M.D. UNIVERSITY, ROHTAK

SCHEME OF STUDIES AND EXAMINATION

(Under NEP-2020)

BACHELOR of TECHNOLOGY

(MECHANICAL & AUTOMATION ENGINEERING)

SEMESTER 3rd & 4th

Scheme effective from academic session 2026-27

'H' Scheme (Under NEP-2020)

1. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab) per week	1 credit

2. Structure of the Undergraduate Engineering program:

Sr. No.	Category
1	Humanities and Social Sciences including Management courses
2	Basic Science Courses
3	Engineering Science courses
4	Program Core Courses (Branch specific)
5	Professional Elective courses relevant to chosen specialization/branch
6	Open Elective Courses (from Humanities, Technical Emerging or other Subjects)
7	Project work, Seminar and Internship in Industry or elsewhere
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition] etc. (non-credit)

3. Course code and definition:

Course Code	**Definitions**
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
PEC	Professional Elective courses
OEC	Open Elective courses
PRROJ/SEM	Seminar Employment Enhancement Courses (Project/Summer Internship/ Seminar)

PROGRAM OUTCOMES (PO)

Engineering Graduates will be able to:

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

PO6. Analyse and evaluate societal and environmental aspects while solving complex engineering problems, considering their impact on sustainability with reference to economy, health, safety, legal frameworks, culture, and the environment.

PO7. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO10. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO11. Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Semester-3

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Scheme (Marks)				Duration of Exam (Hours)
			L	P	T			Internal awards	Theory	Practical	Total	
1	26PCC-MA-201-H	Thermodynamics	3	0	0	3	**3**	25	50		75	3
2	26PCC-MA-203-H	Mechanics of Solid	3	0	0	3	**3**	25	50		75	3
3	26BSC-MATHME-203-H	Mathematics III (PDE, Probability & Hypothesis Testing)	3	0	1	4	**4**	30	70		100	3
4	26PCC-MA-207-H	Mechanics of Fluid	3	0	0	3	**3**	25	50		75	3
5	26ESC-MA-209-H	Basics of Electronics Engineering	3	0	0	3	**3**	25	50		75	3
6	26BSC-MA-211-H	Materials Science	3	0	0	3	**3**	25	50		75	3
7	26LC-MA-231-H	Mechanics of Solid Lab	0	2	0	2	**1**	5		20	25	3
8	26LC-MA-233-H	Mechanics of Fluid Lab	0	2	0	2	**1**	5		20	25	3
9	26LC-MA-235-H	Basics of Electronics Engineering Lab	0	2	0	2	**1**	5		20	25	3
10	*26AU-ENV-202-H	Environmental Science	2	0	1	3		Refer Note 1				
		Total				28	22				550	
	For Honors course											
1	26PCC-MA-221-H	Engineering Mechanics	3	0		3	**3**	25	50		75	3
2	26LC-MA-223-H	Engineering Mechanics Lab	0	2		2	**1**	5		20	25	3
		Total				**5**	4				100	

Note-1:26AU-ENV-202-H is a mandatory non–credit course in which students must obtain passing marks in theory. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of a degree. However, these marks will appear on the student detailed marks certificate.

Marks Distribution:

- Internal Assessment: 30 marks
- Theory Examination: 70 marks

The institute will conduct the theory examination at its own level

Semester-4

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Scheme (Marks)				Duration of Exam (Hours)
			L	T	P			Internal awards	Theory	Practical	Total	
1	26PCC-MA-202-H	Kinematics of Machines	3	0	0	3	**3**	25	50		75	3
2	26PCC-MA-204-H	Heat Transfer	3	1	0	4	**4**	30	70		100	3
3	26PCC-MA-206-H	Manufacturing Machines	3	0	0	3	**3**	25	50		75	3
4	26PCC-MA-208-H	Electrical Machines	3	1	0	4	**4**	30	70		100	3
5	26PCC-MA-210-H	Operation Research	3	1	0	4	**4**	30	70		100	3
6	26BSC-MA-212-H	Numerical Analysis & Programming	3	0	0	3	**3**	25	50		75	3
7	26LC-MA-232-H	Kinematics of Machines Lab	0	0	2	2	**1**	5		20	25	3
8	26LC-MA-234-H	Heat Transfer Lab	0	0	2	2	**1**	5		20	25	3
9	26LC-MA-236-H	Electrical Machines Lab	0	0	2	2	**1**	5		20	25	3
		Total				27	24				600	
For Honors course												
1	26PCC-ME-224-H	Product Design and Development	3	0		3	**3**	25	50		75	3
2	26LC-ME-226-H	Product Design and Development Lab	0	2		2	**1**	5		20	25	3
		Total				**5**	4				100	

At the end of the 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 a typed report along with a certificate from the organization& its evaluation shall be carried out in the 5th Semester.

Coursecode	26PCC-MA-201-H				
Category	ProfessionalCoreCourses				
Course title	Thermodynamics				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**0**	**0**	**3**	
Objectives:	The objective of the paper is to introduce basic concepts,thermodynamicsandotherconcepts relatedtothermal science.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	3	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	1	-	-	-	2	3	3	3
CO4	3	3	2	2	2	3	1	-	-	-	2	3	2	3
WT. AVG	**3.00**	**2.75**	**2.50**	**2.25**	**2.25**	**2.25**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.46

UNIT-I

Basic concepts: Introduction to the Basic definitions of Engineering Thermodynamics. Thermodynamic systems: Closed,openandisolatedsystems.MicroscopicandMacroscopicview.IntensiveandExtensive properties. Zerothlaw of Thermodynamics. Phase, State, Process, Cycle. Point functions and Path functions. Equation of state. Work and Heat.

First Law of Thermodynamics: Internal energy - a property arising from the First Law of Thermodynamics. Reversible Non flow processes p-*v* diagrams. Concept of Flow work, Enthalpy. Analysis of unsteady flow and steady flow processes and their applications. Throttling process.

UNIT-II

Second Law of Thermodynamics: Limitations of First law and necessity of Second Law of Thermodynamics. Claussius and Kelvin Planck statements. Reversible and Irreversible processes. Carnot cycle, Reversed Carnot cycle. Clausius inequality. Entropy - a property arising from the Second law of Thermodynamics. Expressions for change in entropy during various processes and representations on t-s diagrams.

Availability and Irreversibility: High-grade and low-grade energy. Available and unavailable energy.Deadstate.LossofavailableenergyduetoHeattransferthroughafinite temperaturedifference.Availability.ReversibleworkandIrreversibility.Availabilityinnon-flowsystemsandsteadyflow systems. Second law efficiency.

UNIT-III

ThermodynamicPropertyRelations: HelmholtzandGibbsfunction.MathematicalconditionsforExact differentials (Properties). Maxwell Relations. Clapeyron Equation.

PropertiesofaPureSubstance: PhaseequilibriumofaPuresubstanceon t-*v*diagram.Normal boiling point of a Pure substance. Saturation states. Compressed liquid. p-v&p-t diagram of a pure substance. Saturatedsteam, Dryand saturated steam, Superheated steam. Use of Steamtables and Mollier diagram.Differentprocessesofvapouronp-vandt-sdiagrams.Measurement ofDrynessfraction.

UNIT-IV:

Gas Power Cycles: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycle and Brayton cycle.

Vapour Power Cycles: Carnot cycle. Simple Rankine cycle. Effect of various parameters on the efficiency of Rankine cycle. Reheat and Regenerative cycles.

CourseOutcomes:

1. Aftercompletingthiscourse,thestudentswillbeabletoapplyenergybalancetosystemsandcontrol volumes, in situations involving heat and work interactions
2. Studentscanevaluatechangesinthermodynamicpropertiesofsubstances
3. Thestudentswillbeabletoevaluatetheperformanceofenergyconversion devices
4. Thestudentswillbeabletodifferentiatebetweenhighgradeandlowgradeenergies

TextBooks:

1. P.K.Nag,“EngineeringThermodynamics”,TataMcGraw Hill

ReferenceBooks:

1. Sonntag/Vanhylene,“FundamentalsofThermodynamics”,Wiley
2. RahulGupta,“EngineeringThermodynamics”,AsianBooksP. Ltd.
3. GordonRosers,“YonMahew;EngineeringTermodynamics”,AddisonWesley
4. Y.V.C.Rao,“EngineeringThermodynamics”,KhannaPublication

Course code	26PCC-MA-203-H				
Category	Professional Core Courses				
Course title	Mechanics of Solid				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**0**	**0**	**3**	
Objectives:	The students in this course are required to analyse reasons for failure of different componentsandselecttherequiredmaterialsfor different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress,strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles to the solutionofappliedproblemstodevelopthe requiredcompetencies.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
DurationofExam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

O

CO/PO	PO1	PO2	PO3	PO4	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	3	2	2	1	-	-	-	2	3	3	3
WT. AVG	**3.00**	**3.00**	**2.50**	**2.00**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.46

UNIT-I

Simple Stresses & strains: Tensile, Compressive, shear and volumetric stresses and Strains, stress strain diagram, complementary shear stress, lateral strain and Poisson's ratio.

CompoundbarsandTemperaturestresses:Stressesincompoundbarscarryingaxialloadsandsubjected to temperature stresses.

Complex stresses and strains: Principal stress and strain due to combination of stresses, Mohr's circletheories of Failures.

UNIT-II

Simple bending: Shear force and bending moment diagrams of cantilevers, beams under concentrated,uniformly varying loads with and without overhangs.

Stresses in beams and cantilevers under bending, beam of uniform strength, flitched beams, bending due to eccentric loads.

Slopeanddefectionofcantileversandbeamsunderconcentratedanduniformlydistributedloads.

UNIT-III

Columns:Combineddirectandbendingstressesincolumns,Euler'sandRankineGordon equations.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts.Power transmitted by shafts; combined bending and torsion.

UNIT-IV

Springs:Close-coiled,opencoiledspringsundertorqueandmoment.

Cylinders:Thinandthickcylinders,Lame'sTheorem,compoundcylinders,sphericalvessels. Course

Outcomes:

1. After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

TextBooks:

1. JindalU.C.,"StrengthofMaterials",GalgotiaPublication,NewDelhi,1998.
2. RyderG.H.,"StrengthofMaterials",Macmillan,Delhi,2003.
3. R.K.Bansal,"StrengthofMaterials",LaxmiPublication,NewDelhi,2001.

ReferenceBooks:

1. SadhuSingh,"StrengthofMaterials",KhannaPublishers,NewDelhi,2000.
2. TimoshenkoS.P.,"ElementsofStrengthofMaterials",East-Westaffiliated,NewDelhi,2000.
3. HibblerR.C.,"MechanicsofMaterials",PrenticeHall,NewDelhi,1994.
4. PopovEgerP.,"Engg.Mechanicsofsolids",PrenticeHall,NewDelhi,1998.
5. Fenner,Roger.T,"MechanicsofSolids",U.K.B.C.Publication,NewDelhi,1990.

Course code	26BSC-MATHME-203-H				
Category	Basic Science course				
Course title	**Mathematics III (PDE, Probability & Hypothesis Testing)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester-III
	3	0	**0**	**3**	
Branch	Mechanical Engineering				
Classwork	25 Marks				
Examination	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

COURSE OBJECTIVES:

1. Formulation, Classification and solution methodologies for first (linear and non-linear, both) and second order PDE with applications inengineering.
2. Understand the concept of probability, random variable and some specific Probability distribution like binomial, Poison, Exponential and normal distributions and their applications in different engineering, science
3. Understand the concept of bivariate random variable and bivariate distribution. Also analyze the correlation and regression problems.
4. Understanding the concept of curve fitting and sampling, hypothesis, and hypothesis testing using various statistical technique like z, t-test and chi square distribution etc.

COURSE OUTCOMES (CO):

By the end of the Course, Students will be able to:

CO1: **To define** the concepts and terminology of Partial differential equation (PDE) including formulation, classification and solution methodologies for first (linear and non-linear, both) and second order PDE with applications in engineering.

CO2: Understand the concept of Methods of Separation of variables with applications in real world problems.

CO3: **Understand** the concepts and related terminology of probability and statistics including conditional probability, Baye's rule, random variables, expectation, probability distributions, Bivariate distribution and conditional probability density, correlation, regression, tests etc.

CO4: **Apply** the knowledge & ideas ofmethod of least square and standard probability distributions (Binomial, Poisson, Normal, Exponential) in modelling and analysis of real-world problems.

CO5: **Analyze** and**classify various** statistical tests, and justify their selection for solving given engineering and real-world problems.

CO - PO mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	-	-	2	-	-	3	2	3
CO2	3	3	2	2	3	2	-	-	2	-	-	3	3	3
CO3	3	2	3	2	3	2	-	-	2	-	-	3	3	3
CO4	3	2	2	3	2	2	-	-	2	-	-	3	2	3
WT.AVG	**3.00**	**2.25**	**2.25**	**2.25**	**2.50**	**1.75**	**-**	**-**	**2.00**	**-**	**-**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.38

Note: Examiner will set nine (09) questions in all with two questions from each unit and Q.1 is compulsory and covering all Units. This Q1 is compulsory and of short answer type. Each question carries equal marks (10 marks). Examinee have to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Formulation of PDE, Lagrange's linear PDEs; First order non-linear PDEs, Charpit's Method. Second-order linear PDE equations and their classification, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

UNIT-II

Initial and boundary conditions, D'Alembert's solution of the wave equation,Separation of variables method to simple problems in Cartesian coordinates. Methods of Separation of variable's applications to one dimensional Heat and Wave Equations, Two-dimensional Heat flow and Laplace equation.

UNIT-III

Probability spaces, conditional probability, Bayes' rule, Discrete random variables, Bernoulli, Binomial, Poisson Probability Distribution. Expectation of Discrete Random Variables, Moments, Correlation coefficient, Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, conditional densities,

UNIT-IV

Co-efficient of Correlation and Rank Correlation, Lines of Regression, 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, single mean, difference of means, Small samples: Tests for single mean, difference of means, Chi-square test for goodness of fit and independence of attributes.

Textbooks/References:

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
5. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
6. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi Reprint 2013.

Coursecode	26PCC-MA-207-H				
Category	ProfessionalCoreCourses				
Course title	Mechanics of Fluid				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**0**	**0**	**3**	
Objectives:	The objective of this subject to provide an understanding of the fundamentals of fluid mechanics, an appreciation of the design principles in fluid systems, the ability to analysesexistingfluidsystemsandcontributeto new designs.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
DurationofExam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	3	2	1	-	-	-	2	3	3	3
CO3	3	3	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	3	3	3	3	2	1	-	-	-	2	3	3	3
WT. AVG	**3.00**	**2.75**	**2.50**	**2.25**	**2.75**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.75**	**3.00**

V

Overall Mapping of Subject: **2.50**

UNIT-I

Fluid Properties and Fluid Statics: Define Fluid**,** fluid mechanics, properties of fluids, Newtonian and Non-Newtonian Fluids; Kinematic and dynamic Viscosity; Incompressible and compressible fluids, compressibility.Forces on plane surfaces, forces on curved surfaces, buoyant forces, stability of floating bodies, metacentre and metacentric height.

Kinematics of Fluid Motion: Steady and unsteady flow; uniform and non-uniform flow; Laminar and turbulent flow; streamline, path line and streak line; continuity equation, irrotational and rotational flow, velocity potential and stream function, vortex flow, vortex lines, vortex tubes, free and forced vortex.

UNIT-II

Dynamics of Fluid Flow: Eulers equation of motion and its integration to yield Bernoulli's equation, graphical representation of Bernoulli's equation and its practical applications – Pitot tube, Venturi meter; steady flow momentum equation, force exerted by jet on plane surface and force exertedon a pipe bend.

UNIT-III

Dimensional Analysis and Principles of Similarity: Buckingham Theorem and its applications, Geometric, Kinematics and Dynamic similarity; Dimensionless numbers-Reynolds, Froude, Euler, Mach, Weber Number and their significance.

BoundaryLayerFlow:LaminarandturbulentboundaryLayerandlaminarsublayer. Boundary Layer thickness, displacement, momentum and energy thickness.
LaminarFlow:Reynold'sexperiment,criticalvelocity,steadylaminarflowthroughacirculartube, flow between parallel plates, measurement of viscosity.

UNIT-IV

Turbulent Flow:Shear stress in turbulent flow. Hydrodynamically smooth& through boundaries.Velocity distribution for turbulent flow in smooth and rough pipes.

AnalysisofPipeFlow:Energylosses,minorlossesinpipelines,conceptofequivalentlength,flow between two reservoirs, multiple pipe systems – in series and parallel, siphon.

Flow Measurements:Measurement of flow using Venturi meter, orifice meter, Pitot tube, Flow nozzle, Measurement of flow in open channels – rectangular, triangular, trapezoidal weir, Cipolletti weir.
CourseOutcomes:Attheendofthecourse,thestudentshallbeableto:

1.Expeditethepropertiesoffluidalongwithpressuremeasurementtechniquesandconceptofstability.2. Understand the characteristics of fluid and application of continuity and Bernoulli's equation.

3.Conceptualisationofboundarylayer,laminarandturbulentflow.

4.Analyseflowsthroughpipesandopen channels.

TextBooks:

1. R.K.Basal,"FluidMechanics&HydraulicMachines",LaxmiPublications(P)Ltd.,2002.
2. D.S.Kumar,"FluidMechanicsandFluidPowerEngineering",S.K.Kataria&Sons,2000.

ReferenceBooks:

1. I.H.Shames,"MechanicsofFluids",TataMcGraw Hill
2. V.L.StreeterandE.B.Wylie,"FluidMechanics",TataMcGrawHill

Coursecode	26ESC-MA-209-H				
Category	ProfessionalCoreCourses				
Course title	Basics of Electronics Engineering				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**0**	**0**	**3**	
Objectives:	The objective of the paper is to acquaint the student with mathematical techniques being adoptedinindustrywhichhelpmanagersin decisiontaking.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
DurationofExam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	3	2	3	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	2	2	1	-	-	-	2	3	2	3
CO4	3	3	3	2	3	2	1	-	-	-	2	3	3	3
CO5	2	2	2	2	2	2	1	-	-	-	2	2	2	2
WT. AVG	**2.80**	**2.40**	**2.60**	**2.00**	**2.40**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**2.80**	**2.40**	**2.80**

Overall Mapping of Subject: 2.29

Unit-I

Semiconductor Diodes: Introduction to Junction Diode, Rectifiers (Half wave & Full wave), Filters,

Voltage Regulation and Voltage Multiplier. Types of Diodes (Zener, Photo, LED), Liquid Crystal

Display (LCD), Introduction to Silicon Controlled Rectifier (SCR), DIAC, TRIAC.

Bipolar Junction Transistor: BJT Characteristics, CB, CE & CC Configuration, Load Line (DC & AC),Leakage Current, Saturation, Active & Cut off mode of operation of Transistor, Biasing methods.

Unit-II

Small Signal Amplifier: CB, CE, CC, Amplifier, Hybrid Model Analysis of Common Emitter Amplifier,RC Coupled Amplifier, Mid-Band Model, gain and Impedance, Comparison of Different Configurations,Darlington Amplifier

Large Signal Amplifier: Introduction to Class A, Class B, Class C Amplifier, Class B Push Pull
Amplifier.

Oscillator: Concept of Negative & Positive feedback, Introduction to LC Oscillators

Unit-III

Field Effect Transistor: Introduction, Classification, FET Characteristics, Depletion & EnhancementMOSFET.

Operational Amplifier: Op-Amp Model, Concept of Ideal Op-Amp, Concept of Virtual Ground,
Inverting & Non-Inverting Amplifier, Differential Amplifier, Adder & Sub tractor, V – I & I – V
Converter, Integrator, Differentiator, Comparators.

Unit-IV

Digital Circuits: Binary operation, Boolean Algebra, Different Types of Codes (BCD, Gray, Excess-3,ASCII) DeMorgan's Law, Karnaugh Map, Different Types of Gates, Half Adder, Full Adder, Encoders,Decoders, Multiplexers, DeMultiplexers, Flipflops, Counters, Shift Registers, Introduction to RAMs and ROMs.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

Text Books:

1. Millman & Halkias, "Electronic Devices & Circuits", Tata Mcgraw Hill
2. R.L. Boylestos& L. Nashesky, "Electronic Devices & Circuits", Pearson Education
3. S. Salivahenan, N. Suresh Kr. & A. Vollavaraj, "Electronic Devices & Circuit", Tata McGraw
Hill.

Reference Books:

1. R.P. Jain, "Modern Digital Electronics", Tata Mcgraw Hill
2. Malvino& Leach, "Digital Principle And Applications", Tata Mcgraw Hil

Coursecode	26BSC-MA-211-H				
Category	ProfessionalCoreCourses				
Course title	Materials Science				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**0**	**0**	**3**	
Objectives:	.The objective of the paper is to introduce the student about knowledge of structure of materials and effect of deformation. This paper also provides understanding of heat treatment on materials and applications of different types of alloys and composite materials.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
DurationofExam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	3	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	1	-	-	-	2	3	3	3
WT. AVG	**3.00**	**2.67**	**2.67**	**2.33**	**2.33**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.67**	**3.00**

Overall Mapping of Subject: 2.47

UNIT - I

Structure of metal: Crystal structure, miller indices, lattices, imperfections, elementary treatment of point and line defects and their relation to mechanical properties.

Deformation: Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.

UNIT - II

Creep: Basic consideration in the selection of material for high and low temperature service, creep curve,effect of material variables on creep properties, brittle failure at low temperature.

Solidification: Phases in metal system, lever rule, solidification of metal and alloys, solid solution, eutectic, eutectoid and inter-metallic compounds, Iron carbon equilibrium diagram, TTTdiagram.

UNIT - III

Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing,hardening, tempering, isothermal treatment, case hardening – carburizing, nitriding etc, precipitatinghardening of aluminum alloys.

Materials: Plain: Carbon steels, effect of alloying elements, properties, uses, springs, and wear resistingsteels, IS standards codes for steels.

UNIT - IV

Corrosion:Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.

Fiber Reinforced Composites: General characteristics, Applications, Introduction to Fibers – glass,

carbon, Kevlar 49 fibers. Matrix – Polymeric, Metallic, Ceramic Matrix, Coupling agents and fillers.

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects insuch structures
2. Understand how to tailor material properties of ferrous and non-ferrous alloys
3. How to quantify mechanical integrity and failure in materials

Text Books:

1. V. Raghavan, "Material Science & Engineering", Prentice Hall India Ltd., 2001.
2. S.K. Hazra Chaudhuri, "Material Science & Processes", Indian Book Publishers, Calcutta, 1983.
3. R.B. Gupta, "Material Science Processes", Satya Prakashan, New Delhi, 2000.

Reference Books:

1. Degarmo E. Paul et.al, "Materials & Processes in Manufacture", Prentice Hall India, New Delhi, 2001.
2. Raymond A Higgim., "Engineering Metallurgy Part 1", Prentice Hall India, New Delhi, 1998.
3. L. Krishna Reddi, "Principles of Engineering Metallurgy", New Age Publication, New Delhi, 2001.
4. Buduisky et al, "Engineering Materials & Properties", Prentice Hall India, New Delhi, 2004.

CourseCode	26LC-MA-231-H				
Category	ProfessionalCoreCourses				
Coursetitle	Mechanics of Solid Lab				
Schemeand Credits	L	T	P	Credit	
	0	**0**	**2**	**1**	
Classwork	**5 Marks**				
Exam	**20Marks**				
Total	**25 Marks**				
DurationofExam	**3 Hours**				

Listofexperiments: -

1. TostudytheBrinellhardnesstestingmachine&performtheBrinellhardnesstest.
2. TostudytheRockwellhardnesstestingmachine&performtheRockwellhardnesstest.
3. TostudytheErichsensheetmetaltestingmachine&performtheErichsensheetmetaltest.
4. TostudytheImpacttestingmachineandperformtheImpacttests(Izod&Charpy).
5. TostudytheUniversaltestingmachineandperformthetensile test.
6. Toperformcompression&bendingtestsonUTM.
7. ToperformthesheertestonUTM.
8. TodrawshearForce,BendingMomentDiagramsforasimplySupportedBeamunderPointand Distributed Loads.
9. TodetermineMechanicalAdvantageandEfficiencyofSingleandDoublePurchaseWinch Crab.
10. TodetermineMechanicalAdvantageandEfficiencyofWormandWormGear .

Course Outcomes: The students who have undergone the course will be able to understand working ofUTM ,Rockwell , Brinell hardness tester, Mechanical advantage of gears .

Note:1.AtleastsevenexperimentsaretobeperformedintheSemester.

2.At least 6 experiments should be performed from the above list. The remaining experiments may either be performedfrom the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	-	-	2	-	-	3	2	3
CO2	3	3	2	2	3	2	-	-	2	-	-	3	3	3
CO3	3	2	3	2	3	2	-	-	2	-	-	3	3	3
CO4	3	2	2	3	2	2	-	-	2	-	-	3	2	3
WT.AVG	**3.00**	**2.25**	**2.25**	**2.25**	**2.50**	**1.75**	**-**	**-**	**2.00**	**-**	**-**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.38

CourseCode	26LC-MA-233-H				
Category	ProfessionalCoreCourses				
Coursetitle	Mechanics of Fluid Lab				
Schemeand Credits	L	T	P	Credit	
	0	**0**	**2**	**1**	
Classwork	**5 Marks**				
Exam	**20Marks**				
Total	**25 Marks**				
DurationofExam	**3 Hours**				

List of Experiments

1. Determination of the metacentric height of a given body
2. Determine of Cd, Cv and Cc for the given orifice
3. Calibration of the contracted rectangular notch and triangular notch and determination of flow rate
4. Determination of the velocity of water by the pitot tube
5. Objective- Verification of Bernoulli's theorem
6. Calibration and flow rate determination using venturi meter, orifice meter and nozzle meter
7. Determination of head loss in given length of pipe.
8. Estimation of friction in pipes.
9. Perform Reynold experiment.

Course Outcomes

1. Students will be able to distinguish and calibrate different flow measuring devices
2. Students will be able to characterise the flow and visualise the flow around the objects using techniques.

Note:

1.AtleastsevenexperimentsaretobeperformedintheSemester.

2. At least 6 experiments should be performed from the above list. The remaining experiments may either be performedfrom the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	-	-	-	2	3	3	3
CO2	3	2	3	2	2	2	2	-	-	-	2	3	2	3
WT.AVG	**3.00**	**2.50**	**2.50**	**2.00**	**2.50**	**2.00**	**2.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Oerall Mapping of Subject: 2.42

CourseCode	26LC-MA-235-H				
Category	ProfessionalCoreCourses				
Coursetitle	Basics of Electronics Engineering Lab				
Schemeand Credits	L	T	P	Credit	
	0	**0**	**2**	**1**	
Classwork	**5 Marks**				
Exam	**20Marks**				
Total	**25 Marks**				
Duration of Exam	**3 Hours**				

List of Experiments

1. To get familiar with the working knowledge of the following instruments:
a) Cathode ray oscilloscope (CRO)
b) Multimeter (Analog and Digital)
c) Function generator
d) Power supply
2. a) To measure phase difference between two waveforms using CRO
b) To measure an unknown frequency from Lissajous figures using CRO
3. a) Plot the forward and reverse V-I characteristics of P-N junction diode
b) Calculation of cut-involtage c) Study of Zener diode in breakdown region
4. To plot and study the input and output characteristics of BJT in common-emitter configuration
5. To find frequency response of a given amplifier and calculate its bandwidth
6. To get familiar with pin-configuration of typical op-amp(741) and its use as:
a) Inverting amplifier
b) Non-inverting amplifiler
c) Summing amplifier
d) Difference amplifier
7. Use of op-amp as
a) Integrator
b) Differentiator
8. To assemble Wein Bridge oscillator circuit and calculation of oscillation-frequency and its verification
from the observed output .
9. Verification of truth tables of logic gates (OR,AND, NOT, NAND, NOR).
10. Verification of truth tables of flip-flops (S-R, J-K).

Course Outcomes: The students who have undergone the course will be able to understand working ofCRO , BJT, Amplifier and accessories and understand the basic electronics devices and circuits.

Note:

1. At least ten experiments are to be performed in the Semester.
2 .At least eight experiments should be performed from the above list . Remaining twoexperiments may either be performed from the above list or as designed & set by the concernedinstitute as per the scope of the syllabus.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	3	2	1	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	1	-	-	-	2	3	3	3
CO4	3	2	3	2	3	3	1	-	-	-	2	3	2	3
WT.AVG	**3.00**	**2.25**	**2.50**	**2.25**	**3.00**	**2.25**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.48

Course code: 26-AU-ENV-202-H
Course Title: Environmental Science
Semester: 3rd
Branch: Compulsory for all branches of Engineering

Environmental Science							
Lecture	Tutorial	Practical/Field visit	Total contact hours per week	Credit	Theory	Practical/ Field visit	Total
02	0	01	03	0	70	30	100

ENVIRONMENTAL SCIENCE			
Course Code	26-AU-ENV-202-H	**External marks:**	**70**
Credits	**0**	**Internal marks:**	**30**
L-T-P	**2-0-1**	**Total marks:**	**100**
		Duration of Examination:	**3 hrs**

COURSE OBJECTIVES:

- People working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished product. It will guide the students living in a historic transitional period of burgeoning awareness of the conflict between human activities and environmental constraints to help and save the fragile and endangered planet with the natural resources already overexploited

COURSE OUTCOMES (CO):

By the end of the Course, Students will be able to:

CO1:	Solve various engineering problems applying environmentally sustainable approach to produce eco-friendly products.
CO2:	Use relevant pollution control methods to solve domestic and industrial problems.
CO3:	To recognize eco-friendly and sustainable energy resources for combating global problems like climate change, acid rain and resource depletion etc.
CO4:	To solve local solid hazardous and e-waste problems.

CO - PO mapping

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	2	1	2	3	3	2	2	2	2	2	2
CO2	2	3	3	2	2	2	3	3	2	2	2	2	3	2
CO3	2	2	2	3	2	3	3	3	3	2	2	2	2	2
CO4	2	2	2	2	2	3	3	3	3	3	2	2	2	3
WT.AVG	**2.00**	**2.50**	**2.25**	**2.25**	**1.75**	**2.50**	**3.00**	**3.00**	**2.50**	**2.25**	**2.00**	**2.00**	**2.25**	**2.25**

Overall Mapping of Subject: 2.36

AU-ENV-202-H: (ENVIRONMENTAL SCIENCE)

Theory 70 Marks Field Work 30 Marks (Practical/Field visit)

Unit-1 The Multidisciplinary nature of environmental studies. Definition, scope and importance. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Interaction between earth, man, and environment. (2 lectures)

Unit-2 Natural Resources:

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation; deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.
b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Water logging, salinity, case studies.
e) Energy resources: Growing energy needs; renewable and non- renewable energy source, use of alternate sources, case studies.
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
   * Role of an individual in conservation of natural resources.
   * Equitable use of resources for sustainable lifestyles. (5 lectures)

Unit-3 Ecosystem and biodiversity conservation

* Structure of ecosystem, Biotic and Abiotic components
* Energy flow in the ecosystem.
* Ecological succession.
* Food chains, food webs and ecological pyramids.
* Aquatic and terrestrial ecosystems
* Different level of biodiversity: Genetic, Species and ecosystem diversity.
* Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
* Biodiversity at global, National and local levels.
* India as a mega-diversity nation.
* Hot-spots of biodiversity.
* Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
* Endangered and endemic species of India.
* Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. (5 lectures)

Unit-4 Environmental Assessment and Management:

Aim**s** and objectives of environmental impact assessment (EIA), Environmental Impact Statement (EIS) and environment management plan (EMP). Structure and role of central and state pollution control board, ISO14000: implementation in industries benefit.

* Environment Protection Act.
* Air (Prevention and Control of pollution) Act.

* Water (Prevention and Control of pollution) Act.
* Wildlife Protection Act.
* Forest Conservation Act.
* Issues involved in enforcement of environmental legislation.
* Public awareness. (3 lectures)

Unit-5 Environmental pollution: Definition, causes, effects and control measures of :

a) Air pollution.
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal pollution
g) Nuclear hazards

* Bag filters, cyclone separator, electrostatic precipitator, catalytic converter.
* Role of an individual in prevention of pollution.
* Pollution case studies.
* Disaster management: floods, earthquakes, cyclones, and landslides. (5 lectures)

Unit-6 Contemporary environmental issues:

* From unsustainable to sustainable development.
* Urban problems related to energy, National solar mission.
* Water conservation, rain water harvesting, watershed management, Namami Gange and Yamuna action plan.
* Resettlement and rehabilitation of people: its problems and concerns case studies.
* Environmental ethics: Issues and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, sea level rise, nuclear accidents and holocaust. Case studies.
* Wasteland reclamation.
* Carbon sequestration and carbon credits, carbon foot print
* Waste management- Swachha Bharat Abhiyan
* Consumerism and waste products. (5 lectures)

Unit-7 Human population and the Environment. Population growth, variation among nations. Population explosion- Family Welfare Programme. Environment and human health. Epidemiological issues: Fluorosis, Arsenocosis, Goitre, Dengue. Human Rights, Value Education, HIV/AIDS. Woman and Child Welfare. Role of Information Technology in Environment and human health. Case Studies. (5 lectures)

Unit-8 Field Work:

* Visit to a local area to document environmental assets - river/forest/grassland/hill/mountain.
* Visit to a local polluted site-urban/Rural/ Industrial/ Agricultural.
* Study of common plants, insects, birds.
* Study of simple ecosystems- pond, river, hill slopes, etc.
* Study of different soil types/ samples. (Field work equal to 15 lecture hours).

Course code	**26PCC-MA-221-H**				
Category	Professional Core Courses				
Course title	**Engineering Mechanics**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. To understand the basic force system. 2. To learn about Applying principles of particle kinematics. 3. To understand the concepts of particle dynamics. 4. To Learn energy methods & momentum methods.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	3	2	1	-	-	-	2	3	3	3
CO3	3	3	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	3	2	3	3	1	-	-	-	2	3	2	3
WT.AVG	**3.00**	**2.50**	**2.50**	**1.75**	**2.75**	**2.25**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.48

UNIT-I

Engineering Mechanics:Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application

Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.

UNIT-II

Principles of Lifting Machines: Introduction : Simple Machine , Compound Machine ,Lifting , Mechanical Advantage, Input of a Machine , Output of a Machine , Efficiency of a Machine, Ideal Machine, Velocity Ratio, Relation Between Efficiency, Mechanical Advantage and Velocity Ratio of a Lifting Machine, Reversibility of a Machine, . Condition for the Reversibility of a Machine, Self-locking Machine, Friction in a Machine, Law of a Machine, Maximum Mechanical Advantage of a Lifting Machine, Maximum Efficiency of a Lifting Machine.

Simple Lifting Machines: Introduction :Types of Lifting Machines, Simple Wheel and Axle, Differential Wheel and Axle, Weston's Differential Pulley Block, Geared Pulley Block, Worm and Worm Wheel, Worm Geared Pulley Block, Single Purchase Crab Winch, Double Purchase Crab Winch, Simple Pulley, First System of Pulleys, Second System of Pulleys, Third System of Pulleys, Simple Screw Jack, Differential Screw Jack , Worm Geared Screw Jack.

UNIT-III

Centroid , Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems.

Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects.

UNIT-IV

Truss and Frame: Truss, classification of truss, assumptions in truss analysis, perfect truss.

Applications of Friction: Introduction: Ladder Friction, Wedge Friction, . Screw Friction, Relation Between Effort and Weight Lifted by a Screw Jack, Relation Between Effort and Weight Lowered by a Screw Jack, Efficiency of a Screw Jack.

Particle Dynamics: Energy methods and momentum methods, Newton's second law of motion; dynamic equilibrium and D'Alembert's principle.

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

1. Understand the basic force system.
2. Apply principles of particle kinematics.
3. Grasp the concepts of particle dynamics.
4. Learn energy methods & momentum methods.

Recommended Books:-

Engineering Mechanics – Irving H. Shames, PHI Publication
Engineering Mechanics – U.C.Jindal, Galgotia Publication
Engineering Mechanics – A.K.Tayal, Umesh Publication

Course code	**26LC-MA-223-H**				
Category	Engineering Science courses				
Course title	**Engineering Mechanics Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester III
	0	0	2	1	
Objectives:	To understand various basic issues of Mechanical Engineering like IC engines, machines and mechanics of machines.				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of single start and Double start and Triple start worm & Worm Wheel.
2. To find the Mechanical Advantage, velocity Ratio and Efficiency of a Differential Wheel and Axle.
3. To find Moment of Inertia of a Fly Wheel.
4. To study reciprocal theorem of deflection using a simply supported beam.
5. To study moment area theorem for slopes and deflections of the beam.
6. Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.
7. Experimental and analytical study of behavior of struts with various end conditions.
8. To study theory of friction.
9. Experiment on a two-hinged arch for horizontal thrust & influence line for Horizontal thrust.
10. Experimental and analytical study of a 3 bar pin jointed Truss.
11. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.

Course Outcomes: The students who have undergone the course will be able to understand working of IC engines, types of boilers and accessories and understand the basic mechanics.

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

1. Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	-	-	-	-	2	3	2	3
CO2	3	3	2	3	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	3	2	1	-	-	-	2	3	2	3
WT.AVG	**3.00**	**2.25**	**2.25**	**2.50**	**2.50**	**1.75**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.41

Semester-4

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Scheme (Marks)				Duration of Exam (Hours)
			L	T	P			Internal awards	Theory	Practical	Total	
1	26PCC-MA-202-H	Kinematics of Machines	3	0	0	3	**3**	25	50		75	3
2	26PCC-MA-204-H	Heat Transfer	3	1	0	4	**4**	30	70		100	3
3	26PCC-MA-206-H	Manufacturing Machines	3	0	0	3	**3**	25	50		75	3
4	26PCC-MA-208-H	Electrical Machines	3	1	0	4	**4**	30	70		100	3
5	26PCC-MA-210-H	Operation Research	3	1	0	4	**4**	30	70		100	3
6	26BSC-MA-212-H	Numerical Analysis & Programming	3	0	0	3	**3**	25	50		75	3
7	26LC-MA-232-H	Kinematics of Machines Lab	0	0	2	2	**1**	5		20	25	3
8	26LC-MA-234-H	Heat Transfer Lab	0	0	2	2	**1**	5		20	25	3
9	26LC-MA-236-H	Electrical Machines Lab	0	0	2	2	**1**	5		20	25	3
					Total	27	24				600	
For Honors course												
1	26PCC-ME-224-H	Product Design and Development	3	0		3	**3**	25	50		75	3
2	26LC-ME-226-H	Product Design and Development Lab	0	2		2	**1**	5		20	25	3
					Total	**5**	4				100	

At the end of the 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 a typed report along with a certificate from the organization& its evaluation shall be carried out in the 5th Semester.

Coursecode	26PCC-MA-202-H				
Category	ProfessionalCoreCourses				
Course title	Kinematics of Machines				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**0**	**0**	**3**	
Objectives:	The objective of the subject is to expose the students to learn the fundamentals of various laws governing rigid bodies and its motions.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75 Marks**				
DurationofExam	**03 Hours**				

Note: The examiner will set a total of nine questions. Question No. 1 will be compulsory and will consist of six parts of 2.5 marks each, covering all units. The remaining eight questions, each carrying 15 marks, will be set by taking two questions from each unit. Students are required to attempt a total of five questions, including the compulsory Question No. 1 and one question from each unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	3	2	2	3	2	1	-	-	-	2	3	2	3
CO5	3	3	3	2	3	2	1	-	-	-	2	3	3	3
WT.AVG	**3.00**	**2.60**	**2.40**	**1.80**	**2.60**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.60**	**3.00**

Overall Mapping of Subject: 2.42

UNIT-I

Introduction Definition of mechanisms and machines, kinematic links, kinematic pairs, kinematic chains, degree of freedom, Grubler's criterion, kinematic inversion, equivalent linkages, four-bar planar mechanisms, straight-line mechanisms, steering mechanisms, pantograph, and related numerical problems.

Kinematic Analysis of Plane Mechanisms Displacement analysis of plane mechanisms, velocity

diagrams, velocity determination using relative velocity method, instantaneous center of velocity, Kennedy's theorem, graphical and analytical methods for velocity and acceleration analysis, and related numerical problems.

Unit-II

Cams: Classification of cams and followers, disc cam nomenclature, construction ofdisplacement, velocityandaccelerationdiagrams 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, efficiencyoninclinedplane,frictioninjournalbearing,frictioncircleandfrictionaxis,pivotsand 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.

CourseOutcomes:Studentswouldbeable:

1. Tounderstandtheapplicationsofmechanismsandmachines.
2. Tounderstandaboutthebasicsof Camsand Friction
3. Studentsget familiarity with the power transmitted with Belts and pulleys and also Gearsand Gear Trains.
4. StudentshavingfamiliaritywithcalculatingKinematicsAnalysisofPlaneMechanisms
5. StudentswouldbeabletoknowtheKinematicssynthesisofMechanisms.

TEXTBOOKS:

1. TheoryofMechanismsandMachines:AmitabhaGhoshandAshokkumarMalik,Third Edition Affiliated East-West Press.
2. TheoryofMachinesandMechanisms:JosephEdwardShigleyandJohnJosephUicker,Jr. Second Edition, MGH, New York.

References:

1. MechanismandMachineTheory:J.S.RaoandR.V.DukkipatiSecondEditionNewageInternational.
2. TheoryandMachines:S.S.Rattan,TataMcGrawHill.
3. TheoryofMachines,Beven,PearsonIndianEducationServicePvt.Ltd.India.

Coursecode	26PCC-MA-204-H				
Category	ProfessionalCoreCourses				
Course title	Heat Transfer				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	Theobjectiveofthispaperistointroducethe studentsabouttheknowledgeofconduction, thermal radiation.				
Class Work	**30Marks**				
Exam	**70Marks**				
Total	**100Marks**				
DurationofExam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
CO5	3	3	3	2	3	3	2	-	-	-	2	3	3	3
WT.AVG	**3.00**	**2.40**	**2.40**	**1.80**	**2.40**	**2.40**	**1.20**	**-**	**-**	**-**	**2.00**	**3.00**	**2.60**	**3.00**

Overall Mapping of Subject: 2.41

UNIT-I

Conduction: One-dimensional steady-state conduction, Simple convection, Overall heat transfer coefficient,SimplecasesofHeatTransferthrough homogeneousandcompositeplanewalls,cylindersand spheres with constant and variable thermal conductivity, Critical thickness of insulation, Heat transfer from Fins of uniform cross-section.

UNIT–II

Convection: Concept of Hydrodynamic and Thermal boundary layers, Application of Dimensional analysis to Free and Forced convection, Important Dimensions- less numbers.

Heat transfer during Change of Phase: Film condensation and Drop-wise condensation. Flow regimes, Heat transfer coefficient for Film Condensation. Boiling: Classification. Boiling regimes. Heat transfer correlations in boiling.

UNIT–III

Heat exchangers: Types of Heat exchangers. LMTD and NTU methods for exchangers Design. Simple calculations.

Radiation: Kirchhoff's law. Planck's distribution law. Wein's displacement law. Stefan-Boltzmann's relation.Configurationfactor.Radiant heatinterchangebetweenblackandgreysurfaces.Solar Radiation, Radiation shielding.

UNIT–IV

Gas Turbines: Gas Power Cycles–Thermal refinements. Performance of Gas turbines, combined cycle. Principles of Jet Propulsion. Turbojet and turboprop engines, Rocket engines.

Steam Turbines: Classification. Impulse and Reaction Turbines. Compounding of steam turbines. Velocity diagrams. Conditions for maximum efficiency. Governing of steam turbines. Losses in steam turbines. Reheat Factor.

CourseOutcome(COs):Attheendofthecourse,thestudentshallbeableto:

1. Understandthebasicconceptofconduction,convectionandradiationheat transfer.
2. Formulationofonedimensionconductionproblems.
3. Applicationofempiricalcorrelationsforbothforcedandfreeconvectionfordeterminesthevalue of convection heat transfer coefficient.
4. Expeditebasicconceptoftheradiationheattransferforblackandgreybody.
5. LearningofthermalanalysisandsizingofHeatexchangers.

TextBooks:

1. R.Yadav,"SteamTurbines",AsiaPublications.
2. D.S.Kumar;"Heat&MassTransfers",S.K.Kataria&Sons.
3. M.L.Mathur,F.S.Mehta,"ThermalEngineering",JainPublication
4. R.K.Rajput,"ThermalEngineering",LaxmiPublication

ReferenceBooks:

1. J.P.Holman;"HeatTransfers"McGrawHill,USA
2. Mills;"HeatTransfers",C.B.SPublications.
3. Kearton;"SteamTurbine",C.B.SPublications
4. AroraDomkundwaR,"ACourseinheat&MassTransfer",DhanpatRai&Co.
5. OnkarSingh,"Appliedthermodynamics",NewAgePublications
6. Dhomkundwar,"AcourseinThermalEngg.",DhanpatRai Publications
7. P.L.Ballaney,"ThermalEngg."DhanpatRaiPublications
8. CohenRojers,"GasTurbineTheory",Pearson'sEducation.

Coursecode	26PCC-MA-206H				
Category	ProfessionalCoreCourses				
Course title	Manufacturing Machines				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**0**	**0**	**3**	
Objectives:	The objective of the paper is to facilitate the student with manufacturing processes using machinetoolsinusetodayandit'sapplication indifferenttypeof Industries.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
DurationofExam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	–	–	–	2	3	2	3
CO2	3	3	3	2	3	2	1	–	–	–	2	3	3	3
CO3	3	2	2	2	2	2	1	–	–	–	2	3	2	3
WT.AVG	**3.00**	**2.33**	**2.33**	**1.67**	**2.33**	**2.00**	**1.00**	**–**	**–**	**–**	**2.00**	**3.00**	**2.33**	**3.00**

Overall Mapping of Subject: 2.27

UNIT-I

Introduction:Classificationofmachinetoolsbasedonapplicationandproductionrate:Generalpurpose, Single purpose and Special purpose machines, Classification based on-types of machine tools and the processes, Generating and forming.

Elementsofmetalcuttingprocesses:Elementsoftoolgeometry,cuttingtoolmaterialsandapplicatios.

Lathe: Various types of lathe: Centre lathe, facing lathe, gap-bed lathe, capstan and turret lathe, CNC lathe, major difference between CNClatheandconventional lathe.Major sub-assemblies of

alathe: Bed, headstock,tailstock,carriageconsistingofsaddle,cross-slide,compoundslide,toolpostand apron.Work holding devices: self centering three jaw chuck, independent four jaw chuck, collets, face plates, dog carriers, centers and mandrels.

UNIT-II

Lathe contd... Driving mechanisms, apron mechanism, thread cutting mechanism and calculations, features of half-nut engagement – disengagement, indexing dial mechanism.Operations on lathe: taper turning, related calculations, thread cutting, facing, under-cutting, drilling, boring, parting-off, knurling, chamfering.

ReciprocatingTypeMachineTools: Shaper,PlanerandSlotter:Constructionalfeatures,basic machines and kinematics and related calculations .

UNIT III:

Drilling Machines: Constructional features of bench drilling machine, radial drilling machine, multi-spindle drilling machine, feed mechanism, work holding devices, Tool – holding devices. Different drilling operations: Drilling, reaming, counter boring and countersinking etc., estimation of drilling time.

Milling Machines: Types of general-purpose milling machines: horizontal, vertical and universal. Types of milling cutters and their applications, different milling operations, work-holding devices: vice, clamps, chucks, dividing head and its use, simple, compound and differential indexing. Indexing calculations and machiningtimecalculations.

UNITIV:

Grinding Machines: Different types of grinding machines: cylindrical, surface and centre-less grinding machines,basicconstructionalfeaturesandmechanisms,specifications, differentgrinding operations,honing, lapping and super-finishing processes.

Gear Manufacturing Machines:Gearforming,geargeneration,gearshapingandgear hobbing Course Outcomes : Students would be able :

1. Tounderstandabouttheworking&applicationsoflateanddrillingmachine.
2. Tounderstandaboutthemillingoperations.
3. StudentsgetfamiliarwithShaper,Planerand Slotter

TextBooks:

1. P.N.Rao,"ManufacturingTechnology:MetalCutting&MachineTools",TataMcGrawHill, Delhi, 2004.
2. B.S.Raghuwanshi,"WorkshopTechnology",Vol.2,DhanpatRai&Sons,2003.
3. HazraChandhariS.K.,"ElementsofWorkshopTechnology",Vol.2,MediaPromoters,2003.

ReferenceBooks:

1. P.C.Sharma,"ATextBookofProduction.Engineering",S.Chand,NewDelhi,2004.
2. BawaH.S.,"WorkshopTechnology",Vol.2,TataMcGrawHill,2004.
3. Juneja&Shekhon,"FundamentalofMetalCutting",NewAgePublications

4. S.F.KrarStevanF.andCheckA.F.,“TechnologyofM/CTools”,McGrawHillBookCo., 1986.
5. KibbeRichardetal,“M/cToolpractices”,PrenticeHallIndia,2003.
6. BangaloreHMT,“ProductionTechnology”,TataMcGrawHill,1980.
7. R.K.Jain,“ProductionTechnology”,KhannaPublishers.

Coursecode	26PCC-MA-208-H				
Category	ProfessionalCoreCourses				
Course title	Electrical Machines				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	Providingsoundknowledgeabouttheprinciples ofoperationofvariouselectricalmachines,their constructional features, and their behavior and characteristicsundervariousconditionofoperation.				
Class Work	**30Marks**				
Exam	**70Marks**				
Total	**100Marks**				
DurationofExam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, with the first being compulsory, and select one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	3	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
WT.AVG	**3.00**	**2.33**	**2.67**	**2.00**	**2.33**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.67**	**3.00**

Overall Mapping of Subject: 2.39

UNIT–I

D.C. Machines:D.C. Machines, constructional features, Principles of operation, DC generator analysis, DC motor analysis, Motor-speed-torque characteristic, speed control, applications of

DC motors, starters and controllers of DC motors.

UNIT–II

A.C. Machines: Three-phase induction motors, revolving magnetic field theory, induction motor as a transformer,equivalentcircuit,computationofperformance,starting,autostart,speedcontrol.

UNIT–III

Three-Phase Synchronous Machine: Synchronous generator/motor phasor diagrams, equivalent circuits, computation of synchronous machine performance, synchronous condenser.

UNIT–IV

Single-phase induction motors, double revolving field theory, different types of single – phase induction motors, characteristics andtypical applications.Fractional KW motors, stepper motors, hysteresis motor, Servo motors AC series motor and Universal motors.

CourseOutcomes:Studentswouldbeable

1. Tounderstandabouttheworking&applicationsofDC&ACmachine.
2. Tounderstandaboutthethreephasesynchronous machine.
3. Studentsgetfamiliarwithinductionmotors.

TextBooks:

1. HughesEdward,“ElectricalTechnology”,AddisonWesleyLongmaLtd.
2. NagrathIJandKothari,“DP.ElectricalM/C”,TataMcGrawHill.

ReferenceBooks:

1. KosowL.L.,“ElectricalMachines&Transforms”,PrenticeHallIndia.
2. FitzeraldKingsley,“Kusko,Dumas”,ElectricalMachines,TataMcGrawHill.
3. M.G.Say,“ACMachines”,Pitman&Sons.
4. P.S.Bimbhna,“ElectricalMachinery”,KhannaPublication.

Coursecode	26PCC-MA-210-H				
Category	ProfessionalCoreCourses				
Course title	Operation Research				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to acquaint the student with mathematical techniques being adoptedinindustrywhichhelpmanagersin decisiontaking.				
Class Work	**30Marks**				
Exam	**70Marks**				
Total	**100Marks**				
DurationofExam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	3	2	3	2	1	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	1	-	-	-	2	3	3	3
CO4	3	3	2	3	2	3	1	-	-	-	2	3	2	3
CO5	3	3	3	2	2	2	2	-	-	-	2	3	3	3
WT.AVG	**3.00**	**2.80**	**2.60**	**2.40**	**2.40**	**2.20**	**1.20**	**-**	**-**	**-**	**2.00**	**3.00**	**2.60**	**3.00**

Overall Mapping of Subject: 2.48

UNIT-I

Linear Programming: Formulation of LP Problem. GraPrentice Hall Indiacal and Simplex method for maximization and minimization LP Problems.Dualityin Simplex Problems, Sensitivity Analysis.

UNIT-II

Transportation Models: Stepping stone method & MODI method for optimality check, North West CornerMethod, Least-cost Method and Vogel's Approximation Method (VAM)for solving balancedand unbalanced transportation problems. Problems of degeneracy and maximisation.
Assignment Models: Assignment model for maximisation&minimisation problems. TravellingSalesman Problems,Industrial Problems.

UNIT-III

Queuing Theory: Basic structure, Terminology, Classification, Birth and Death Process. QueuingModels upto 2 service stations.
Sequencing Theory: Processing of n-jobs through m-machines with each job having same processing order.Processing of two jobs through m-machines with each job having different processing order.

UNIT-IV

Network Models: Introduction to PERT and CPM. Fundamental concept of Network models and constructionofnetworkdiagrams.Activitytimeestimates.Criticalpathandprojecttime duration.Probability of completing the project on or before specified time.Concept of Float and slack.

Games Theory: Two-person zero-sum games.Minimax and Maximin principle.Arithmetic, Algebraic, Matrix Algebra method. Solution by Dominance, Subgame, GraPrentice Hall Indiacal and Linear programming method.

CourseOutcomes(COs):Attheendofthecourse,thestudentshallbeableto:

1. Discuss the role of operations research in decision-making, and its applications in industry andshould be able to formulate and design real-world problems through models & experiments.
2. Knowledgeofvarioustypesofdeterministicmodelslikelinearprogramming,transportation model etc.
3. Explorevarioustypes ofstochasticmodelslikewaitinglinemodel, projectlinemodel,simulation etc.
4. Deducetherelationshipbetweenalinearprogramanditsdualandperformsensitivityanalysis.
5. Describe different decision making environments and apply decision making process in the real world situations

TextBooks:

1. N.D.Vohra,"OperationsResearch",TataMcGrawHill,2004.
2. J.K.Sharma,"OperationResearch",MacmillanIndiaLtd.2005.
3. H.A.Taha,"OperationsResearch",Prentice-HallIndia,6thEdition,2004.

ReferenceBooks:

1. RichardBronson,GovindasamiNaadimuthu,“OperationsResearch”,TataMcGrawHill,2004
2. A.P.Verma,“QuantitativeTechniques”,AsianBooksPvt.Ltd., 2004
3. A.P.Verma,“OperationsResearch”,S.K.Kataria&Sons,2004.

Coursecode	26PCC-MA-212-H				
Category	ProfessionalCoreCourses				
Course title	Numerical Analysis & Programming				
SchemeandCredits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**0**	**0**	**3**	
Objectives:	To develop numerical ability and to impart knowledge in Statistical methods andProbability theory and their applications in Engineeringtoenablethemtoapplythatfor solvingrealworld problems.				
Class Work	**25 Marks**				
Exam	**50Marks**				
Total	**75Marks**				
DurationofExam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	-	-	-	2	3	2	3
CO2	3	3	2	2	3	1	1	-	-	-	2	3	3	3
CO3	3	2	3	2	2	2	1	-	-	-	2	3	3	3
CO4	3	2	2	3	3	2	1	-	-	-	2	3	2	3
WT.AVG	**3.00**	**2.25**	**2.25**	**2.25**	**2.50**	**1.50**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.33

UNIT-I

Numerical Techniques: The solution of linear and non-linear equations: Direct Iteration method,Regula-Falsi method, Newton – Raphson method. Solution of system of simultaneous equations byGauss elimination, Gauss-Jacobi and Gauss-Seidal methods.

Finitedifferences:Forward,backwardandCentraldifferences.

UNITII:

Interpolation and Numerical Calculus: Newton's interpolation for equi-spaced values. Divided differences and interpolation formula in terms of divided differences. Stirling's central difference interpolation formula, Lagrange's interpolation formula for unequi-spaced values. Numerical Differentiation.Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule.

UNIT III:

Numerical solution of ordinary differential equations: Picard's method, Euler's method, modified Euler'smethod,Runge-Kuttamethodoffourthorder,Milne'spredictor-corrector method.

UNITIV:

Computer Programming:Writing programmes in C++ for solving numerical problems.For example, Programme for solving algebraic and transcendental equations by Newton-Rapson Method, solving simultaneousequationsbyGauss-Seidalmethod.ProgrammeforInterpolationbyLagrange's method. Programme for estimating the value an integral by Simpson's rule. Programme for solving differential equation by Runge-Kutta method, etc.

CourseOutcomes:Studentswouldbeable:

1. Tounderstandabouttheapplicationofdifferentnumericaltechanics
2. TounderstandaboutthebasicsofC++forsolvingnumericalproblems
3. Studentsgetfamiliarwithdifferentialequation.
4. ToUnderstandaboutthecomputer programming.

TextBooks:

1. V.P.Mishra;"TextBookofEngineeringMathematics",GalgotiaPublications,Delhi.
2. B.S.Grewal,"HigherEngineeringMathematics",KhannaPublications,Delhi.
3. V.P.JaggiandA.B.Mathur,"AdvancedEngineerMathematics",KhannaPublications,Delhi.

ReferenceBooks:

1. S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice Hall of India Pvt. Ltd., New Delhi.
2. M.K.Jain,S.R.KIyengar,R.K.Jain,"NumericalMethodsforScientificandEngineering Computation", New Age International Publishers, New Delhi.

CourseCode	26LC-MA-232-H				
Category	ProfessionalCoreCourses				
Coursetitle	KinematicsofMachinelab				
Schemeand Credits	L	T	P	Credit	
	0	**0**	**2**	**1**	
Classwork	**5 Marks**				
Exam	**20Marks**				
Total	**25 Marks**				
DurationofExam	**3 Hours**				

LISTOF EXPERIMENTS: -

1. TostudyvarioustypesofKinematiclinks,pairs,chainsandMechanisms.
2. Tostudyinversionsof4BarMechanisms,Singleanddoubleslidercrankmechanisms.
3. Toplotsliderdisplacement,velocityandaccelerationagainstcrankrotationforsingleslidercrank mechanism.
4. Tofindcoefficientoffrictionbetweenbeltandpulley.
5. Tostudyvarioustypeofcamandfollowerarrangements.
6. Toplotfollowerdisplacementvscamrotationforvarious CamFollower systems.
7. Togeneratespurgearinvolutetoothprofileusingsimulatedgearshapingprocess.
8. Tostudyvarioustypesofgears –Helical,crosshelicalworm,bevel gear.
9. Tostudyvarioustypesofgeartrains –simple,compound,reverted,epicyclicand differential.
10. TostudytheworkingofScrewJackanddetermineitsefficiency.
11. Createvarioustypesoflinkagemechanism inCADandsimulateformotionoutputsandstudythe relevant effects.
12. Creationofvariousjointslikerevolute,planes,spherical,camfollowerandstudythedegreeof freedom and motion patterns available.
13. Todesignacamprofilebyusingtherequirementgraphusingon-lineengineeringhandbookand verify the same using a 3D mechanism on CAD.

Course Outcomes: The students who have undergone the course will be able to understand working ofMATLAB, properties ofMatrix & basic numerical methods for problem solving.

Note:1.AtleasttenexperimentsaretobeperformedintheSemester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performedfrom the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	-	-	-	-	2	3	2	3
CO2	3	3	3	2	3	2	1	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	1	-	-	-	2	3	3	3
CO4	3	2	3	2	3	2	1	-	-	-	2	3	2	3
WT.AVG	**3.00**	**2.25**	**2.75**	**2.25**	**3.00**	**1.75**	**0.75**	**-**	**-**	**-**	**2.00**	**3.00**	**2.50**	**3.00**

Overall Mapping of Subject: 2.39

CourseCode	26LC-MA-234-H				
Category	ProfessionalCoreCourses				
Coursetitle	Heat Transferlab				
Schemeand Credits	L	T	P	Credit	
	0	**0**	**2**	**1**	
Classwork	**5 Marks**				
Exam	**20 Marks**				
Total	**25 Marks**				
DurationofExam	**3 Hours**				

LISTOF EXPERIMENTS:

1. Todeterminethethermalconductivityofametallic rod.
2. Todeterminethethermalconductivityofaninsulatingpower.
3. Measurementofheattransferrateinachannelflowusing winglets.
4. Todeterminethethermalconductivityofasolidbytheguardedhotplate method.
5. Tofindtheeffectivenessofapinfininarectangularductnaturalconvectiveconditionandplot temperature distribution along its length.
6. Tofindtheeffectivenessofapinfininarectangularductunderforcedconvectiveandplottemperature distribution along its length.
7. Todeterminethesurfaceheattransfercoefficientforaheatedverticaltubeundernaturalconvection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
8. To determine average heat transfer coefficient for a externally heated horizontal pipe under forced convection&plotReynoldsandNusseltnumbersalongthelengthofpipe.Alsocomparetheresultswith thoseofthecorrelations.9. To measurethe emmisivityof the graybody(plate) atdifferent temperature and plot the variation of emmisivity with surface temperature.
9. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counterflowconditions.Alsoplotthetemperaturedistributioninboththecasesalongthelengthofheat of heat exchanger.11. To verify the Stefen-Boltzmann constant for thermal radiation.
12. Todemonstratethesuperthermalconductingheatpipeandcompareitsworkingwiththatofthebest conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.
13. Tostudythetwophasesheattransferunit.
14. Todeterminethewatersideoverallheattransfercoefficientonacross-flowheatexchanger.
15. DesignofHeatexchangerusingCADandverificationusingthermalanalysispackageeg.IDeasetc.

Course Outcomes: The students who have undergone the course will be able tounderstand workingof Heat Exchanger, fins , black body Radiationetc.

Note:1.Atleasttenexperimentsaretobeperformedinthe Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experimentsmayeitherbeperformedfromtheabovelistorasdesigned&setbytheconcerned institute as per the scope of the syllabus.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	2	-	-	-	2	3	2	3
CO2	3	3	2	2	3	2	2	-	-	-	2	3	3	3
CO3	3	2	3	3	3	2	2	-	-	-	2	3	3	3
CO4	3	2	2	3	2	3	2	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	2.50	2.50	2.00	2.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.42

CourseCode	26LC-MA-236-H				
Category	ProfessionalCoreCourses				
Coursetitle	Electrical Machines lab				
Schemeand Credits	L	T	P	Credit	
	0	**0**	**2**	**1**	
Classwork	**5 Marks**				
Exam	**20Marks**				
Total	**75 Marks**				
DurationofExam	**3 Hours**				

LISTOF EXPERIMENTS:-

1. Tostudythemagnetizationcharacteristicsofaseparatelyexcited D.Cgeneratorfordifferent speeds
2. Tostudythespeedcontrolofad.c.shuntmotorusingA.FieldcurrentcontrolmethodB.Armature control method
3. Toplottorque-speedcharacteristicsandarmaturecurrentcharacteristicsofa D.Cshunt motor.
4. Todeterminetheexternalorloadcharacteristicsofa D.C.shuntgeneratorbyactuallyloadingthe machine.
5. Tostudy3-point/4-pointstarterfor D.C.shuntmotor.
6. Toperformnoloadandshortcircuittestonathree-phasesynchronous generator.
   A.Measuretheresistanceofthestator windings
   B.Findthevoltageregulationatfullloadat
   (i) Unitypower factor
   (ii) 0.85powerfactorleading
   (iii) 0.85powerfactorlaggingbysynchronousimpendence method.
7. Tostudytheeffectofvariationoffieldcurrentuponthestatorcurrentandpowerfactorofasynchronous motor running at no load and half load, hence draw V and inverted V curves of the motor.
8. To Performno load and blocked rotor test onthree-phase inductionmotor and draw its equivalent circuit.

2 To perform load test on 3-phase induction motor and compute torque, output power, efficiency, input power factor and slip for various load settings. Plot the relevant graphs.Performnoloadandblockedrotortestonsingle-phaseinductionmotor.

Course Outcomes: The students who have undergone the course will be able to understand working of DC motor, induction motor ,single and multiphase motor.

Note:1.Atleasttenexperimentsaretobeperformedinthe Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performedfrom the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	2	1	-	-	-	2	3	3	3
WT.AVG	**3.00**	**2.00**	**2.00**	**3.00**	**3.00**	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**3.00**	**3.00**

Overall Mapping of Subject: 2.50

Course code	**26PCC-ME-224-H**				
Category	Professional Core Courses				
Course title	Product Design and Development				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	To Design products creatively while applying engineering design principles. • To Apply principles of human factors, ethics and environmental factors in product design. • To Work in groups or individually in their pursuit of innovative product design. • To implement value design for optimum product cost.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of a short-answer type, covering all four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Product Development Process: General problem-solving process - Flow of Work during the process of designing - Activity Planning Timing and scheduling, Planning Project and Product Costs - Effective Organization Structures - Interdisciplinary Cooperation, Leadership and Team behaviour.

Task Clarification: Importance of Task Clarification - Setting up a requirements list - Contents, Format, Identifying the requirements, refining and extending the requirements, Compiling the requirements list, Examples. Using requirements lists - Updating, Partial requirements lists, Further uses - Practical applications of requirements lists.

UNIT-II

Conceptual Design: Steps in Conceptual Design. Abstracting to identify the essential problems - Aim of Abstraction, Broadening the problem. Formulation, Identifying the essential problems from the requirements list, establishing functions structures, Overall function, Breaking a function down into sub-functions. Developing working structures - Searching for working principles, Combining Working Principles, Selecting Working Structures, Practical Application of working structures. Developing Concepts - Firming up into principle solution variants, Evaluating principle solution variants, Practical Applications of working structures. Examples of Conceptual Design - One Handed Household Water Mixing Tap, Impulse - Loading Test Rig.

UNIT-III

Embodiment Design: Steps of Embodiment Design, Checklist for Embodiment Design Basic rules of Embodiment Design Principles of Embodiment Design - Principles of Force Transformations, Principles of Division of Tasks, Principles of Self Help, Principles of Stability and Bi-Stability, Principles of Fault-Free Design Guide for Embodiment Design -

General Considerations, Design to allow for expansion, Design to allow for creep and relaxation, Design against Corrosion, Design to minimize wear, Design to Ergonomics, Design for Aesthetics, Design for Production, Design for Assembly, Design forMaintenance, Design for Recycling, Design for Minimum risk, Design to standards. Evaluation of Embodiment Designs.

UNIT-IV

Mechanical Connections, Mechatronics and Adaptronics: Mechanical Connections - General functions and General Behaviour, Material connections, From Connections, Force connections, Applications. Mechatronics - General Architecture and Terminology, Goals and Limitations, Development of Mechatronic Solution, Examples. Adaptronics - Fundamentals and Terminology, Goals and Limitations, Development of Adaptronics Solutions, Examples.

Course Outcomes: After successful completion of the course, the student will be able to • Apply knowledge of basic science and engineering fundamentals • Undertake problem identification, formulation and solution • Understanding of the principles of sustainable design and development • Understanding of professional and ethical responsibilities and commitment to them.

Textbooks:

1. G.Paul; W. Beitzetal, Engineering Design, Springer International Education, 2010.
2. Kevin Otto: K. Wood, Product Design And Development, Pearson Education, 2013.
3. Kenith B. Kahu, Product Planning Essentials, Yes dee Publishing, 2011.
4. K.T. Ulrich, Product Design and Development, TMH Publishers, 2011.

Online Learning Resources:

• https://nptel.ac.in/courses/112107217 • https://nptel.ac.in/courses/112104230
• https://www.youtube.com/watch?v=mvaqZAFdL6U
• https://nptel.ac.in/courses/107103082 •https://quizxp.com/nptel-product-design-and-manufacturing assignment-5/

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	–	–	–	2	3	2	3
CO2	3	3	3	2	2	2	1	–	–	–	2	3	3	3
CO3	3	2	3	2	2	3	3	2	–	–	2	3	3	3
CO4	2	2	2	1	1	3	3	3	2	2	2	2	2	3
WT.AVG	**2.75**	**2.25**	**2.50**	**1.50**	**1.75**	**2.50**	**2.00**	**1.25**	**0.50**	**0.50**	**2.00**	**2.75**	**2.50**	**3.00**

Overall Mapping of Subject: 2.02

Course code	**26LC-ME-226-H**				
Category	Professional Core Courses				
Course title	**Product Design and Development Lab**				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	To understand the process of product dissection, analyze the working principles, and apply design concepts to develop a product architecture.				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Following are the details of the lab experiments performed by the students.

Product Design experiments:

1. Product Dissection: Understanding the process of disassembling a product to analyze its design and functionality
2. Working Principle: Analyzing the underlying principles and mechanisms of a product
3. Application: Understanding the product's purpose, benefits, and user needs
4. Disassembly: Plan Creating a systematic plan to disassemble a product
5. Parts and Function: Identifying and explaining the functions of individual parts and modules
6. Design Concept: Applying design principles to develop a product concept
7. Product Architecture: Defining the overall structure and organization of a product
8. Design Synthesis: Combining design elements to create a cohesive product design
9. Design Embodiment: Translating design concepts into a physical product

Course Outcomes:

1. Understand the importance of product dissection in design and development
2. Analyze the working principles and applications of a product
3. Develop a disassembly plan for a product
4. Identify and explain the functions of product parts and modules
5. Apply design concepts to synthesize and embody a product design

Note:

At least seven experiments are to be performed in the Semester.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO5	3	3	3	2	3	2	2	-	-	-	2	3	3	3
WT.AVG	**3.00**	**2.40**	**2.40**	**1.80**	**2.40**	**1.80**	**1.20**	**-**	**-**	**-**	**2.00**	**3.00**	**2.60**	**3.00**

Overall Mapping of Subject: 2.40