Chain Drives.

Course Outcomes (COs): After studying this course, students will be able:

CO 1- Understand the various practical demonstrations of mechanism.
CO 2- Knowledge of Motions in mechanism with practical demonstration.
CO 3- Learning the Special purpose machine members used in designing of a machine.
CO 4- Synthesis of working model using the various linkages.
Note: 1. At least ten experiments are to be performed in the Semester.

Course code					
Course title	Computer Aided Design and Manufacturing _Lab				
Category	**Laboratory Course**				
Semester and Credits	L	T	P	**Credits**	Semester
	0	0	2	1	IV
Marks for Sessional	50 Marks				
Marks for End term Examination	50 Marks				
Total	100 Marks				

Note: 1. At least Six experiments are to be performed in the Semester.

Course Objectives:

At the end of the course, the student shall be able to: Display of the basic fundamentals of modeling package. Explore the surface and solid modeling features. Learning the techniques of 3D modeling of various mechanical parts.

List of Experiments:

The students will be required to carry out the following exercises using software packages (e.g. Solid works / Pro Engineer/AutoCAD/ I-Deas/ Solid Edge/CURA etc.)

1. CAD Modeling Assignments

(i) Use and learn import/export techniques and customization of software.

(ii) Construction of simple machine parts and components like Coupling, Crankshaft, Pulley, Piston , Connecting rod, nuts, bolts, gears and helical springs

(iii) Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing, Drill jigs and Milling fixture.

(iv) Make the part family/family table of a bolt.

2. CAM Assignments Tool path generation, Part programming, G and M codes development for machining operations, Physical interpretation of machining features and tool geometries.

3. To perform reverse engineering of a product using 3D scanner.

4. To print coupling, crankshaft, pulley, piston, connecting rod, nuts, bolts with FDM 3D printer with suitable filament like Nylon, ABS etc.

5. To print a product with FDM 3D printer which is developed with reverse engineering.

6. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.

7. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.

8. Draw 3D models by extruding simple 2D objects, dimension and name the objects.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Display of the basic fundamentals of modeling package.

CO 2- Explore the surface and solid modeling features.

CO 3- Learning the techniques of 3D modeling of various mechanical parts.

CO 4- To expedite the procedure and benefits of FEA and CAE.

Course code				
Course title	Production Process-II _Lab (P)			
Category	**Laboratory Course**			
Semester and Credits	L	T	P	**Credits**
	0	0	2	1
Marks for Sessional	50 Marks			
Marks for End term Examination	50 Marks			
Total	100 Marks			

Note: 1. At least Six experiments are to be performed in the Semester.

Course Objectives:

To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines,NC,CNC machine etc.

To understanding with the practical knowledge required in the core industries and different types of components using the machine tools

List of Experiments:

1. Study and Practice of Orthogonal and Oblique Cutting on a Lathe.
2. Machining time calculation and comparison with actual machining time while cylindrical turning on a Lathe and finding out cutting efficiency.
3. Study of Tool Life while Milling a component on the Milling Machine.
4. Study of Tool Wear of a cutting tool while Drilling on a Drilling Machine.
5. Study of Speed, Feed, Tool, Preparatory (Geometric) and miscellaneous functions for N. C part programming.
6. Part Programming and proving on a NC lathe for:- a. Outside Turning b. Facing and Step Turning c. Taper Turning d. Drilling e. Outside Threading
7. Part Programming and Proving on a NC Milling Machine:-
   a. Point to Point Programming
   b. Absolute Programming
   c. Incremental Programming
8. Part Programming and Proving for Milling a Rectangular Slot.

Course Outcome (COs): At the end of the course, the student shall have practical exposure of:

CO 1- vapour power cycles and find and compare different cycles based on their performance parameters and efficiencies.

CO 2- steam boilers, their types and components.

CO 3- fundamentals of flow of steam through a nozzle.

CO 4- steam turbines and can calculate their work done and efficiencies.

CO 5- types and working of condensers and compressors and define their different types of efficiencies

Course code				
Course title	Instrumentation and Control _Lab			
Category	**Laboratory Course**			
Semester and Credits	L	T	P	**Credits**
	0	0	2	1
Marks for Sessional	25 Marks			
Marks for End term Examination	25 Marks			
Total	50 Marks			

Course Objectives :

1. To understand about the applications of measurement systems.
2. To understand about the basics and working principle of pressure, temperature and flow measurement.
3. Identify the different variation of measurement parameter with various input conditions.
4. To analyze the primary, secondary and tertiary measurements.
5. To learn about the various control devices and parts of measurement systems

List of Experiments :

1. To Study various Temperature Measuring Instruments (a) Mercury – in glass thermometer (b) Thermocouple
2. To study the working of Bourdon Pressure Gauge and to check the calibration of the gauge in a dead-weight pressure gauge calibration set up.
3. To study a Linear Variable Differential Transformer (LVDT) and use it in a simple experimental set up to measure a small displacement.
4. To measure load (tensile/compressive) using load cell on a tutor.
5. To measure torque of a rotating shaft using torsion meter/strain gauge torque transducer.
6. To measure the speed of a motor shaft with the help of non-contact type pick-ups (magnetic or photoelectric).
7. To measure the stress and strain using strain gauges mounted on simply supported beam/cantilever beam.
8. To measure static/dynamic pressure of fluid in pipe/tube using pressure transducer/pressure cell.
9. To test experimental data for Normal Distribution using Chi Square test.
10. Vibration measurement.
11. To study various types of measurement Error

Note: 1. At least eight experiments are to be performed in the Semester.

Course Outcomes:

CO1 - To understand about the applications of measurement systems.
CO2 - To understand about the basics and working principle of pressure, temperature and flow measurement.
CO3 - Identify the different variation of measurement parameter with various input conditions.
CO4 - To analyze the primary, secondary and tertiary measurements.
CO5 - To learn about the various control devices and parts of measurement systems

Course code				
Course title	Scientific and Technical writing Skills*			
Category	**Mandatory Course**			
Semester and Credits	L	T	P	**Credits**
	0	0	2	0
Marks for Sessional	30 Marks			
Marks for End Term Examination	70 Marks			
Total	100 Marks			

COURSE OBJECTIVES: The Course prepares second semester engineering and Technology students to:
1 Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
2 Foster their ability to write convincing job applications and effective reports.
3 Develop their speaking skills to make technical presentations , participate in group discussions.
4 Strengthen their listening skill which will help them comprehend lectures and talks in their areas of sp

UNIT I INTRODUCTION TECHNICAL ENGLISH
Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- Reading – reading short technical texts from journals-newspapers- Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development –subject verb agreement - compound words

UNIT II READING AND STUDY SKILLS
Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing-Writing- interpreting cgarts, graphs- Vocabulary Development-vocabularyused in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives

UNIT III TECHNICAL WRITING AND GRAMMAR
Listening- Listening to classroom lectures/ talkls on engineering/technology -Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words-Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING
Listening- Listening to documentaries and making notes. Speaking – mechanics of presentations- Reading – reading for detailed comprehension- Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development-finding suitable synonyms-paraphrasing-. Language Development- clauses- if conditionals

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS
Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- verbal analogies Language Development- reported speech

COURSE OUTCOMES: At the end of the course learners will be able to:

1 Read technical texts and write area- specific texts effortlessly.

2 Listen and comprehend lectures and talks in their area of specialisation successfully.

3 Speak appropriately and effectively in varied formal and informal contexts.

4 Write reports and winning job applications. ecialisation.

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