PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

PERIYAR MANIAMMAI
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

Criterion 1 – Curricular Aspects

Key Indicator	1.1	Curriculum Design and Development
Metric	1.1.3	Average percentage of courses having focus on employability/ entrepreneurship/ skill Development offered by the department.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS COPY OF THE COURSES HIGHLIGHTING THE FOCUS ON EMPLOYABILITY/ ENTREPRENEURSHIP/ SKILL DEVELOPMENT

1. List of courses for the programmes in order of

S. No.	Programme Name
i.	Bachelor of Technology(Mechanical Engineering)(Full Time)
ii.	Bachelor of Technology(Mechanical Engineering)(Part Time)
iii.	Master of Technology(Renewable Energy)(Full Time)
iv.	Master of Technology(Renewable Energy)(Part Time)

2. Syllabus of the courses as per the list.

Legend : Words highlighted with **Blue Color** - Entrepreneurship

Words highlighted with **Red Color** - Employability

Words highlighted with **Purple Color** - Skill Development

1. **List of Courses**

Name of the Course	Course Code	Year of introduction	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
B.Tech. Mechanical Engineering (Full Time)			
2021-22 ACADEMIC YEAR			
Calculus and Linear Algebra	XMA101	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Programming for Problem Solving	XCP102	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Applied Chemistry for Engineers	XAC103	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Engineering Graphics and Design	XEG104	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Speech Communication	XGS105	**2021-22**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Constitution of India	XUM106	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Programming for Problem Solving Laboratory	XCP107	**2021-22**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Applied Chemistry Laboratory for Engineers	XAC108	**2021-22**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Calculus, Ordinary Differential Equations and Complex Variable	XMA201	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Electrical and Electronic Engineering Systems	XBE202	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Applied Physics for Engineers	XAP203	**2015-16**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,

Technical Communication	XGS204	**2021-22**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Workshop Practices	XWP205	**2008-09**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Engineering Mechanics	XEM206	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Electrical and Electronic Engineering Systems Laboratory	XBE207	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Applied Physics for Engineers Laboratory	XAP208	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
PDE, Probability & Statistics	XME301	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Thermodynamics	XME302	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Strength of Materials	XME303	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Engineering Mechanics	XEM304	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Entrepreneurship Development	XUM305	**2015-16**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Manufacturing Processes	XME306	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Mechanical Engineering Laboratory I (Manufacturing Technology)	XME307	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Inplant Training – I	XME308	**2015-16**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Applied Thermodynamics	XME401	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,

Solid Mechanics	XME402	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Human Ethics, Values, Rights and Gender Equality	XUM403	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Fluid Mechanics & Fluid Machines	XME404	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Materials Engineering	XME405	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Instrumentation & Control	XME406	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Mechanical Engineering Laboratory II (Thermal Engineering and Fluid Mechanics)	XME407	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Operation Research	XME501	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Heat Transfer	XME502	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Automobile Engineering	XME503	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
CAD/CAM	XME504	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Kinematics & Theory of Machines	XME505	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Constitution of India	XUM506	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Mechanical Engineering Laboratory I (Thermal)	XME507	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Inplant Training – II	XME508	**2015-16**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,

CNC Programming for Lathe Operations	XMEM01	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Economics for Engineers	XUM601	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Manufacturing Technology	XME602	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Design of Machine Elements	XME603	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Elective-I		**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Elective-II		**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Mechanical Engineering Laboratory II (Design)	XME606	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Pneumatics and Hydraulics	XMEM02	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Automation in Manufacturing	XME702	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Elective III		**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Elective-IV		**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Elective V		**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Cyber Security	XUM706	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Mechanical Engineering Laboratory III (Manufacturing)	XME707	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,

Project phase – I	XME708	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Inplant Training – III	XME709	**2015-16**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Non Destructive Testing	XMEM03	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Elective VI		**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
Project phase – II	XME804	**2018-19**	Employability/ Entrepreneurship/ Skill development - Assignment, Test,Seminar, Quiz,
B.TECH -MECHANICAL ENGINEERING - PART TIME			
2021-22 – ACADEMIC YEAR – NIL			
M.TECH RENEWABLE ENERGY (FULL TIME)			
2021-22 – ACADEMIC YEAR			
Process Modelling and Simulation in Energy Systems	YRE103	**2007-08**	Skill Development on Simulation and modeling of various energy equipments
Research Methodology and IPR	YRM107	**2018-19**	Skill Development on how to write the paper and patent it
English for Research Paper Writing	YEGOE1	**2018-19**	Skill Development – Assignment, Note Taking, Library Skills, Group Discussion
Computational Fluid Dynamics	YRE202	**2007-08**	Skill Development on flow analysis
Mini Project	YRE207	**2018-19**	Employability- Design, Analysis Fabrication, Testing , Report preparation
Constitution of India	YPSOE1	**2018-19**	Skill Development on Various laws and acts
Project Phase – I	YRE301	**2007-08**	Employability- Design, Analysis Fabrication, Testing , Report preparation
Project Phase – II	YRE401	**2007-08**	Employability- Design, Analysis Fabrication, Testing , Report preparation

M.Tech Renewable Energy (Part Time)			
2021-22 – ACADEMIC YEAR			
Wind Energy, Tidal Energy and OTEC	QRE102	**2007-08**	Employability on Various energy sectors
Research Methodology and IPR	QRE202	**2018-19**	Skill Development on how to write the paper and patent it
Computational Fluid dynamics	PYRE301	**2007-08**	Skill Development on flow analysis

SYLLABUS FOR B.TECH MECHANICAL (FT)

ACADEMIC YEAR 2021-22

COURSE CODE			COURSE NAME	L	T	P	C
XMA101			Mathematics I (Calculus and Linear Algebra)	3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		4	1	0	5

PREREQUISITE: Differentiation and Integration

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1:Apply orthogonal transformation to reduce quadratic form to canonical forms.	Cognitive	Applying
CO2:Apply power series to tests the convergence of the sequences and series. Half range Fourier sine and cosine series.	Cognitive Psychomotor	Applying Guided Response
CO3: Find the derivative of composite functions, implicit functions also finding the solution using Euler's theorem and Jacobian.	Cognitive	Applying
CO4:Explain the functions of two variables by Taylors expansion, by finding maxima and minima with and Without constraints using Lagrangian Method. Directional derivatives, Gradient, Curl and Divergence.	Cognitive Affective	Understanding Receiving
CO5:Apply Differential and Integral calculus to notions of Curvature and to improper integrals.	Cognitive	Applying

Unit1: Matrices	**12**
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors- Cayley-Hamilton Theorem –Diagonalisation of Matrices–Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
Unit 2: Sequences and series	**12**
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
Unit 3: Multivariable Calculus: Partial Differentiation	**12**
Limits and continuity –Partial differentiation – Total Derivative –Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.	
Unit 4: Multivariable Calculus: Maxima and Minima and Vector Calculus	**12**
Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers –Directional Derivatives - Gradient, Divergence and Curl.	
Unit5: Differential and Integral Calculus	**12**
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	

LECTURE	TUTORIAL	TOTAL

45	**15**	**60**

Text Books:

1.Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2015**. (Unit-1, Unit-3 and Unit-4).**

2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014. **(Unit-2).**

3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010. **(Unit-5).**

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

Cos Versus GA mapping

Table 1: Mapping of Cos with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Semester	**:**	**I**
Course Code	**:**	**XCP102**
Course Name	**:**	**PROGRAMMING FOR PROBLEM SOLVING**
Prerequisite	**:**	**Basic Understanding Skills**

L	T	P	C			C	P	A			L	T	P	H	
3	0	0	3			3	0	0			3	0	0	3	

Course Objectives		
• To learn programming language basics and syntax		
• To ignite logical thinking		
• To understand structured programming approach		
• To deal with user defined data types		
• To know about data storage in secondary memory		
Course Outcome: After the completion of the course, students will be able to	**Domain C or P or A**	**Level**

CO1	***Define*** programming fundamentals and ***Solve*** simple programs using I/O statements	Cognitive	Remember Understand Apply
CO2	***Define*** syntax and ***write simple programs*** using control structures and arrays	Cognitive	Remember Understand Apply
CO3	***Explain*** and ***write simple programs*** using functions and pointers	Cognitive	Remember Understand Apply
CO4	***Explain*** and ***write simple programs*** using structures and unions	Cognitive	Remember Understand Apply
CO5	***Explain*** and ***write simple programs*** using files and ***Build*** simple projects	Cognitive	Remember Understand Apply

COURSE CONTENT

UNIT I	**PROGRAMMING FUNDAMENTALS AND I/O STATEMENTS**	**9**
	Introduction to components of a computer system, Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure - Header files – Data Types- Variables - Output statements – Input statements.	
UNIT II	**CONTROL STRUCTURE AND ARRAYS**	**9**
	Control Structures – Conditional Control statements: Branching, Looping - Unconditional control structures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declaration – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional arrays - Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration – Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings.	
UNIT III	**FUNCTIONS AND POINTERS**	**9**
	Functions: Built in functions – User Defined Functions - Parameter passing methods - Passing arrays to functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address operator - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference - Pointer to arrays - Use of Pointers in self-referential structures-Notion of linked list	
UNIT IV	**STRUCTURES AND UNIONS**	**9**
	Structures and Unions - Giving values to members - Initializing structure - Functions and structures - Passing structure to elements to functions - Passing entire function to functions - Arrays of structure - Structure within a structure and Union.	
UNIT V	**FILES**	**9**
	File management in C - File operation functions in C - Defining and opening a file - Closing a file - The getw and putw functions - The fprintf & fscanf functions - fseek function – Files and Structures.	

		L	**T**	**P**	**Total**
		45	**0**	**0**	**45**

TEXT BOOKS

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 2010
2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008

REFERENCE BOOKS

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill, 7th edition 2017.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education

Inc. 2005

3. Johnson baugh R. and Kalin M., "Applications Programming in ANSI C", III Edition, Pearson Education India, 2003

E-REFERENCES

1. https://www.indiabix.com/c-programming/questions-and-answers/
2. https://www.javatpoint.com/c-programming-language-tutorial
3. https://www.w3schools.in/c-tutorial/

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	0	0	3	0	0	0	0	0	2	3	2	0
CO 2	3	2	0	0	2	0	0	0	0	0	2	3	2	0
CO 3	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 4	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 5	2	2	1	0	2	0	0	1	0	2	2	2	2	0
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0
Scaled Value	3	2	1	1	3	0	0	1	0	1	2	3	2	0

Note:									
	Total	0	1-5	6-10	11-15				
	Scaled value	0	1	2	3				
	Relation	No	Low	Medium	High				

Semester	**I**
Subject Name	**APPLIED CHEMISTRY FOR ENGINEERS**
Subject Code	**XAC103**

L –T –P –C	**C:P:A**	**L –T –P –H**
3- 1 – 0– 4	**2.5:1:0.5**	**3- 1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	***Identify***the periodic properties such as ionization energy, electron affinity, oxidation states and electro negativity. ***Describe*** the various water quality parameters like hardness and alkalinity.	Cognitive – Remembering Psychomotor - Perception
CO2	***Explain*** *and* ***Measure*** microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive - Understanding
CO3	***Interpret*** bulk properties and processes using thermodynamic and kinetic considerations.	Psychomotor - Set Cognitive - Applying Psychomotor - Mechanism Affective - Receive

CO4	***Describe, Illustrate*** *and* ***Discuss*** the chemical reactions that are used in the synthesis of molecules.	Cognitive - Remembering Analyzing Psychomotor – Perception Affective - Responding
CO5	***Apply, Measure*** and ***Distinguish*** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	Cognitive - Remembering, Applying Psychomotor - Mechanism

The objective of this course

- Understand the application of chemistry in engineering.

COURSE CONTENT

UNIT I **PERIODIC PROPERTIES AND WATER CHEMISTRY** **11 HRS**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries. **Water Chemistry**-Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.

UNIT II **USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA** **15 HRS**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electroless plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).

UNIT III **ATOMIC AND MOLECULAR STRUCTURE** **13 HRS**

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles.. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Intermolecular forces and potential energy surfaces

Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and

trajectories on these surfaces.

UNIT IV	SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	10 HRS

Principles of spectroscopy and selection rules. Electronic spectroscopy-chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.

UNIT V	STEREOCHEMISTRY AND ORGANIC REACTIONS	11 HRS

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule- Aspirin and paracetamol.

L = 45 hrs T = 15 hrs P=0 hrs Total = 60 hrs

TEXT BOOKS

1. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., 1993.
2. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science, 2006.
3. Trapp. C, Cady, M. Giunta. C, Atkins's Physical Chemistry, 10th Edition, Oxford publishers, 2014.
4. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd, 1983.
5. Morrison R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn& Bacon Ltd., 1976.
6. Banwell. C.N, Fundamentals of Molecular Spectroscopy, (3th Edition), McGraw-Hill Book Company, Europe 1983.
7. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (4th edition), S./ Chand & Company Ltd. New Delhi, 1977.
8. P. S. Kalsi, Stereochemistry: Conformation and mechanism, (9th Edition), New Age International Publishers, 2017.

REFERENCES BOOKS

1. Puri B R Sharma L R and Madan S Pathania, "Principles of Physical Chemistry", Vishalpublishing Co., Edition 2004.
2. Kuriocose, J C and Rajaram, J, "Engineering Chemistry", Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000.

E REFERENCES

1. http://www.mooc-list.com/course/chemistry-minor-saylororg
2. https://www.canvas.net/courses/exploring-chemistry
3. http://freevideolectures.com/Course/2263/Engineering-Chemistry-I
4. http://freevideolectures.com/Course/3001/Chemistry-I
5. http://freevideolectures.com/Course/3167/Chemistry-II
6. http://ocw.mit.edu/courses/chemistry/

Mapping of COs with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	0	0	0	0	0	2	3	3	0	0	0	0	0
CO2	2	0	0	0	0	0	1	2	2	0	0	0	0	0
CO3	3	0	0	0	0	0	2	3	3	0	0	0	0	0
CO4	3	0	0	0	0	0	3	3	3	0	0	0	0	0
CO5	3	0	0	0	0	0	2	2	3	0	0	0	0	0
Total	13	0	0	0	0	0	10	13	14	0	0	0	0	0

1 - Low, 2 – Medium, 3- High

Semester	**I**
Subject Name	**Engineering Graphics and Design**
Subject Code	**XEG104**

L –T –P –C	**C:P:A**	**L –T –P –H**
1- 0 – 2– 3	**1.75:1:0.25**	**1- 0– 4 – 5**

Course Outcome		**Domain/Level C or P or A**
CO1	***Apply*** the national and international standards, ***construct*** and ***practice*** various curves	Cognitive (Apply) Psychomotor (Guided response) Affective (Responds to Phenomena)
CO2	***Interpret*****,** ***construct*** **and** ***practice*** orthographic projections of points, straight lines and planes.	Cognitive (Understand) Psychomotor (Mechanism) Affective (Responds to Phenomena)
CO3	***Construct Sketch*** **and** ***Practice*** projection of solids in various positions and true shape of sectioned solids.	Cognitive (Apply) Psychomotor (Complex over response) Affective (Responds to phenomena)
CO4	***Interpret*****,** ***Sketch*** **and** ***Practice*** the development of lateral surfaces of simple and truncated solids, intersection of solids.	Cognitive (Understand) Psychomotor (Complex over response) Affective (Responds to phenomena)
CO5	***Construct sketch*** **and** ***practice*** isometric and perspective views of simple and truncated solids.	Cognitive (Apply) Psychomotor (Complex over response) Affective (Responds to phenomena)

Objectives:

- to prepare the student to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare the student to communicate effectively
- to prepare the student to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE CONTENT

UNIT I	**INTRODUCTION, FREE HAND SKETCHING OF ENGG OBJECTS AND CONSTRUCTION OF PLANE CURVE**	**12+6 hrs**

Importance of graphics in engineering applications – use of drafting instruments – BIS specifications and conventions as per SP 46-2003.
Pictorial representation of engineering objects – representation of three dimensional objects in two dimensional media – need for multiple views – developing visualization skills through free hand sketching of three dimensional objects.
Polygons & curves used in engineering practice – methods of construction – construction of ellipse, parabola and hyperbola by eccentricity method – cycloidal and involute curves – construction – drawing of tangents to the above curves. Practice on basic tools of CAD

UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**12+6 hrs**

General principles of orthographic projection – first angle projection – layout of views – projections of points, straight lines located in the first quadrant – determination of true lengths of lines and their inclinations to the planes of projection – traces – projection of polygonal surfaces and circular lamina inclined to both the planes of projection-CAD practice on points and lines

UNIT III	**PROJECTION OF SOLIDS AND SECTIONS OF SOLIDS**	**12+6 hrs**

Projection of simple solids like prism, pyramid, cylinder and cone when the axis is inclined to one plane of projection – change of position & auxiliary projection methods – sectioning of above solids in simple vertical positions by cutting plane inclined to one reference plane and perpendicular to the other and above solids in inclined position with cutting planes parallel to one reference plane – true shapes of sections-CAD practice on solid models

UNIT IV	**DEVELOPMENT OF SURFACES AND INTERSECTION OF SOLIDS**	**12+6 hrs**

Need for development of surfaces – development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones – development of lateral surfaces of the above solids with square and circular cutouts perpendicular to their axes – intersection of solids and curves of intersection –prism with cylinder, cylinder & cylinder, cone & cylinder with normal intersection of axes and with no offset-CAD practice on intersection of solids.

UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**12+6 hrs**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones – principles of perspective projections – projection of prisms, pyramids and cylinders by visual ray and vanishing point methods-CAD practice on isometric view

L = 30 hrs T = 0 hrs P=60 hrs Total = 90 hrs

TEXT BOOKS

1. Bhatt,N.D, "Engineering Drawing", Charotar Publishing House, 46th Edition-2003.

2. Natarajan,K.V, " A Textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006 .

3. Dr. P.K. Srividhya, P. Pandiyaraj, "Engineering Graphics", PMU Publications, Vallam, 2013

REFERENCES

1. Luzadder and Duff, "Fundamentals of Engineering Drawing" Prentice Hall of India PvtLtd, XI Edition - 2001.
2. Venugopal,K. and Prabhu Raja, V., "Engineering Graphics", New Age International(P) Ltd., 2008.
3. Gopalakrishnan.K.R,. "Engineering Drawing I & II", Subhas Publications, 1998.
4. Shah,M.B and Rana,B.C.,"Engineering Drawing", Pearson Education,2005.

E-REFERENCES

1. http://periyarnet/Econtent
2. http://nptel.ac.in/courses/112103019/

Mapping of COs with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2
CO1	3	3	3	2	3	2	3	1	1	2	3	3	3	
CO2	3	3	3	1	3	1	3	1	1	1	2	3	3	
CO3	3	3	3	1	3	1	3	1	1	1	2	3	3	
CO4	3	3	3	1	3	1	3	1	1	1	2	3	3	
CO5	3	3	3	1	3	1	3	1	1	1	2	3	3	
Total	15	15	15	6	15	6	15	5	5	6	11	15	15	

1 - Low, 2 – Medium, 3- High

	Semester – I	L	T	P	SS	C
COURSE CODE WITH NAME	**XGA105 and Speech Communication**	**0**	**1**	**2**	**0**	**3**
Pre-requisites		**L**	**T**	**P**	**SS**	**H**
C: P: A	**2.6:0.4:0**	**0**	**1**	**4**	**0**	**5**

COURSE OUTCOMES:		**Domain**	**Level**
CO1	***Ability*** to recall the types of speeches	Cognitive	Remember
CO2	***Apply*** the techniques in public speaking	Cognitive	Apply
CO3	***Identify*** the common patterns in organizing a speech	Cognitive	Remember
CO4	***Construct*** the nature and style of speaking	Cognitive	Create
CO5	***Practicing*** the speaking skills and techniques in everyday life	Psychomotor	Guided Response

UNIT I – Types of Speeches	**9**
1.1 – Four types of speeches 1.2 – Analyzing the audience 1.3 - Developing ideas and supporting materials	
UNIT II – Public Speaking	**9**

2.1 - Introduction to Public Speaking 2.2 - Competencies Needed for successful speech making 2.3 – Speaking about everyday life situations	
UNIT III – Organization of Speech	**9**
3.1 – Developing a speech out line 3.2 - Organizing the speech 3.3 – Introduction - development – conclusion	
UNIT IV – Presentation	**9**
4.1 - Tips for preparing the draft speech 4.2 – Presentation techniques using ICT tools 4.3 – Using examples from different sources	
UNIT V – Activities	**9**
5.1 – Reading activities 5.2 – Creative presentations 5.3 – Media presentation techniques	
Suggested Readings: (i) Michael Swan. *Practical English Usage.* OUP. 1995 (ii) Sanjay Kumar and Pushp Lata. *Communication Skills*. Oxford University Press. 2011	

Semester	**I**
Subject Name	**CONSTITUTION OF INDIA**
Subject Code	**XUM106**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 0– 0	**0:0:0**	**3- 0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	**To Study** History of Constitution	**Understanding**
CO2	**To Explain** the Union Executive	**Remembering**
CO3	**To Identify** the concept of Union Legislature	**Applying**
CO4	**To Analysis** the Union Judiciary	**Analyzing**
CO5	**To Explain** the Centre State Relation	**Evaluating**

COURSE CONTENT

UNIT I **8 HRS**

Constitutional History- The Constitutional Rights- Preamble- Fundamental Rights- Fundamental Duties- Directive principles of State Policy.

UNIT II **9 HRS**

The Union Executive- The President of India (powers and functions)- Vice-President of India-The Council of Ministers-Prime Minister- Powers and Functions.

UNIT III **10 HRS**

Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya Sabha- Legislative Procedure in India- Important Committes of Lok Sabha- Speaker of the Lok Sabha

UNIT IV **9 HRS**

The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appelete jurisdictions- Advisory Jurisdiction- Judicial review.

UNIT V **9 HRS**

Centre State relations- Political Parties- Role of governor, powers and functions of Chief Minister-Legislative Assembly- State Judiciary- Powers and Functions of the High Courts.

L = 45 hrs T = 0 hrs P=0 hrs Total = 45 hrs

REFERENCES BOOKS

1. W.H.Morris Shores- Government and politics of India, NewDelhi,B.1.Publishers,1974.
2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House, 1977.
3. R.Thanker- The Government and politics of India, London:Macmillon, 1995.
4. A.C.Kapur- Select Constitutions S,Chand & Co.,NewDelhi, 1995
5. V.D.Mahajan- Select Modern Governments,S,Chand &Co, NewDelhi,1995.
6. B.C.Rout- Democractic Constitution of India.
7. Gopal K.Puri- Constitution of India, India 2005.

Mapping of COs with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2			1										
CO2	2			1										
CO3	2			1					1					
CO4	2			1				1	1					
CO5	2	2		1				1	1					
Total	10	2		5				2	3					

1 - Low, 2 – Medium, 3- High

COURSE CODE	**XCP107**	**L**	**T**	**P**	**C**
COURSE NAME	**PROGRAMMING FOR PROBLEM SOLVING LAB**	**0**	**0**	**1**	**1**
PREREQUISITES	**Basic Understanding Skills**	**L**	**T**	**P**	**H**
C:P:A	**0.75:0.25:0**	**0**	**0**	**2**	**2**

LEARNING OBJECTIVES

- To learn programming language basics and syntax
- To ignite logical thinking

- To understand structured programming approach
- To deal with user defined data types
- To know about data storage in secondary memory

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Solve*** simple programs using I/O statements	Cognitive Psycomotor	Apply Responding
CO2	***Solve*** programs using control structures and arrays	Cognitive Psycomotor	Apply Responding
CO3	***Solve*** programs using functions and pointers	Cognitive Psycomotor	Apply Responding
CO4	***Solve*** programs using structures	Cognitive Psycomotor	Apply Responding
CO5	***Solve*** programs using files	Cognitive Psycomotor	Apply Responding

S.No	List of Experiments	COs
1	Program to display a Leave Letter as per proper format	CO1
2	i. Program for addition of two numbers ii. Program to solve any mathematical formula.	CO1
3	Program to find greatest of 3 numbers using Branching Statements	CO2
4	Program to display divisible numbers between n1 and n2 using looping Statement	CO2
5	Program to search an array element in an array.	CO2
6	Program to find largest / smallest element in an array.	CO2
7	Program to perform string operations.	CO3
8	Program to find area of a rectangle of a given number use four function types.	CO3
9	Programs to pass and receive array and pointers using four function types	CO3
10	Programs using Recursion for finding factorial of a number	CO3
11	Program to read and display student mark sheet of a student structures with variables	CO4
12	Program to read and display student marks of a class using structures with arrays	CO4
13	Program to create linked list using structures with pointers	CO4
14	Program for copying contents of one file to another file.	CO5
15	Program using files to store and display student mark list of a class using structures with array	CO5

HOURS	TUTORIAL	PRACTICAL	TOTAL
	0	30	30

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	0	0	3	0	0	0	0	0	2	3	2	0
CO 2	3	2	0	0	2	0	0	0	0	0	2	3	2	0
CO 3	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 4	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 5	2	2	1	0	2	0	0	1	0	2	2	2	2	0
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0
Scaled Value	3	2	1	1	3	0	0	1	0	1	2	3	2	0

Note:	Total	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester	**I**
Subject Name	**APPLIED CHEMISTRYFOR ENGINEERS LAB**
Subject Code	**XAC108**

L –T –P –C	C:P:A	L –T –P –H
0- 0 – 1– 1	0.25:0.5:0.25	0- 0– 2 – 2

Course Outcome		Domain/Level C or P or A
CO1	Ability to Identify the principles of chemistry relevant to the study of science and engineering	Coginitive – Remember Psychomotor - Perception
CO2	Analyze and Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, extent of hardness, chloride content of water, etc.	Coginitive – Analyze Psychomotor – Perception Affective - Receive
CO3	Analyze the synthetic procedure and rate constants of reactions from concentration of reactants/products as a function of time	Cognitive - Apply

COURSE CONTENT

EXP.NO	TITLE	CO RELATION
1	Determination of chloride ion present in the water sample by Argentometric method.	**CO1**
2	Determination of total, temporary and permanent hardness of water sample by EDTA method.	**CO1**
3	Determination of cell constant and conductance of solutions.	**CO2**
4	Potentiometry - determination of redox potentials and emfs.	**CO2**
5	Determination of surface tension and viscosity.	**CO3**
6	Adsorption of acetic acid by charcoal.	**CO3**
7	Determination of the rate constant of a reaction.	**CO4**
8	Estimation of iron by colorimetric method.	**CO4**
9	Synthesis of a polymer/drug.	**CO5**
10	Saponification/acid value of oil.	**CO5**

TOTAL – 30 HRS

TEXT BOOKS

Laboratory Manual "ChemistryLab", Department of Chemistry, PMIST, Thanjavur.

REFERENCES

1. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
2. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.

E-RESOURCES- MOOC's

1. http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques
2. http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques
3. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011

Mapping of COs with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2
CO1	3	3	3	3	2	3	3	0	1	1	1	0	0	0
CO2	2	2	2	2	1	2	2	1	1	1	1	1	1	1
CO3	2	2	2	2	1	2	2	0	1	1	0	0	0	0
Total	7	7	7	7	4	7	7	1	3	3	2	1	1	1

1 - Low, 2 – Medium, 3- High

COURSE CODE			**COURSE NAME**	**L**	**T**	**P**	**C**
XMA201			**Calculus, Ordinary Differential Equations and Complex Variable**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0.5**	**0.5**		**3**	**1**	**0**	**4**

PREREQUISITE: Mathematics I (Calculus and Linear Algebra)

COURSE OUTCOMES:

Course outcomes:	**Domain**	**Level**
CO1: Find double and triple integrals and to find line, surface and volume of an integral by **Applying** Greens, Gauss divergence and Stokes theorem.	Cognitive	Applying
CO2: Solve first order differential equations of different types which are solvable for p, y, x and Clairaut's type.	Cognitive	Applying
CO3:Solve Second order ordinary differential equations with variable coefficients using various methods.	Cognitive	Applying
CO4:Use CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation.	Cognitive Psychomotor	Applying Guided Response
CO5:Apply Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series.	Cognitive Affective	Applying Receiving

Unit 1: Multivariable Calculus (Integration)	**12**
Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes.	
Unit 2: First order ordinary differential equations	**12**

Exact - linear and Bernoulli's equations - Euler's equations - Equations not of first degree: equations solvable for p - equations solvable for y- equations solvable for x and Clairaut's type.

Unit 3: Ordinary differential equations of higher orders **12**

Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation **12**

Differentiation-Cauchy-Riemann equations- analytic functions-harmonic functions-finding harmonic conjugate- elementary analytic functions (exponential, trigonometric, logarithm) and their properties- Conformal mappings- Mobius transformations and their properties.

Unit 5: Complex Variable – Integration **12**

Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)- Liouville's theorem (without proof)- Taylor's series- zeros of analytic functions- singularities- Laurent's series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.

LECTURE	TUTORIAL	TOTAL
45	15	60

Text Book:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40thth Edition, 2008.

Reference Books:

1.G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3.W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn. Wiley India, 2009.
4. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
5.E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
7.J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

Cos Versus GA mapping

Table 1: Mapping of Cos with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Semester	**II**
Subject Name	**ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS**
Subject Code	**XBE202**

L –T –P –C	**C:P:A**	**L –T –P –H**
3- 1– 0– 4	**3:1:0**	**3- 1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	**Define and Relate** the fundamentals of electrical parameters and **build** and **explain** AC, DC circuits by Using measuring devices	Understanding
CO2	**Define and Explain** the operation of DC and AC machines.	Understanding
CO3	**Recall and Illustrate** various semiconductor devices and their applications and displays the input output characteristics of basic semiconductor devices.	Understanding
CO4	**Relate and Explain the** number systems and logic gates. **Construc**t the different digital circuit.	Understanding
CO5	**Label and Outline the** different types of microprocessors and their applications.	Understanding

COURSE CONTENT

UNIT I	**FUNDAMENTALS OF DC AND AC CIRCUITS, MEASUREMENTS**	**12 HRS**

Fundamentals of DC– Ohm's Law – Kirchhoff's Laws - Sources - Voltage and Current Relations –Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities, Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).

UNIT II	**ELECTRICAL MACHINES**	**12 HRS**

Construction, Principle of Operation, Basic Equations, Types and Application of DC Generators, DC motors - Basics of Single-Phase Induction Motor and Three Phase Induction Motor- Construction, Principle of Operation of Single-Phase Transformer, Three phase transformers, Auto transformer.

UNIT III	**SEMICONDUCTOR DEVICES**	**12 HRS**

Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications

UNIT IV	**DIGITAL ELECTRONICS**	**12 HRS**

Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subtractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.

UNIT V	**MICROPROCESSORS**	**12 HRS**

Architecture, 8085, pin diagram of 8085, ALU timing and control unit, registers, data and address bus, timing and control signals, Instruction types, classification of instructions, addressing modes, Interfacing Basics: Data transfer concepts – Simple Programming concepts.

L = 45 hrs T = 15 hrs P=0 hrs Total = 60 hrs

TEXT BOOKS

1. Metha V.K, Rohit Mehta, 2020. Principles of Electronics,12th ed, S Chand Publishing.

2. Albert Malvino, David J.Bates., 2017. Electronics Principles. 7th ed, Tata McGraw-Hill. New Delhi.
3. Rajakamal, 2014. Digital System-Principle & Design. 2nd ed. Pearson education.
4. Morris Mano, 2015. Digital Design. Prentice Hall of India.
5. Ramesh, S. Gaonkar, 2013, Microprocessor Architecture, Programming and its Applications with the 8085, 6th ed , India: Penram International Publications.

REFERENCES BOOKS

1. Cotton, H.,2005 Electrical Technology. CBS Publishers & Distributors Pvt Ltd.
2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.
3. Jacob Millman and Christos, C. Halkias, 1967, Electronics Devices, New Delhi: Tata McGraw-Hill.
4. Millman, J. and Halkias, C. C., 1972. Integrated Electronics: Analog and Digital Circuits and Systems, Tokyo: McGraw-Hill, Kogakusha Ltd.
5. Mohammed Rafiquzzaman, 1999. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International.

E REFERENCES

1. NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof. G.D. Roy, IIT Kharagpur.
2. Prof.L.Umanand, http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, IISc Bangalore.
3. http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura, IIT Madras.
4. Dr.L.Umanand, http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, IISC Bangalore.

Mapping of COs with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	1	1			1	1	1			
CO2	3	3	1	1	1	1			1	1	1			
CO3	2	2	2	1	2	2	1	1	1	1	1			
CO4	2	2	1	1	1	1	1	1	1	1	1			
CO5	2	2	1	1	1	1	1	1	1	1	1			
Total	12	12	6	5	6	6	3	3	5	5	5			

1 - Low, 2 – Medium, 3- High

Semester	**II**
Subject Name	**APPLIED PHYSICS FOR ENGINEERS**
Subject Code	**XAP203**

L –T –P –C	**C:P:A**	**L –T –P –H**
3- 1 – 0– 4	**2.8:0.8:0.4**	**3- 1– 0 – 4**

PREREQUISITE: Basic Physics in HSC level

Course Outcome		**Domain/Level C or P or A**
CO1	***Identify*** the basics of mechanics, ***explain*** the principles of elasticity and ***determine*** its significance in engineering systems and technological advances.	Cognitive - Remember, Understand

CO2	***Illustrate*** the laws of electrostatics, magneto-statics and electromagnetic induction; ***use*** and ***locate*** basic applications of electromagnetic induction to technology.	Psychomotor - Mechanism Cognitive - Remember, Analyze,
CO3	***Understand*** the fundamental phenomena in optics by measurement and ***describe*** the working principle and application of various lasers and fibre optics.	Psychomotor – Mechanism Affective- Respond Cognitive - Understand, Apply
CO4	***Analyse*** energy bands in solids, ***discuss*** and ***use*** physics principles of latest technology using semiconductor devices.	Psychomotor- Mechanism Affective- Receive Cognitive- Understand, Analyze
CO5	***Develop*** Knowledge on particle duality and ***solve*** Schrodinger equation for simple potential.	Psychomotor- Mechanism Affective- Receive Cognitive- Understand, Apply

UNIT I	**MECHANICS OF SOLIDS**	**12 HRS**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.
Elasticity: Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending.

UNIT II	**ELECTROMAGNETIC THEORY**	**12 HRS**

Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarisation, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.

UNIT III	**OPTICS, LASERS AND FIBRE OPTICS**	**12 HRS**

Optics: Dispersion- Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism- Interference of light in thin films: air wedge - Diffraction: grating.
LASER: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser

- CO_2 laser - Applications

Fibre Optics: Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

UNIT IV **SEMICONDUCTOR PHYSICS** **12 HRS**

Semiconductors: Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.

Diodes and Transistors: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

UNIT V **QUANTUM PHYSICS** **12 HRS**

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

L = 45 hrs T = 15 hrs P=0 hrs Total = 60 hrs

TEXT BOOKS

1.Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.

2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

REFERENCES BOOKS

1. Palanisamy P. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.

2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.

3. Senthil Kumar G., "Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.

4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.

E REFERENCES

NPTEL , Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

Mapping of CO's with PO

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1	PS2
CO1	3	2	2	2	1	-	-	-	1	-	-	1		
CO2	3		1		1	-	-	-		-	-	1		
CO3	3	2	2	2	1	-	-	-	1	-	-	1		
CO4	3	2	2	2	1	-	-	-	1	-	-	1		
CO5	3		2			-	-	-		-	-	1		
Total	**15**	**6**	**9**	**6**	**4**				**3**			**5**		
Scaled to 0,1,2,3 scale	**3**	**2**	**2**	**2**	**1**				**1**			**1**		

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

Semester	**II**
Subject Name	**XGS204**
Subject Code	**TECHNICAL COMMUNICATION**

L –T –P –C	C:P:A	L –T –P –H
2- 0 – 0– 2	**3:0:0**	**2- 0– 0 – 2**

Course Outcome		**Domain/Level C or P or A**
CO1	***Ability*** to understand the basic principles	Remember
CO2	***Apply*** the techniques in writing	Apply
CO3	***Identify*** communicative styles	Remember
CO4	***Construct*** the nature of writing	Create
CO5	***Ability*** to recall the Techniques	Remember
CO6	***Apply*** the techniques in practice	Apply

COURSE CONTENT

UNIT I	**Basic Principles**	**9 HRS**

1.1 – Basic Principles of Technical Writing
1.2 – Styles used in Technical Writing
1.3 – Language and Tone

UNIT II	**Techniques**	**9 HRS**

2.1 – Special Techniques used in writing
2.2 – Definition & Description of mechanism
2.3 – Description- Classification-Interpretation

UNIT III	**Communication**	**9 HRS**

3.1 – Modern development in style of writing
3.2 - New letter writing formats

UNIT IV	**Report Writing**	**9 HRS**

4.1 – Types of Report writing
4.2 – Project writing formats

Suggested Readings:

(i) John Sealy, Writing and Speaking Author; Oxford University Press, New Delhi, 2009
(ii) Williams K.S, Communicating Business. Engage Learning India Pvt Ltd, 2012

Semester	**I**
Subject Name	**Workshop Practices**
Subject Code	**XWP205**

L –T –P –C	C:P:A	L –T –P –H
1- 0 – 2– 3	**1:2:0**	**1- 0– 4 – 5**

Course Outcome		**Domain/Level C or P or A**
CO1	***Summarize*** the machining methods and ***Practice*** machining operation.	Cognitive (Understand) Psychomotor (Guided Response)
CO2	***Defining*** metal casting process, moulding methods and **relates** Casting and Smithy applications.	Cognitive (Remember) Psychomotor(Perception)

CO3	***Plan*** basic carpentry and fitting operation and ***Practice*** carpentry and fitting operations.	Cognitive (Apply) Psychomotor (Guided Response)
CO4	***Summarize*** metal joining operation and ***Practice*** welding operation.	Cognitive (Understand) Psychomotor(Guided Response)
CO5	***Illustrate*** the, electrical and electronics basics and ***Makes*** appropriate connections**.**	Cognitive (Understand) Psychomotor (Origination)

COURSE CONTENT

EXP.NO	TITLE	CO RELATION
1	Introduction to machining process	CO1
2	Plain turning using lathe operation	CO1
3	Introduction to CNC	CO1
4	Demonstration of plain turning using CNC	CO1
5	Study of metal casting operation	CO2
6	Demonstration of moulding process	CO2
7	Study of smithy operation	CO2
8	Study of carpentry tools	CO3
9	Half lap joint – Carpentry	CO3
10	Mortise and Tenon joint – Carpentry	CO3
11	Study of fitting tools	CO3
12	Square fitting	CO3
13	Triangular fitting	CO3
14	STUDY OF WELDING TOOLS	CO4
15	Square butt joint – welding	CO4
16	Tee joint – Welding	CO4
17	Introduction to house wiring	CO5
18	One lamp controlled by one switch	CO5
19	Two lamps controlled by single switch	CO5
20	Staircase wiring	CO5

TEXT BOOKS

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.

REFERENCES

1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

E RESOURCES

1. http://nptel.ac.in/courses/112107145/

Mapping of COs with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2
CO1	2	1	2	2	1			1	1		1	2	3	
CO2	2	1	2	2	1			1	1		1	2	3	
CO3	2	1	2	2	1			1	1		1	2	3	
CO4	2	1	2	2	1			1	1		1	2	3	
CO5	2	1	2	2	1			1	1		1	2	3	
Total	**10**	**5**	**10**	**10**	**5**			**5**	**5**		**5**	**10**	**15**	

1 - Low, 2 – Medium, 3- High

Semester	**II**
Subject Name	**ENGINEERING MECHANICS**
Subject Code	**XEM206**

L –T –P –C	C:P:A	L –T –P –H
3- 0 – 0– 3	**3:0:0**	**3- 0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	***Explain*** the principles forces, laws and their applications.	Cognitive-Understanding, Apply
CO2	***Classification*** of friction, and ***apply*** the forces in Trusses and beams.	Cognitive-Understanding, Apply
CO3	***Explain*** and ***Apply*** moment of Inertia and Virtual work	Cognitive-Understanding, Apply
CO4	***Outline*** and ***Examine*** Dynamics	Cognitive-Understanding, Apply
CO5	***Explain*** free and forced vibration	Cognitive-Remember, Understanding

Objectives

- The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.
- A working knowledge of statics with emphasis on force equilibrium and free body diagrams.
- Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

COURSE CONTENT

UNIT I **9+6 hrs**

INTRODUCTION TO ENGINEERING MECHANICS

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in

Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy

UNIT II **FRICTION AND BASIC STRUCTURAL ANALYSIS** **9+6 hrs**

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines

UNIT III **CENTROID , CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD** **9+6 hrs**

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

UNIT IV **REVIEW OF PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS OF RIGID BODIES** **9+6 hrs**

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

UNIT V **MECHANICAL VIBRATIONS** **9+6 hrs**

Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums

L = 45 hrs T = 30 hrs P=0 hrs Total = 75 hrs

TEXT BOOKS / REFERENCES

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by

Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Upon successful completion of the course, student will have:

- Ability to apply mathematics, science, and engineering
- Ability to design and conduct experiments, as well as to analyze and interpret data
- Ability to identify, formulate, and solve engineering problems
- Ability to apply modern engineering tools, techniques and resources to solve complex mechanical engineering activities with an understanding of the limitations.
- Ability to comprehend the thermodynamics and their corresponding processes that influence the behavior and response of structural components
- Ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) and thermodynamics to model, analyze, design, and realize physical systems, components, or processes

Mapping of COs with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO2	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO3	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO4	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO5	2	2	2	1	3	1	1	3	3	3	1	3	2	
Total	15	10	6	5	15	5	5	11	15	11	5	15	10	

1 - Low, 2 – Medium, 3- High

Semester	**II**
Subject Name	**ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS LABORATORY**
Subject Code	**XBE207**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 1– 1	**1.5:1:0.5**	**0- 0– 2 – 2**

PREREQUISITE: Physics

COURSE OBJECTIVES:

The course helps to

a. Learn the basic concepts of electrical and electronics components.
b. Understand the basic wiring methods and connection.
c. Study the characteristics of diodes, Zener diodes, NPN transistors.
d. Verify the working of simple logic gates, adders and subtractors.

Course Outcome		Domain/Level C or P or A
CO1	**Apply** the fundamental electrical concepts and **differentiate** the various electronic components.	Cognitive - Understand Psychomotor- Set Affective- Valuing
CO2	**Implement** and **execute** the different types of wiring connections.	Cognitive - Understand Psychomotor- Set Affective- Valuing
CO3	**Demonstrate** the Fluorescent lamp connection with choke.	Cognitive - Understand Psychomotor- Set Affective- Valuing
CO4	**Characterize** and **display** the basic knowledge on the working of PN junction and Zener diode.	Cognitive - Understand Psychomotor- Set Affective- Valuing
CO5	**Implement** and **execute** the various digital electronic circuits such as Adders and Subtractors.	Cognitive - Understand Psychomotor- Set Affective- Valuing

List of Experiments

1. Study of Electrical Symbols, Tools and Safety Precautions, Power Supplies.
2. Study of Active and Passive elements – Resistors, Inductors and Capacitors, Bread Board.
3. Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
4. Fluorescent lamp connection with choke.
5. Staircase Wiring
6. Forward and Reverse bias characteristics of PN junction diode.
7. Forward and Reverse bias characteristics of zener diode.
8. Input and Output Characteristics of NPN transistor.
9. Construction and verification of simple logic gates.
10. Construction and verification of adders and subtractors.

L = 0 hrs T = 0 hrs P=30 hrs Total = 30 hrs

Mapping of CO's with PO

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	1	1	1	1			1	1	1			
CO2	3	3	1	1	1	1			1	1	1			
CO3	2	2	2	1	2	2	1	1	1	1	1			
CO4	2	2	1	1	1	1	1	1	1	1	1			
CO5	2	2	1	1	1	1	1	1	1	1	1			
Total	12	12	6	5	6	6	3	3	5	5	5			
Scaled Value	3	3	2	1	2	2	1	1	1	1	1			

0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

COURSE CODE	**XAP208**	**L**	**T**	**P**	**C**
COURSE NAME	**APPLIED PHYSICS FOR ENGINEERS LAB**	**0**	**0**	**1**	**1**
C:P:A	**0:2:0**	**L**	**T**	**P**	**H**
PREREQUISITE:	**Basic Physics in HSC level**	**0**	**0**	**2**	**2**

COURSE OUTCOMES		**Domain**	**Level**
CO1	***Determine*** the significance of elasticity in engineering systems and technological advances.	Psychomotor:	Mechanism
CO2	***use*** and ***locate*** basic applications of electromagnetic induction to technology.	Psychomotor: Affective:	Mechanism Respond
CO3	***Describe*** the working principle and application of various lasers and fibre optics.	Psychomotor:	Mechanism
CO4	***use*** physics principles of latest technology using semiconductor devices.	Psychomotor:	Mechanism

LABORATORY

1.	Torsional Pendulum - determination of moment of inertia and rigidity modulus of the given material of the wire.
2.	Uniform Bending - Determination of the Young's Modulus of the material of the beam.
3.	Non-Uniform Bending - Determination of the Young's Modulus of the material of the beam.
4.	Meter Bridge - Determination of specific resistance of the material of the wire.
5.	Spectrometer - Determination of dispersive power of the give prism.
6.	Spectrometer - Determination of wavelength of various colours in Hg source using grating.
7.	Air wedge - Determination of thickness of a given thin wire.
8.	Laser - Determination of wavelength of given laser source and size of the given micro particle using Laser grating.
9.	Post office Box - Determination of band gap of a given semiconductor.
10.	PN Junction Diode - Determination of V-I characteristics of the given diode.

REFERENCE BOOKS

1. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.
2. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.

3. Umayal Sundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
Hours	**0**	**0**	**30**	**15**

Mapping of CO's with PO

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1	PS2
CO1	3	2	2	2	1	-	-	-	1	-	-	1		
CO2	3		1		1	-	-	-		-	-	1		
CO3	3	2	2	2	1	-	-	-	1	-	-	1		
CO4	3	2	2	2	1	-	-	-	1	-	-	1		
Total	**12**	**6**	**7**	**6**	**4**				**3**			**5**		
Scaled to 0,1,2,3 scale	**3**	**2**	**2**	**2**	**1**				**1**			**1**		

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

Semester	**III**
Subject Name	**PDE, PROBABILITY & STATISTICS**
Subject Code	**XME301**

L –T –P –C	C:P:A	L –T –P –H
3- 1 – 0– 4	**3.5:0.25:0.25**	**3- 1– 0 – 4**

Course Outcome		Domain/Level C or P or A
CO1	**Solve** homogeneous and non homogeneous linear partial differential equations of second order by complementary function and particular integral method.	Cognitive (Apply)
CO2	**Solve** one dimensional heat equation, wave equation using separation of variables method to simple problems in Cartesian coordinates.	Cognitive (Apply)
CO3	**Find** expectation values and moments of a discrete and continuous random variables and their properties, distribution functions Define densities of normal, exponential and gamma.	Cognitive (Remember) Psychomotor (Guided Response)
CO4	**Find** statistical parameters of the Binomial, Poisson and Normal distributions and to find correlation, regression and rank correlation coefficients of two variables.	Cognitive (Remember)
CO5	**Apply** large sample test for single proportion, difference of proportions, single mean, difference of means and to test ratio of variances, Chi square.	Cognitive(Apply) Affective(Receiving)

Objective

(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

COURSE CONTENT

UNIT I **12 hrs**

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.

UNIT II **12 hrs**

Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; 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 **12 hrs**

Expectation of Discrete Random Variables, Moments, Variance of a sum, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

UNIT IV **12 hrs**

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.

UNIT V **12 hrs**

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.

L = 45 hrs T = 15 hrs P=0 hrs Total = 60 hrs

TEXT BOOKS

1.B .S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.

2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.

REFERENCES

1.P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003 (Reprint).

2. S. Ross, "A First Course in Probability", 6th Ed., Pearson Education India, 2002.

3. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

E-REFERENCES

Nptel

Probability and Statistics by Prof.Someshkumar, Department of Mathematics, IIT Kharagpur. (http://nptel.ac.in/noc/noc_courselist.php)

Mapping of COs with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1						1	1		1

CO2	3	2	1						1	1		1
CO3	3	2	1	1					1	1		1
CO4	3	2	1	1	1	1			1	1	1	1
CO5	3	2	1	1	1	1	1		1	1	1	1
Total	15	10	5	3	2	2	1		5	5	2	5

1 - Low, 2 – Medium, 3- High

Semester	**III**
Subject Name	**THERMODYNAMICS**
Subject Code	**XME302**

L –T –P –C	**C:P:A**	**L –T –P –H**
3- 1 – 0– 4	**3.5:0.25:0.25**	**3- 1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	After completing this course, the students will be able to ***apply*** energy balance to systems and control volumes, in situations involving heat and work interactions	Cognitive –Applying
CO2	Students can ***Study*** the changes in thermodynamic properties of substances	Cognitive – Remembering
CO3	The students will be able to ***study*** the performance of energy conversion devices	Cognitive – Remembering
CO4	The students will be able to ***differentiate*** between high grade and low grade energies.	Cognitive – Understanding
CO5	Student can ***apply*** the energy balance to systems operating at different cycles.	Cognitive - Applying

The objective of this course

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

COURSE CONTENT

UNIT I	**BASIC CONCEPTS**	**5 hrs**

Fundamentals - System & Control volume; Property, State & Process; Exact & 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.

UNIT II	**LAWS OF THERMODYNAMICS**	**5 hrs**

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 & Non-cyclic processes; Concept of total energy E ;

Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy

UNIT III PROPERTIES OF SUBSTANCES AND STEAM TABLES 8 hrs

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 & determination of properties, Mollier's chart.

UNIT IV FLOW PROCESS AND THERMO DYNAMIC RELATIONS 10 hrs

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 V ENTROPY AND CYCLES 12 hrs

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 T-s 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.

L = 40 hrs T = 12 hrs P=0 hrs Total = 52 hrs

TEXT BOOKS / REFERENCES

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

Mapping of COs with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2
CO1	2	-	1	-	3	-	2	2	2	-	-	2		3
CO2	3	-	-	2	3	-	1	-	1	-	-	3		3
CO3	1	-	1	3	1	-	1	2	-	2	-	1		3

CO4	2	-	-	1	1	-	2	1	2	2	-	1		3
CO5	-	-	-	1	1	-	-	-	1	1	-	2		3
Total	8	-	2	7	9	-	6	5	6	5	-	9		15

1 - Low, 2 – Medium, 3- High

Semester	**III**
Subject Name	**STRENGTH OF MATERIALS**
Subject Code	**XME303**

L –T –P –C	**C:P:A**	**L –T –P –H**
3- 1 – 0– 4	**3.5:0.25:0.25**	**3- 1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	After completing this course, the students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components	Cognitive (Understand, Apply)
CO2	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	Cognitive (Understand, Apply)
CO3	The students will be able to understand inertia and different types of springs and evaluate the different types of inertia and deflection of different types of beams with different loading conditions.	Cognitive (Understand, Apply)
CO4	The students will be able to understand torsion on shaft and springs and evaluate deflection, torsional stresses on shaft, helical spring and leaf spring	Cognitive (Understand, Apply)
CO5	After completing this course, The students will be able to understand and compute stresses in hollow cylindrical and spherical objects.	Cognitive (Understand, Apply)

Objectives

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

COURSE CONTENT

UNIT I **STRESS, STRAIN AND DEFORMATION OF SOLIDS** **8 hrs**

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 - LOADS AND STRESSES	8 hrs

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	DEFLECTION OF BEAMS	8 hrs

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

UNIT IV	TORSION AND SHAFTS	8 hrs

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs

UNIT V	ANALYSIS OF STRESSES IN TWO DIMENSIONS	8 hrs

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

L = 40 hrs T = 12 hrs P=0 hrs Total = 52 hrs

TEXT BOOKS / REFERENCES

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.

Mapping of COs with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	3	1	2	1	2	1	2	3	2	
CO2	3	3	2	3	3	1	2	1	2	1	3	3	2	
CO3	3	3	2	3	3	1	2	1	2	1	2	3	2	
CO4	3	3	2	3	3	1	2	1	2	1	2	3	2	
CO5	3	3	2	3	3	1	2	1	2	1	3	3	2	
Total	15	15	10	15	15	5	10	5	10	5	12	15	10	

1 - Low, 2 – Medium, 3- High

Semester	**III**
Subject Name	**ENGINEERING MECHANICS**
Subject Code	**XEM304**

L –T –P –C	C:P:A	L –T –P –H
3- 1 – 0– 4	**3.5:0.25:0.25**	**3- 1– 0 – 4**

Course Outcome	Domain/Level C or P or A

CO1	***Explain*** the principles forces, laws and their applications.	Cognitive-Understanding, Apply
CO2	***Classification*** of friction, and ***apply*** the forces in Trusses and beams.	Cognitive-Understanding, Apply
CO3	***Explain*** and ***Apply*** moment of Inertia and Virtual work	Cognitive-Understanding, Apply
CO4	***Outline*** and ***Examine*** Dynamics	Cognitive-Understanding, Apply
CO5	***Explain*** free and forced vibration	Cognitive-Remember, Understanding

Objectives

- The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.
- A working knowledge of statics with emphasis on force equilibrium and free body diagrams.
- Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

COURSE CONTENT

UNIT I	**INTRODUCTION TO ENGINEERING MECHANICS**	**9+6 hrs**
	Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy	
UNIT II	**FRICTION AND BASIC STRUCTURAL ANALYSIS**	**9+6 hrs**
	Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines	
UNIT III	**CENTROID , CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD**	**9+6 hrs**
	Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.	
UNIT IV	**REVIEW OF PARTICLE DYNAMICS AND INTRODUCTION**	**9+6 hrs**

	TO KINETICS OF RIGID BODIES	
	Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.	
UNIT V	**MECHANICAL VIBRATIONS**	**9+6 hrs**
	Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums	

L = 45 hrs T = 30 hrs P=0 hrs Total = 75 hrs

TEXT BOOKS / REFERENCES

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Upon successful completion of the course, student will have:

- Ability to apply mathematics, science, and engineering
- Ability to design and conduct experiments, as well as to analyze and interpret data
- Ability to identify, formulate, and solve engineering problems
- Ability to apply modern engineering tools, techniques and resources to solve complex mechanical engineering activities with an understanding of the limitations.
- Ability to comprehend the thermodynamics and their corresponding processes that influence the behavior and response of structural components
- Ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) and thermodynamics to model, analyze, design, and realize physical systems, components, or processes

Mapping of COs with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO2	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO3	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO4	3	2	1	1	3	1	1	2	3	2	1	3	2	
CO5	2	2	2	1	3	1	1	3	3	3	1	3	2	
Total	15	10	6	5	15	5	5	11	15	11	5	15	10	

1 - Low, 2 – Medium, 3- High

Semester	**III**	
Subject Name	**ENTREPRENEURSHIP DEVELOPMENT**	
Subject Code	**XUM305**	
L –T –P –C **3- 0 – 0– 3**	**C:P:A** **2.7:0:0.3**	**L –T –P –H** **3- 0– 0 – 3**

Course Outcome		**Domain/Level** **C or P or A**
CO1	***Recognise*** and ***describe*** the personal traits of an entrepreneur.	C (Understand) A(Receiving)
CO2	***Determine*** the new venture ideas and ***analyse*** the feasibility report.	C(Understand, Analyze)
CO3	***Develop*** the business plan and ***analyse*** the plan as an individual or in team.	C (Analyze) A(Receiving)
CO4	***Describe*** various parameters to be taken into consideration for launching and managing small business.	C (Understand)
CO5	***Explain*** the technological management and Intellectual Property Rights	C (Understand)

COURSE CONTENT

UNIT I	**ENTREPRENEURIAL TRAITS AND FUNCTIONS**	**9 hrs**
	Definition of Entrepreneurship; competencies and traits of an entrepreneur; factors affecting Entrepreneurship Development; Role of Family and Society ; Achievement Motivation; Entrepreneurship as a career and national development;	
UNIT II	**NEW PRODUCT DEVELOPMENT AND VENTURE CREATION**	**9hrs**
	Ideation to Concept development; Sources and Criteria for Selection of Product; market assessment ; Feasibility Report ;Project Profile; processes involved in starting a new venture; legal formalities; Ownership; Case Study.	
UNIT III	**ENTREPRENEURIAL FINANCE**	**9 hrs**
	Financial forecasting for a new venture; Finance mobilization; Business plan preparation;	

	Sources of Financing, Angel Investors and Venture Capital; Government support in startup promotion.	
UNIT IV	**LAUNCHING OF SMALL BUSINESS AND ITS MANGEMENT**	**9hrs**
	Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units.	
UNIT V	**TECHNOLOGY MANAGEMENT, IPR PORTFOLIO FOR NEW PRODUCT VENTURE**	**9hrs**
	Technology management; Impact of technology on society and business; Role of Government in supporting Technology Development and IPR protection; Entrepreneurship Development Training and Other Support Services.	
L = 45 hrs T = 0 hrs P=0hrs Total = 45hrs		

TEXT BOOKS

1. Hisrich, 2016, *Entrepreneurship*, Tata McGraw Hill, New Delhi.
2. S.S.Khanka, 2013, *Entrepreneurial Development*, S.Chand and Company Limited, New Delhi.

REFERENCES

1. Mathew Manimala, 2005, *Entrepreneurship Theory at the Crossroads, Paradigms & Praxis*, Biztrantra ,2nd Edition.
2. Prasanna Chandra, 2009, *Projects – Planning, Analysis, Selection, Implementation and Reviews*, Tata McGraw-Hill.
3. P.Saravanavel, 1997, *Entrepreneurial Development*, Ess Pee kay Publishing House, Chennai.
4. Arya Kumar,2012, *Entrepreneurship: Creating and Leading an Entrepreneurial Organisation*, Pearson Education India.
5. Donald F Kuratko, T.V Rao, 2012, *Entrepreneurship: A South Asian perspective*, Cengage Learning India.
6. Dinesh Awasthi, Raman Jaggi, V.Padmanand, Suggested Reading / Reference Material for Entrepreneurship Development Programmes (EDP/WEDP/TEDP), EDI Publication, Entrepreneurship Development Institute of India, Ahmedabad. Available from: http://www.ediindia.org/doc/EDP-TEDP.pdf

E-REFERENCES

1. Jeff Hawkins, " Characteristics of a successful entrepreneur", ALISON Online entrepreneurship courses, "https://alison.com/learn/entrepreneurial-skills
2. Jeff Cornwall, "Entrepreneurship -- From Idea to Launch", Udemy online Education, https://www.udemy.com/entrepreneurship-from-idea-to-launch/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	1	0	3	1	0	3	1	2	2	1	1
CO2	1	2	3	1	0	3	1	3	3	1	2	2	1	1
CO3	1	2	3	1	0	3	1	0	3	1	2	2	1	1
CO4	1	2	2	1	0	3	1	1	3	3	3	3	1	1
CO5	1	3	3	1	0	3	1	3	3	3	3	3	1	1
	5	10	14	5	0	15	5	7	15	9	12	12	5	5

1 - Low , 2 – Medium , 3- High

Semester	**III**	
Subject Name	**MANUFACTURING PROCESSES**	
Subject Code	**XME306**	
L –T –P –C **3- 0 – 0– 3**	**C:P:A** **3:0:0**	**L –T –P –H** **3- 0– 0 – 3**

Course Outcome		**Domain/Level** **C or P or A**
CO1	Summarise the metal casting and metal forming process. Identify the defects in the metal casting process.	C (Understand)
CO2	Relate the various cutting force components for the formation of chip. Identify the tool wear, tool life, cutting tool materials, cutting fluids.	C(Apply)
CO3	Compare various additive manufacturing and joining process	C (Understand)
CO4	Explain electrical energy and chemical based unconventional machining process	C (Understand)
CO5	Explain mechancial and thermal energy based unconventional machining process	C (Understand)

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

COURSE CONTENT

UNIT I	**CONVENTIONAL MANUFACTURING PROCESSES**	**9 hrs**
	Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.	
UNIT II	**METAL CUTTING**	**9hrs**
	Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining	
UNIT III	**ADDITIVE MANUFACTURING AND JOINING PROCESS**	**9 hrs**
	Rapid prototyping and rapid tooling Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.	
UNIT IV	**UNCONVENTIONAL MACHINING PROCESSES – ELECTRICAL ENERGY AND CHEMICAL BASED PROCESS**	**9hrs**
	Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish.	

UNIT V	UNCONVENTIONAL MACHINING PROCESSES – MECHANCIAL AND THERMAL ENERGY BASED PROCESS	9hrs
	Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic, Machining, principles and process parameters	
L = 45 hrs T = 0 hrs P=0hrs Total = 45hrs		

TEXT BOOKS

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India,2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

REFERENCES

1. Paul Degarma E, Black J.T. and Ronald A. Kosher, Elighth Edition, Materials and
2. Processes, in Manufacturing Prentice – Hall of India, 2003.
3. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd., 2004.
4. P.N. Rao, Manufacturing Technology- Foundry, Forming and Welding, TMH-2003; 2nd Edition, 2003
5. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson Education, 2006.
6. Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
7. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998
8. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

E-REFERENCES

1. http://nptel.iitm.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	2	-	-	2	-	1	2	3	3	
CO2	3	3	3	1	2	-	-	2	-	1	2	3	3	
CO3	3	3	3	1	2	-	-	2	-	1	2	3	3	
CO4	3	3	3	-	2	-	-	2	-	1	2	3	3	
CO5	3	3	3	-	2	-	-	2	-	1	2	3	3	
	15	15	15	2	10	-	-	10	-	5	10	15	15	

1 - Low, 2 – Medium, 3- High

Semester	**III**
Subject Name	**Mechanical Engineering Laboratory I (Manufacturing)**
Subject Code	**XME307**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 1– 1	**0:1:0**	**0- 0– 2 – 2**

Course Outcome	**Domain/Level** **C or P or A**
Experiment with welding and riveting	Coginitive (Remembering) (Applying) Psychomotor (Guided response) (Perception)
Experiment with Lathe for turning, knurling and threading	Coginitive (Remembering) (Applying) Psychomotor (Guided response) (Perception)
Measure cutting forces and tool deformation	Coginitive (Remembering) (Applying) Psychomotor (Guided response) (Perception)
Measure and compare linear dimensions of work pieces	Coginitive (Remembering) (Applying) Psychomotor (Guided response) (Perception)
Understand advanced measurement techniques	Coginitive (Remembering) (Applying) Psychomotor (Guided response) (Perception)

Objectives:

1. To provide an understanding of advanced manufacturing methods.
2. To get an idea of the dimensional & form accuracy of products

COURSE CONTENT

		CO Relation
1.	Arc welding – complex joints (any one type)	CO1
2.	Riveted joints	CO1
3.	Taper turning and external thread cutting using lathe	CO2
4.	Step turning and knurling using lathe	CO2
5.	Measurement of cutting forces in Turning process	CO3

6.	Use of Tool Maker's Microscope	CO3
7.	Bore diameter measurement using Vernier Caliper and telescopic gauge	CO4
8.	Comparator and sine bar	CO4
9.	Use of Autocollimator	CO5
10.	Surface finish measurement equipment	CO5

TEXT BOOKS

1. Hajra Choudhury S.K and Hajra Choudhury. A.K., "Elements of Workshop Technology, Volume I and II", Media Promoters and Publishers Private Limited, Mumbai.
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005
3. Mikell. P. Groover, Automation Production Systems, and Computer Integrated Manufacturing, Prentice Hall of India Ltd., New Delhi, 1998.
4. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES

1. Paul Degarma E, Black J.T. and Ronald A. Kosher, Materials and Processes, in Manufacturing Prentice – Prentice Hall of India.
2. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd.,
3. Milton C.Shaw, 'Metal Cutting Principles', Oxford University Press, Second edition,2005.
4. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2003.
5. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005

E-REFERENCES

1.http://nptel.iitm.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	2	1	1	-	-	1	-	-	1		3
CO2	2	3	-	2	1	1	-	-	-	-	-	1		3
CO3	2	3	-	2	1	1	-	-	1	-	-	1		3
CO4	2	3	2	1	1	1	-	-	1	-	-	1		3
CO5	2	3	-	2	1	1	-	-	-	-	-	1		3
	10	15	2	9	5	5			3			5		15

1 - Low, 2 – Medium, 3- High

Semester	**III**	
Subject Name	**Inplant Training – I (15 days)**	
Subject Code	**XME308**	
L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 2– 0	**0:2:0**	**0- 0– 2– 0**
Course Outcome		**Domain/Level C or P or A**

Objectives:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Semester	**IV**	
Subject Name	**APPLIED THERMODYNAMICS**	
Subject Code	**XME401**	
L –T –P –C **3- 1– 0– 4**	**C:P:A** **3.5:0.25:0.25**	**L –T –P –H** **3- 1– 0 – 4**

Course Outcome		**Domain/Level** **C or P or A**
CO1	Understanding of basic fuel types and Calculation of air fuel mixtures or combustion	C (Understand)
CO2	After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.	C(Understand, Analyze)
CO3	Understanding of basic principles of psychrometry and solving the problems of psychrometric chart.	C (Analyze)
CO4	They will be able to understand phenomena occurring in high speed compressible flow	C (Understand)
CO5	They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.	C (Understand)

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

COURSE CONTENT

UNIT I	**Fuels and Stoichiometry**	**8 hrs**
	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	**Power cycles**	**12 hrs**
	Vapor power cycles Rankine cycle with superheat, reheat and regeneration, enregy analysis. Super-critical 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	**Psychyrometry**	**4 hrs**
	Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	
UNIT IV	**Compressible flow and Shocks**	**8 hrs**
	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, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser	
UNIT V	**Compressors and Steam turbines**	**8 hrs**
	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors and Analysis of steam turbines, velocity and pressure compounding of steam turbines	
L = 40 hrs T = 12 hrs P=0hrs Total = 52hrs		

TEXT BOOKS / REFERENCES

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.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	0	0	0	1	3	0	3	3		3
CO2	3	3	1	0	2	0	0	2	3	0	3	3		3
CO3	3	3	1	1	1	0	0	2	3	0	3	3		3
CO4	3	3	1	0	0	0	0	0	3	0	3	3		3
CO5	1	2	1	0	0	0	0	3	3	0	3	3		3
	13	13	5	3	3	0	0	8	15	0	15	15		15

1 - Low, 2 – Medium, 3- High

Semester	**IV**
Course Name	**SOLID MECHANICS**
Course Code	**XME402**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 1 – 0– 4	**3.5:0.25:0.25**	**3–1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	Understand and apply the concepts of 3-dimensional state of strain and stress under different types of loading	C (U), C (App)

CO2	Understand and apply constitutive relations for simple geometries	C (U), C (App)
CO3	Apply the deformation concepts for plane stress and plane strain problems	C (App)
CO4	Apply the deformation concepts for complex cases	C (App)
CO5	Understand and apply energy and potential methods.	C (U), C (App)

Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

COURSE CONTENT

UNIT I	**STRAIN AND STRESS**	**9+6 = 15 Hours**

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions

UNIT II	**CONSTITUTIVE EQUATIONS**	**9+6 = 15 Hours**

Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

UNIT III	**PLANE STRESS AND PLANE STRAIN**	**9+6 = 15 Hours**

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

UNIT IV	**APPLICATION TO COMPLEX CASES**	**9+6 = 15 Hours**

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.

UNIT V	**ENERGY METHODS**	**9+6 = 15 Hours**

Solutions using potentials. Energy methods. Introduction to plasticity.

L = 45 Hours **Tutorial = 15 Hours** **Total = 60 Hours**

TEXT BOOKS

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

REFERENCES

1. S. M. A. Kazimi, Solid Mechanics, First Edition, Tata McGraw Hill Publications, 2001.

E-REFERENCES

1. https://nptel.ac.in/courses/112107147
2. https://nptel.ac.in/syllabus/105101003

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	-	2	1	-	-	-	1	-	-	-	2	
CO2	3	2	-	2	1	-	-	-	1	-	1	1	2	
CO3	3	1	-	1	1	-	-	1	1	-	1	1	2	
CO4	3	2	-	2	1	-	-	-	1	-	-	-	2	
CO5	3	3	3	3	2	-	-	2	1	-	3	3	2	
	15	10	3	10	6			3	5		5	5	10	

1 - Low, 2 – Medium, 3- High

Semester	**IV**
Course Name	**HUMAN ETHICS, VALUES, RIGHTS AND GENDER EQUALITY**
Course Code	**XUM403**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 0 – 0– 0	**3:0:0**	**3–0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	***Relate*** and ***Interpret*** the human ethics and human relationships	C(Remember, Understand)
CO2	***Explain*** and ***Apply*** gender issues, equality and violence against women	C(Understand, Apply)
CO3	***Classify*** and ***Develop*** the identify of women issues and challenges.	C (Analyze) A (Receive)
CO4	***Classify*** and ***Dissect*** human rights and report on violations.	C(Understand. Analyze)
CO5	***List*** and **respond** to family values, universal brotherhood, fight against corruption by common man and good governance.	C (Remember) A(Respond)

COURSE CONTENT

UNIT I	**HUMAN ETHICS AND VALUES**	**7 Hours**

Human Ethics and values - Understanding of oneself and others- motives and needs- Social service, Social Justice, Dignity and worth, Harmony in human relationship: Family and Society, Integrity and Competence, Caring and Sharing, Honesty and Courage, WHO's holistic development - Valuing Time, Co-operation, Commitment, Sympathy and Empathy, Self respect, Self-Confidence, character building and Personality.

UNIT II	**GENDER EQUALITY**	**9 Hours**

Gender Equality - Gender Vs Sex, Concepts, definition, Gender equity, equality, and empowerment. Status of Women in India Social, Economical, Education, Health, Employment, HDI, GDI, GEM. Contributions of Dr.B.R. Ambethkar, Thanthai Periyar and Phule to Women Empowerment.

UNIT III	**WOMEN ISSUES AND CHALLENGES**	**9 Hours**

Women Issues and Challenges- Female Infanticide, Female feticide, Violence against women, Domestic violence, Sexual Harassment, Trafficking, Access to education, Marriage. Remedial Measures – Acts related to women: Political Right, Property Rights, and Rights to Education, Medical Termination of Pregnancy Act, and Dowry Prohibition

Act.

UNIT IV HUMAN RIGHTS **9 Hours**

Human Rights Movement in India – The preamble to the Constitution of India, Human Rights and Duties, Universal Declaration of Human Rights (UDHR), Civil, Political, Economical, Social and Cultural Rights, Rights against torture, Discrimination and forced Labour, Rights and protection of children and elderly. National Human Rights Commission and other statutory Commissions, Creation of Human Rights Literacy and Awareness. - Intellectual Property Rights (IPR). National Policy on occupational safety, occupational health and working environment.

UNIT V GOOD GOVERNANCE AND ADDRESSING SOCIAL ISSUES **11 Hours**

Good Governance - Democracy, People's Participation, Transparency in governance and audit, Corruption, Impact of corruption on society, whom to make corruption complaints, fight against corruption and related issues, Fairness in criminal justice administration, Government system of Redressal. Creation of People friendly environment and universal brotherhood.

L = 15 Hours Self study – 30 Hours Tutorial = 0 Hours Total = 45 Hours

REFERENCES

1. Aftab A, (Ed.), Human Rights in India: Issues and Challenges, (New Delhi: Raj Publications, 2012).
2. Bajwa, G.S. and Bajwa, D.K. Human Rights in India: Implementation and Violations (New Delhi: D.K. Publications, 1996).
3. Chatrath, K. J. S., (ed.), Education for Human Rights and Democracy (Shimala: Indian Institute of Advanced Studies, 1998).
4. Jagadeesan. P. Marriage and Social legislations in Tamil Nadu, Chennai: Elachiapen Publications, 1990).
5. Kaushal, Rachna, Women and Human Rights in India (New Delhi: Kaveri Books, 2000)
6. Mani. V. S., Human Rights in India: An Overview (New Delhi: Institute for the World Congress on Human Rights, 1998).
7. Singh, B. P. Sehgal, (ed) Human Rights in India: Problems and Perspectives (New Delhi: Deep and Deep, 1999).
8. Veeramani, K. (ed) Periyar on Women Right, (Chennai: Emerald Publishers, 1996)
9. Veeramani, K. (ed) Periyar Feminism, (Periyar Maniammai University, Vallam, Thanjavur: 2010).
10. Central Vigilance Commission (Gov. of India) website: http://cvc.nic.in/welcome.html.
11. Weblink of Transparency International: https://www.transparency.org/

Weblink Status report: https://www.hrw.org/world-report/2015/country-chapters/india

Table 1: Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1								2						
CO2								3	1					
CO3								2						
CO4								3		2				
CO5								3	2	2		2		
Total		2						13	3	4		2		
Scaled Value		1						3	1	1		1		

1 – 5 → 1, 6-10 → 2, 11 – 15→ 3

0 – No relation, 1 – Low relation, 2 – Medium relation, 3 – High relation

Semester	**IV**
Course Name	**FLUID MECHANICS & FLUID MACHINES**
Course Code	**XME404**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 1 – 0– 4	**3.5:0.25:0.25**	**3–1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	**Recalling** of fluids properties and **understanding** the equations related to fluid flow. Ability to **solve** problems related to momentum equation and Bernoulli's equation	**Cognitive-** Remembering, understanding and apply
CO2	**Understanding** the concept of incompressible fluid flow fluid flow through channels and ducts. **Discuss** the concept of boundary layer and ability **apply** Darcy Weisbach equation in different condition	**Cognitive-** Understanding and apply
CO3	**Understanding** the need and methods of dimensional analysis and ability to **derive** equations using dimensional analysis	**Cognitive-** Understanding and apply
CO4	**Explain** the working of different types of pumps and ability to **analyze** its performance	**Cognitive-** Understanding analyze and apply
CO5	**Explain** the working of different types of turbines and ability to **analyze** its performance	**Cognitive-** Understanding analyze and apply

Objectives

- To learn about the application of mass and momentum conservation laws for fluid flows
- To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows
- To analyze the flow in water pumps and turbines.

COURSE CONTENT

UNIT I	**BASIC CONCEPTS AND PROPERTIES OF FLUIDS**	**9 Hours**

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications

UNIT II	**IN COMPRESSIBLE FLUID FLOW**	**9 Hours**

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram

UNIT III	**DIMENSIONAL ANALYSIS**	**6 Hours**

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis

UNIT IV **HYDRAULIC PUMPS** **8 Hours**

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle

UNIT V **HYDRAULIC TURBINES** **8 Hours**

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines

L = 40 Hours **Tutorial = 12 Hours** **Total = 52 Hours**

TEXT BOOKS / REFERENCE BOOKS

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2003.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.
3. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 2008.
4. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition, 2004.
5. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 2005.
6. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi, 2008.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	3	1	1	1	1	1	1	1		2
CO2	3	3	2	1	3	1	1	2	2	2	1	2		2
CO3	3	3	0	1	3	1	0	2	1	1	0	1		2
CO4	3	3	1	2	3	1	1	2	2	2	1	2		2
CO5	3	3	2	2	3	1	1	2	2	2	1	2		2
Tot	15	15	6	7	15	5	4	9	10	10	4	8		10

1 - Low, 2 – Medium, 3- High

Semester	**IV**
Course Name	**MATERIALS ENGINEERING**
Course Code	**XME405**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 0 – 0– 3	**3:0:0**	**3–0– 0 – 3**

Course Outcome	**Domain/Level**

		C or P or A
CO1	***Recall*** the Basic Properties of Engineering Materials.	Cognitive
CO2	***Classify*** static failure theories.	Cognitive
CO3	***Classify*** the concepts of iron and steel.	Cognitive
CO4	***Analyze*** the heat treatment process and its applications.	Cognitive
CO5	***Analyze*** the properties of alloys.	Cognitive

Objectives

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.

2. To provide a detailed interpretation of equilibrium phase diagrams

3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

COURSE CONTENT

UNIT I **PROPERTIES OF METALLIC MATERIALS** **9 Hours**

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids:Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slipsystems, critically resolved shear stress.Mechanical Property measurement: Tensile, compression and torsion tests; Young'smodulus, relations between true and engineering stress-strain curves, generalized Hooke'slaw, yielding and yield strength, ductility, resilience, toughness and elastic recovery;Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT II **STATIC FAILURE THEORIES** **9 Hours**

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

UNIT III **ALLOYS AND PHASE DIAGRAMS** **9 Hours**

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT IV **HEAT TREATMENT OF MATERIALS** **9 Hours**

Heat treatment of Steel: Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT V **MODERN ENGINEERING MATERIALS** **9 Hours**

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

L = 45 Hours **Tutorial = 0 Hours** **Total = 45 Hours**

TEXT BOOKS

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition,Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

REFERENCE BOOKS

1. Koch, C. C. Nanostructured materials: processing and applications: William Andrew Pub.
2.James F Shackelford, S "Introduction to materials Science for Engineers", 6 th Macmillan Publishing Company, New York, 2004
3.William D CallisterJr, "Materials Science and Engineering – An Introduction", John Wiley and Sons Inc., 6 th edition, New York, 2003
4.Jayakumar S, "Materials Science", RK Publishers, Coimbatore, 2004
5. Bolton, W., Engineering materials technology: Butterworth-Heinemann.

E RESOURCES

1.NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112: related web and video resources under Mechanical Engineering &Metallurgy and Material Science categories
2.http://www.intechopen.com/books

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	3	1	1	-	2	3	3	1	3	2	1
CO2	3	3	1	1	1	-	-	1	1	2	3	2	2	1
CO3	3	2	1	1	1	-	-	1	2	3	1	3	2	1
CO4	2	3	1	3	1	-	-	1	1	2	3	2	2	1
CO5	3	2	3	3	1	1	-	1	3	3	2	1	2	1
Tot	13	12	9	11	5	2		6	10	13	10	11	10	5

1 - Low, 2 – Medium, 3- High

Semester	**IV**
Course Name	**INSTRUMENTATION & CONTROL**
Course Code	**XME406**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 1 – 0– 4	**3.5:0.25:0.25**	**3–1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	***Understand*** the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices.	C (Understand)
CO2	***Understand*** the instrumentation system and elements.	C (Understand)
CO3	***Design*** various Controllers	C (Create)
CO4	***Understand*** the instrumentation system models and functions.	C (Understand)
CO5	***Create*** a project using Instrumentation systems.	C (Create)

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

COURSE CONTENT

UNIT I	**Measurement systems and Characteristics**	**9 Hours**
	Measurement systems and performance – accuracy, range, resolution, error sources.	
UNIT II	**Instrumentation systems and elements**	**9 Hours**
	Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric.	
UNIT III	**Controllers**	**8 Hours**
	Control systems – basic elements, open/closed loop, design of block diagram; control method P, PI, PID, when to choose what, tuning of controllers.	
UNIT IV	**Models**	**8 Hours**
	System models, transfer function and system response, frequency response; Nyquist diagrams and their use.	
UNIT V	**Project**	**6 Hours**
	Practical group based project utilizing above concepts.	

L = 40 Hours **Tutorial = 12 Hours** **Total = 52 Hours**

TEXT BOOKS / REFERENCE 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.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													1	1
CO2													1	1
CO3													1	1
CO4													1	1
CO5													1	1
Tot													5	5

1 - Low, 2 – Medium, 3- High

Semester	**IV**
Subject Name	**Mechanical engineering laboratory II**
	(Thermal Engineering and Fluid Mechanics)
Subject Code	**XME407**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 1– 1	**0:1:0**	**0- 0– 2 – 2**

Course Outcome	**Domain/Level C or P or A**
Measure various properties of fluids using equipments.	Coginitive (Understanding) Psychomotor (Guided response)
Characterize the performance of various fluid machineries.	Coginitive (Understanding) Psychomotor (Guided response)
Determine the various thermal properties.	Coginitive (Understanding) Psychomotor (Guided response)
Identify the Performance of the engines and ***Analyze*** the heat transfer coefficients in different modes.	Coginitive (Understanding) Psychomotor (Guided response)
Determine and ***Experimen***t with emissivity and vapour compression system.	Coginitive (Understanding) Psychomotor (Guided response)

Objectives:

(i) To understand the principles and performance characteristics of flow and thermal devices

(ii) To know about the measurement of the fluid properties

COURSE CONTENT

		CO Relation
1.	Measurement of Coefficient of Discharge of given Orifice and Venturi meters	CO1
2.	Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe	CO1
3.	Determination of the performance characteristics of a centrifugal pump	CO2
4.	Determination of the performance characteristics of Pelton Wheel	CO2
5.	Determination of the performance characteristics of a Francis Turbine	CO2
6.	Determination of the performance characteristics of a Kaplan Turbine	CO2
7.	Determination of the thermal conductivity and specific heat of given objects	CO3
8.	Determination of the calorific value of a given fuel and its flash & fire points	CO3
9.	Determination of the p-V diagram and the performance of a 4-stroke diesel engine	CO4

10.	Determination of the convective heat transfer coefficient for flow over a heated plate	CO4
11.	Determination of the emissivity of a given sample	CO5
12.	Determination of the performance characteristics of a vapour compression system	CO5

TEXT BOOKS

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2003.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.
3. A. Bejan, Heat Transfer John Wiley, 1993
4. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
5. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
6. Rajput, R.K., Thermal Engineering, 6th Edition, Laxmi Publications, 2007
7. Ballaney, P.L., "Thermal Engineering" , Khanna Publishers, 24th Edition, 2003.
8. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.

REFERENCES

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 2008.
2. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition, 2004.
3. Rudramoorthy, R., Thermal Engineering, 4th Edition, Tata McGraw Hill, New Delhi, 2006.
4. Kothandaraman , C.P., Domkundwar .S and A.v. Domkundwar", a course in thermal Engineering", Dhanpal Rai & sons, fifth edition, 2002.
5. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2011.
6. R.B.Mathur and R.P. Sharma, Internal combustion Engines.

E-REFERENCES

1.http://nptel.iitm.ac.in/courses

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	2	1	1	-	-	1	-	-	1		3
CO2	2	3	-	2	1	1	-	-	-	-	-	1		3
CO3	2	3	-	2	1	1	-	-	1	-	-	1		3
CO4	2	3	2	1	1	1	-	-	1	-	-	1		3
CO5	2	3	-	2	1	1	-	-	-	-	-	1		3
	10	15	2	9	5	5			3			5		15

1 - Low, 2 – Medium, 3- High

Semester	**V**
Course Name	**Operations Research**
Course Code	**XME501**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 1 – 0– 4	**3.5:0.25:0.25**	**3–1– 0 – 4**

Course Outcome	**Domain/Level**
	C or P or A

CO1	***Explain*** the basic concepts of optimization and To F***ormulate*** and Solve linear programming problems.	C(Understand, Apply)
CO2	***Apply*** the concepts of transportation problem, assignment problem and travelling salesman problem Participate in the class discussion in the transportation model.	C(Apply) A(Respond to phenomena)
CO3	***Explain*** and demonstrate the basic concepts of PERT- CPM and their applications in product planning control.	C(Understand)
CO4	***Solve*** the Minimal Spanning Tree Problem, Shortest Route Problem, Maximal Flow Problem and Minimal Cost Capacitated Flow Problem**.** Reproduce the Network model.	C(Apply) P(Guided Response)
CO5	***Apply*** the concepts of Game theory to Find the solution and saddle point.	C(Apply, Remember)

COURSE CONTENT

UNIT I	**LINEAR MODELS**	**12 Hours**

Basics of OR, Linear programming problems (L.P.P), Mathematical Formulation of L.P.P, Graphical method, Simplex algorithm, Duality.

UNIT II	**TRANSPORTATION MODELS**	**12 Hours**

Transportation problem, Assignment problem, Travelling Salesman problem.

UNIT III	**PROJECT SCHEDULING BY PERT-CPM**	**12 Hours**

PERT-CPM, product planning control with PERT-CPM.

UNIT IV	**NETWORK MODELS**	**12 Hours**

Network definition, Minimal Spanning Tree Problem, Shortest Route Problem, Maximal Flow Problem, Minimal Cost Capacitated Flow Problem.

UNIT V	**GAME THEORY**	**12 Hours**

Introduction - competitive game - finite and infinite game - two person zero sum game - rectangular game - solution of game- saddle point, solution of a rectangular game with saddle point.

L = 45 Hours **Tutorial = 15 Hours** **Total = 60 Hours**

TEXT BOOKS

1. Kantiswaroop,Gupta P.K and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, (2008).(Unit I,II,III & V)
2. R.Paneerselvam, Operations Research,PHI Learning Private Limited,NewDelhi,(2010)(Unit IV)

REFERENCE BOOKS

1.Hadley G, Linear Programming, Narosa publishing House, (1995).
2. Hadley G, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass, (1973).
3. Gupta R. K. “Linear Programming”,Krishna Prakashan Media(P) Ltd. ,(2009).

E – REFERENCES

1. www.nptel.ac.in
2. Fundamentals of Operations Research, Advanced Operation Research Prof.G.Srinivasan, Department of Management Studies, Indian Institute of Technology, Madras.

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1			1		1		1	
CO2	3	1		1			1		1			
CO3	3	1		1			1		1			
CO4	3	1		1			1		1		1	
CO5	3	1		1			1		1			
Tot	15	5	0	5	0	0	5	0	5	0	2	0

1 - Low, 2 – Medium, 3- High

Semester	**V**
Subject Name	**Heat Transfer**
Subject Code	**XME502**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 - 1 – 0– 4	**3.5:0.25:0.25**	**3- 1– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	Understand the basic modes of heat transfer and Compute temperature distribution in steady-state and unsteady-state heat conduction.	C (Rem)
CO2	Interpret and analyse forced and free convection heat transfer.	C (Rem)
CO3	Understand the principles of radiation heat transfer and basics of mass transfer.	C (Rem)
CO4	Design heat exchangers using LMTD and NTU methods.	C (Understand)
CO5	Understand the basic concepts of mass transfer	C (understand)

Objectives:

(1) The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.

(2) Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.

(3) The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

COURSE CONTENT

UNIT I	**CONDUCTION**	**10+5 hrs**
	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady onedimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry,concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conductionsolutions for both steady and unsteady heat transfer- approximate solution to unsteady conductionheat transfer by the use of Heissler charts.	
UNIT II	**CONVECTION**	**8+5 hrs**

Heat convection,basic equations, boundary layers- Forced convection, external and internal flows-Natural convective heat transfer- Dimensionless parameters for forced and free convection heattransfer-Correlations for forced and free convection- Approximate solutions to laminar boundarylayer equations (momentum and energy) for both internal and external flow- Estimating heat transferrates in laminar and turbulent flow situations using appropriate correlations for free and forcedconvection.

UNIT III **RADIATION** **8+5 hrs**

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law,black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiativeproperties, view factors and the radiosity method.

UNIT IV **HEAT EXCHANGERS** **9+5 hrs**

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods .Boiling and Condensation heat transfer, Pool boiling curve.

UNIT V **MASS TRANSFER** **5+4 hrs**

Introduction mass transfer, Similarity between heat and mass transfer

L = 40 hrs T = 12 hrs P=0hrs Total = 52 hrs

TEXT BOOKS

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002.

E-REFERENCES

1. http://nptel.iitm.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	-	-	1	-	-	1		2
CO2	3	2	-	2	1	1		-	-	-	-	1		2
CO3	2	3	3	2	1	1	1	-	1	-	-	1		2
CO4	2	3	3	2	1	1	1	-	1	-	-	1		2
CO5	3	2	2	1	1	1	1	-	-	-	-	1		2
Total	13	12	14	9	5	4	3		3			5		10

1 - Low, 2 – Medium, 3- High

Semester	**V**
Subject Name	**Automobile Engineering**
Subject Code	**XME503**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 - 0 – 0– 3	**3:0:0**	**3- 0– 0 – 3**

Course Outcome **Domain/Level**

		C or P or A
CO1	***Define and identifies*** the vehicle construction, types and specification of engines.	C(Knowledge) P(Perception)
CO2	***Differentiate and calibrates*** Ignition, Fuel Supply and Emission Control System.	C(Comprehension) P(Guided response)
CO3	***Categories and illustrate*** the various types of clutches and gear boxes.	C(Synthesis) P(Mechanism)
CO4	***Characterize and determine*** *the suspension, steering geometry and wheel specification.*	C(Knowledge) P(Perception)
CO5	***Assembles and Summarize the*** *Electrical systems and Dash board instrumentations.*	C(Evaluation) P(Guided response)

COURSE CONTENT

UNIT I	**Introduction to Vehicle structure**	**9 hrs**
	Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT).	
UNIT II	**Ignition, Fuel Supply and Emission Control System**	**9hrs**
	Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).	
UNIT III	**Transmission System**	**9 hrs**
	Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.	
UNIT IV	**Steering, Suspension and Braking System**	**9 hrs**
	Steering geometry and types of steering gear box, power steering, types of front axle, and types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.	
UNIT V	**Advances in Automobile Engineering**	**9 hrs**
	Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells	

L = 45 hrs T = 0 hrs P=0hrs Total = 45 hrs

TEXT BOOKS

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

E-REFERENCES

1. http://nptel.iitm.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	3	1	1	2	2	3	2	
CO2	3	3	2	3	3	1	3	1	1	2	2	3	2	

CO3	3	3	2	3	3	1	3	1	1	2	2	3	2	
CO4	3	3	2	3	3	1	3	1	1	2	2	3	2	
CO5	3	3	2	3	3	1	3	1	1	2	2	3	2	
Total	15	15	10	15	15	5	15	5	5	10	10	15	10	

1 - Low, 2 – Medium, 3- High

Semester	**V**
Subject Name	**CAD / CAM**
Subject Code	**XME504**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 - 0 – 0– 3	**3:0:0**	**3- 0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	***Define*** Design Process, CAD, CAM and ***explain*** various stages of design and different types of design process *explain* the DOM concept CAM along with benefits of CAD	C(Remember, Understand)
CO2	***Classify*** and ***explain*** different graphical primitives and transformations systems along with complex geometry generation techniques. ***Classify*** and ***outline*** the various Data structure and management systems.	C(Remember, Understand)
CO3	***Define*** modeling and ***Classify*** different types of geometric models also ***outline*** different features of solid modeling packages	C(Remember, Understand)
CO4	***Explain*** and *contrast* NC CNC DNC also ***illustrate*** various tools ,devices and mechanisms used inside NC,CNC and DNC	C(Understand)
CO5	***List*** important NC Codes and ***create*** CNC code for simple CNC operations like turning and facing.	C(Remember, Create)

COURSE CONTENT

UNIT I	**DESIGN PROCESS**	**9 hrs**
	The design process - Morphology of design - Product cycle - Sequential and concurrent engineering - Role of computers - Computer Aided Engineering - Computer Aided Design - Design for Manufacturability – Computer Aided Manufacturing - Benefits of CAD.	
UNIT II	**INTERACTIVE COMPUTER GRAPHICS AND DATA STRUCTURES**	**9hrs**
	Creation of Graphic Primitives - Graphical input techniques - Display transformation in 2-D and 3-D – Viewing transformation - Clipping - hidden line elimination - Mathematical formulation for graphics - Curve generation techniques. Model storages and Data structure - Information system. Engineering Data Management System. Hierarchical data structure. Network data structure - Relational data structure. Data storage, search and retrieval methods. Recent trends in Data Structures.	
UNIT III	**SOLID MODELING**	**9 hrs**
	Geometric Modeling - Wireframe, Surface and Solid models - CSG and B-REP Techniques - Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis.	
UNIT IV	**CONSTRUCTIONAL FEATURES OF CNC MACHINES**	**9 hrs**

Numerical Control (DNC Systems). Design considerations of CNC machines for improving machining accuracy-Structural members-Slideways - Sides linear bearings - Ball screws - Spindle drives and feed drives - work holding devices and tool holding devices -Automatic Tool changers. Feedback devices - Principles of Operation-Machining Centres - Tooling for CNC machines.

UNIT V **PART PROGRAMMING FOR CNC MACHINES** **9 hrs**

Numerical control codes - Standards - Manual Programming - Canned cycles and subroutines – Computer Assisted Programming, CAD / CAM approach to NC part programming - APT language, machining from 3D models. Validation of Programs.

L = 45 hrs T = 0 hrs P=0hrs Total = 45 hrs

TEXT BOOKS

1. Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw-Hill Publishing Co. Ltd., 1998.
2. Sadhu Singh, " Computer Aided Design and Manufacturing ", Khanna Publishers, New Delhi, 1998.

REFERENCES

1. P.Radhakrishnan, “Computer Numerical Control ", New Central Book Agency, 1992.
2. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing Prentice Hall of India, New Delhi, 1994.

E-REFERENCES

1. http://nptel.iitm.ac.in/video.php?subjectId=112102101
2.http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Computer%20Aided%20Design%20&%20ManufacturingI/index.htm
3.http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Computer%20Aided%20Design%20&%20ManufacturingII/index.htm

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	1	3	1	1	2	2	3	3	
CO2	3	2	2	3	3	1	3	1	1	3	2	3	3	
CO3	3	2	2	3	2	1	3	1	1	3	2	3	3	
CO4	3	2	2	3	3	1	3	1	1	2	2	3	3	
CO5	3	3	2	3	2	1	3	1	2	3	3	3	3	
Total	15	11	10	15	12	5	15	5	6	13	11	15	15	

1 - Low, 2 – Medium, 3- High

Semester	**V**
Subject Name	**KINEMATICS AND THEORY OF MACHINES**
Subject Code	**XME505**

L –T –P –C	**C:P:A**	**L –T –P –H**
3- 1 – 0– 4	**4:0:0**	**3- 1– 0– 4**

Course Outcome		**Domain/Level C or P or A**
CO1	To understand the kinematics and rigid- body dynamics of kinematically driven machine	C (Understand),

CO2	To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link	C (Understand)
CO3	To be able to design some linkage mechanisms and cam systems to generate specified output motion	C (Apply)
CO4	To understand the kinematics of gear trains	C (Understand)
CO5	To understand the friction mechanisms in bearing clutches and brakes	C (understand)

Objectives:

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

COURSE CONTENT

UNIT I	**BASICS OF MECHANISMS**	**9+3 hrs**

Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility-Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions-Mechanical advantage-Transmission angle-Description of some common mechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms

UNIT II	**KINEMATICS OF PLANE MECHANISMS**	**9+3 hrs**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation

UNIT III	**CAMS**	**9+3 hrs**

Classification of cams and followers-Terminology and definitions Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions-derivatives of follower motions specified contour cams- circular and tangent cams-pressure angle and undercutting, sizing of cams, Graphical and analytical disc cam profile synthesis for roller and flat face followers.

UNIT IV	**GEARS**	**9+3 hrs**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

UNIT V	**FRICTION IN BEARING CLUTHES AND BRAKES**	**9+3 hrs**

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication-friction clutches- belt and rope drives- friction in brakes

L = 45 hrs T = 15hrs Total = 60 hrs

TEXT BOOKS

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

REFERENCES

1. Rao.J.S. and Dukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., New Delhi, 2003.
2. John Hannah and Stephens R.C., 'Mechanics of Machines', Viva Low-Prices StudentEdition, 2003.

E-REFERENCES

1. http://nptel.iitm.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	2	1	-	2	1	-	2	3	2	
CO2	3	2	3	-	2	1	-	2	1	-	2	3	2	
CO3	3	2	3	-	2	1	-	1	1	-	2	3	2	
CO4	3	2	3	-	3	1	-	2	2	-	2	3	2	
CO5	3	2	2	-	3	1	-	2	1	-	2	3	2	
	15	**9**	**12**	**-**	**12**	**5**	**-**	**9**	**6**	**-**	**10**	**15**	**10**	

1 - Low, 2 – Medium, 3- High

Semester	**V**
Subject Name	**Constitution of India**
Subject Code	**XUM506**

L –T –P –C	**C:P:A**	**L –T –P –H**
2- 0 – 0– 0	**0:0:0**	**2- 0– 0 – 2**

Course Outcome	**Domain/Level C or P or A**

COURSE CONTENT

		CO Relation
1.	Meaning of the constitute	
2.	on law and constitutionalism	
3.	Historical perspective of the Constitution of India	
4.	Salient features and characteristics of the Constitution of India	
5.	Scheme of the fundamental rights	
6.	The scheme of the Fundamental Duties and its legal status	

7. The Directive Principles of State Policy – Its importance and implementation

8. Federal structure and distribution of legislative and financial powers between the Union and the States

9. Parliamentary Form of Government in India – The constitution powers and status of the President of India

10. Amendment of the Constitutional Powers and Procedure

11. The historical perspectives of the constitutional amendments in India

12. Emergency Provisions :National Emergency, President Rule, Financial Emergency

13. Local Self Government – Constitutional Scheme in India

14. Scheme of the Fundamental Right to Equality

15. Scheme of the Fundamental Right to certain Freedom under Article 19

16. Scope of the Right to Life and Personal Liberty under Article 21.

TEXT BOOKS

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law

Semester	**V**
Subject Name	**Mechanical engineering laboratory (Thermal) I**
Subject Code	**XME507**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 2– 2	**0:2:0**	**0- 0– 4 – 4**

Course Outcome	**Domain/Level** **C or P or A**
Measure various properties of fluids using equipments.	Coginitive (Understanding) Psychomotor (Guided response)

Characterize the performance of various fluid machineries.	Coginitive (Understanding) Psychomotor (Guided response)
Determine the various thermal properties.	Coginitive (Understanding) Psychomotor (Guided response)
Identify the Performance of the engines and ***Analyze*** the heat transfer coefficients in different modes.	Coginitive (Understanding) Psychomotor (Guided response)
Determine and ***Experimen***t with emissivity and vapour compression system.	Coginitive (Understanding) Psychomotor (Guided response)

Objectives:

(iii) To understand the principles and performance characteristics of flow and thermal devices

(iv) To know about the measurement of the fluid properties

COURSE CONTENT

		CO Relation
1.	Measurement of Coefficient of Discharge of given Orifice and Venturi meters	CO1
2.	Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe	CO1
3.	Determination of the performance characteristics of a centrifugal pump	CO2
4.	Determination of the performance characteristics of Pelton Wheel	CO2
5.	Determination of the performance characteristics of a Francis Turbine	CO2
6.	Determination of the performance characteristics of a Kaplan Turbine	CO2
7.	Determination of the thermal conductivity and specific heat of given objects	CO3
8.	Determination of the calorific value of a given fuel and its flash & fire points	CO3
9.	Determination of the p-V diagram and the performance of a 4-stroke diesel engine	CO4
10.	Determination of the convective heat transfer coefficient for flow over a heated plate	CO4
11.	Determination of the emissivity of a given sample	CO5
12.	Determination of the performance characteristics of a vapour compression system	CO5

TEXT BOOKS

9. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2003.
10. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.
11. A. Bejan, Heat Transfer John Wiley, 1993
12. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
13. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
14. Rajput, R.K., Thermal Engineering, 6th Edition, Laxmi Publications, 2007
15. Ballaney, P.L., "Thermal Engineering" , Khanna Publishers, 24th Edition, 2003.
16. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.

REFERENCES

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 2008.
2. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition, 2004.
3. Rudramoorthy, R., Thermal Engineering, 4th Edition, Tata McGraw Hill, New Delhi, 2006.
4. Kothandaraman , C.P., Domkundwar .S and A.v. Domkundwar", a course in thermal Engineering", Dhanpal Rai & sons, fifth edition, 2002.
5. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2011.
6. R.B.Mathur and R.P. Sharma, Internal combustion Engines.

E-REFERENCES

1.http://nptel.iitm.ac.in/courses

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	2	1	1	-	-	1	-	-	1		3
CO2	2	3	-	2	1	1	-	-	-	-	-	1		3
CO3	2	3	-	2	1	1	-	-	1	-	-	1		3
CO4	2	3	2	1	1	1	-	-	1	-	-	1		3
CO5	2	3	-	2	1	1	-	-	-	-	-	1		3
	10	15	2	9	5	5			3			5		15

1 - Low, 2 – Medium, 3- High

Semester	**V**
Subject Name	**Inplant Training – II**
Subject Code	**XME508**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 2– 0	**0:2:0**	**0- 0– 2 – 0**

Course Outcome	**Domain/Level C or P or A**

Objectives:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

XMEM01 CNC Programming for Lathe Operations L T P C
0 0 2 0

CNC Machines

Numerical control – definition – components of NC systems, Development of NC, DNC, CNC, and adaptive control systems, Working principle of a CNC system, features and advantages of CNC machines Introduction to CNC systems - Fanuc OI, Siemens 840D, Heidenhein, current trends in programming, Human Machine Interface software – Siemens – Fanuc systems

CNC Hardware System

CNC system elements, Drives, Slide ways, Feedback devices, ATC and Tool Magazines, and Machine Control Units

CNC Part Programming for lathe operations

Part program structure, CNC program procedure – coordinate system, Sequence number, preparatory functions and G codes, miscellaneous functions and M codes, NC dimensioning – reference points – machine zero, work zero, tool zero and tool offsets, Types of motion control: point-to-point, paraxial and contouring Part Program – tool information – speed – feed data – interpolations, Macro – subroutines – canned cycles - Mirror images –Sample programs for lathe operations , Conversational automatic programming, and APT programming- Introduction to Computer assisted part programming – EdgeCAM, Master CAM etc.,

Semester	**VI**	
Subject Name	**Economics for Engineers**	
Subject Code	**XUM601**	
L –T –P –C	**C:P:A**	**L –T –P –H**
3 - 0 – 0– 3	**2.64:0.24:0.12**	**3- 0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	***Explain*** the concepts of economics in engineering and ***identify*** element of cost to prepare cost sheet	C(Understand) P(Perception)
CO2	***Calculate and Explain*** the Break-even point and marginal costing	C(Apply, Understand) P(Perception)
CO3	***Summarize*** and ***Use*** value engineering procedure for cost analysis	C(Understand) A(Receive)
CO4	***Estimate*** replacement problem	C(Understand)
CO5	***Compute, Explain*** and ***make Use of*** different methods of depreciation	C(Understand, Apply)

COURSE CONTENT

UNIT I	**INTRODUCTION TO ECONOMICS**	**8 hrs**
	Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- types of costing, element of costs, preparation of cost sheet and estimation, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost	
UNIT II	**BREAK-EVEN ANALYSIS&SOCIAL COST BENEFIT ANALYSIS**	**12 hrs**
	Margin of Safety, Profit, Cost & Quantity analysis-Product Mix decisions and CVP analysis, Profit/Volume Ratio (P/V Ratio), Application of Marginal costing, Limitations **Social Cost Benefit Analysis**: compare different project alternatives, Calculate direct, indirect and external effects; Monetizing effects; Result of a social cost benefit analysis.	
UNIT III	**VALUE ENGINEERING &COST ACCOUNTING**	**10 hrs**
	Value engineering – Function, aims, Value engineering procedure - Make or buy decision Business operating costs, Business overhead costs, Equipment operating costs	
UNIT IV	**REPLACEMENT ANALYSIS**	**7 hrs**
	Replacement analysis –Types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset.	
UNIT V	**DEPRECIATION**	**8 hrs**
	Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of	

depreciation, Annuity method of depreciation, service output method of depreciation.

L = 45 hrs T = 0 hrs P=0hrs Total = 45 hrs

TEXT BOOKS

1. Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad, Haryana, 2012
2. S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012
3. PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
4. William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.

REFERENCES

1. Luke M Froeb / Brian T Mccann, " Managerial Economics – A problem solving approach" Thomson learning 2007
2. Truett&Truett, "Managerial economics- Analysis, problems & cases " Wiley India 8th edition 2004.
3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
4. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002

E-REFERENCES - 1. http://nptel.iitm.ac.in/video.php

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	0	1	0	0	1	1	1	2	2	3
CO2	2	2	1	2	0	0	2	1	1	2	3	3
CO3	2	2	1	3	0	0	2	2	1	2	2	3
CO4	1	2	1	2	0	0	0	1	1	1	2	3
CO5	1	2	0	1	0	0	1	1	0	1	2	3
Total	7	10	3	9	0	0	6	6	4	8	11	15

1 - Low, 2 – Medium, 3- High

Semester	**VI**
Subject Name	**Manufacturing Technology**
Subject Code	**XME 602**

L –T –P –C	**C:P:A**	**L –T –P –H**
4- 0 – 0– 4	**4:0:0**	**4- 0– 0 – 4**

Course Outcome		**Domain/Level C or P or A**
CO1	**Construct** the Degrees of freedom, principles of location and clamping, principles of jig design, fool proofing, elements of jigs, locates fixture design	C(Creating) A(Receiving)
CO2	**Explain** the basic principles of measurements classify the various linear and angular measuring equipments and **distinguish** their principle of operation and applications.	C (Evaluating) P (Perception)

CO3	***Explain*** the Assembly of different components	C (Remembering)
CO4	***Explain*** and demonstrate the basic concepts of PERT- CPM and their applications in product planning control.	C (Understand)
CO5	***Explain*** the basic concepts of optimization and To F***ormulate*** and Solve linear programming problems.	C (understand)

Objectives

(i) To provide knowledge on machines and related tools for manufacturing various components.

(ii) To understand the relationship between process and system in manufacturing domain.

(iii) To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

COURSE CONTENT

UNIT I **JIGS, FIXTURES AND PRESS TOOLS** **12 hrs**

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design

UNIT II **FORM MEASUREMENT** **16 hrs**

Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as microscale machining, Inspection and workpiece quality

UNIT III **ASSEMBLY PRACTICES** **6 hrs**

Manufacturing and assembly, process planning, selective assembly, Material handling and devices

UNIT IV **LINEAR MODELS,PROJECT SCHEDULING BY PERT-CPM** **8 hrs**

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Travelling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling

UNIT V **PRODUCTION PLANNING& CONTROL** **8 hrs**

Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models

L = 50 hrs T = 0 hrs P=0hrs Total = 50 hrs

TEXT BOOKS

1. Donaldson C and Le Cain C H, "Tool Design", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
2. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2005
3. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
4. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
5. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.
6. Automation, Production Systems, & CIM by Grover; Prentice Hall 2. CAD CAM by C. McMahon and

J. Browne; published by Addison-Wesley.

REFERENCES

1. Bhattacharyya A, "Metal Cutting Theory and Practice", New Central Books Agency (P) Ltd, Calcutta, 2000.
2. Fundamentals of Operations Research, Advanced Operation Research Prof.G.Srinivasan, Department of Management Studies, Indian Institute of Technology, Madras.
3.Modern Production/ Operations Management, E. S. Buffa and R. K. Sarin, John Wiley International, 1994.

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http://nptel.iitm.ac.in/courses

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	-	-	1	-	-	1	3	
CO2	2	2	-	-	-	1	1	-	-	-	-	1	3	
CO3	2	1	-	-	2	1	1	-	-	-	-	1	3	
CO4	2	1	-	-	1	1	1	-	1	-	-	1	3	
CO5	1	-	-	-	1	1	-	-	1	-	-	1	3	
Tot	9	5			4	5	3	3				5	15	

1 - Low, 2 – Medium, 3- High

Semester	**VI**	
Subject Name	**Design of Machine Elements**	
Subject Code	**XME603**	
L –T –P –C **3 – 1 – 0– 4**	**C:P:A** **3:1:0**	**L –T –P –H** **3–1– 0 – 4**

Course Outcome		**Domain/Level** **C or P or A**
CO1	Describe the design process, material selection, calculation of stresses and stress concentrations under variable loading.	C (Understand)
CO2	Design the solid, hollow shafts and to finding the critical speeds also have a design knowledge on sliding and rolling contact bearing	C (Synthesis)
CO3	Summarize the knowledge in helical, leaf, disc and torsional springs	C (Understand)
CO4	Analyze bolted joints in eccentric loading. Examine the welded joints for vessels and steel structures. Differentiate rigid and flexible couplings and also the knuckle joints.	C (Analysis)
CO5	Recognize the need for friction drives and positive drives. Apply BIS standards and catalogues in design and selection of belts and chain for requirement, Select suitable drive combination based on requirement.	C (Understand)

Objectives

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

- A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components

- ❖ An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
- ❖ An overview of codes, standards and design guidelines for different elements
- ❖ An appreciation of parameter optimization and design iteration
- ❖ An appreciation of the relationships between component level design and overall machine system design and performance

COURSE CONTENT

UNIT I	**Steady Stresses and Variable Stresses in Machine Members**	**6+0**
	design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure)	
UNIT II	**Shafts and bearings**	**9+3**
	design of shafts under static and fatigue loadings, Analysis and design of sliding and rolling contact bearings	
UNIT III	**Energy storing Elements**	**6+3**
	helical compression, tension, torsional and leaf springs	
UNIT IV	**Temporary and Permanent Joints**	**9+3**
	threaded fasteners, pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings	
UNIT V	**Transmission elements**	**15+6**
	spur, helical, bevel and worm gears; belt and chain drives, Analysis of clutches and brakes	
L =45 hrs T=15hrs Total = 60 hrs		

TEXT BOOKS

[1] Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
[2] Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

REFERENCES

[1] Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
[2] Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994. [5] R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

E-REFERENCES

1. https://nptel.ac.in/downloads/112105125/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	1	2	2	1	2	2	2	2	
CO2	3	2	3	1	2	1	2	2	1	2	2	2	2	
CO3	3	2	3	1	2	1	2	2	1	2	2	2	2	
CO4	3	2	3	1	2	1	2	2	1	2	2	2	2	

CO5	3	2	2	1	2	1	2	2	1	2	2	2	2	
	14	10	14	6	10	5	10	10	5	10	10	10	10	

1 - Low, 2 – Medium, 3- High

Semester	**VI**
Subject Name	**Mechanical engineering laboratory (Design) II**
Subject Code	**XME606**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 4– 2	**0:2:0**	**0- 0– 4 – 4**

Course Outcome	**Domain/Level C or P or A**
Define different mechanical properties and ***solve*** various deformation problems under different stress and loading conditions.	Coginitive (Remembering) (Applying) Psychomotor (Guided response)
Indentify Strain for various objects.	Coginitive (Understanding) Psychomotor (Guided response)
Examine the molecular structures of heat treated samples.	Coginitive (Understanding) Psychomotor (Perception)
Study about various velocity ratios, kinematic mechanisms and cam –follower motions.	Coginitive (Understanding) Psychomotor (Guided response)
Determine the frequencies of various kinematic systems.	Coginitive (Understanding) Psychomotor (Guided response)

Objectives

(i) To understand the measurement of mechanical properties of materials

(ii) To understand the deformation behavior of materials

(iii) To understand the kinematic and dynamic characteristics of mechanical devices

COURSE CONTENT

		CO Relation
1.	Uniaxial tension test on mild steel rod	CO1
2.	Torsion test on mild steel rod	CO1
3.	Impact test on a metallic specimen	CO1
4.	Brinnell and Rockwell hardness tests on metallic specimen	CO1
5.	Bending deflection test on beams	CO1
6.	Strain measurement using Rosette strain gauge	CO2
7.	Microscopic examination of heat-treated and untreated metallic samples	CO3

8.	Velocity ratios of simple, compound, epicyclic and differential gear trains	CO4
9.	Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms	CO4
10.	Cam & follower and motion studies	CO4
11.	Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient	CO5
12.	Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies	CO5

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. S. Ramamrutham and R. Narayanan, (2003), Strength of Materials, Dhanpat Rai Publications.
4. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
5. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
6. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.

REFERENCES

1. Rowland Richards, (2000), Principles of Solid Mechanics, CRC Press.
2.Timoshenko, S.P. and Young, D.H., (2000), Strength of Materials, East West Press Ltd
3. R.K. Bansal, (2000), Strength of Materials, Laxmi Publications
4. James F Shackelford, S "Introduction to materials Science for Engineers", 6 th Macmillan Publishing Company, New York, 2004.
5. Ghosh.A, and A.K.Mallick, 'Theory of Mechanisms and Machines', Affiliated East-West Pvt. Ltd., New Delhi, 2007.

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1.NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112: related web and video resources under Mechanical Engineering &Metallurgy and Material Science categories

2.http://nptel.iitm.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	2	1	1	-	-	1	-	-	1	2	
CO2	2	3	-	2	1	1	-	-	-	-	-	1	2	
CO3	2	3	-	2	1	1	-	-	1	-	-	1	2	
CO4	2	3	2	1	1	1	-	-	1	-	-	1	2	
CO5	2	3	-	2	1	1	-	-	-	-	-	1	2	
Tot	10	15	2	9	5	5			3			5	10	

XMEM02 **Pneumatics and Hydraulics** **L T P C**
0 0 2 0

S.No	Theory Session	Lab Session
1.	Introduction about Automation	Basic Hydraulics and Hydraulic equipments such as Pumps, motor, Cylinders, Check valves, Direction control valves
2.	Basic Hydraulics and Hydraulic equipments: Pilot operated check valves,	**Hydraulic Lab**: Simple hydraulic circuits using hydraulic equipments,

	throttle valves, solenoid valves, etc.,	cylinder and motor by manual operation
3.	Development of Hydraulic circuits using Check valves, direction control valves, Pilot operated check valves, throttle valves etc.,	**Hydraulic Lab**: Hydraulic circuits using Check valves, throttle valve, meter in and meter out circuits
4.	Working principles of solenoid valves, Relay and development of relay logic circuits	**Hydraulic Lab**: Hydraulic circuits using relay logic
5.	Timers : Switch On delay and Switch off delay	**Hydraulic Lab:** Hydraulic circuits using on delay and off delay
6.	Sensors: Different types of Proximate sensors	**Sensoric Lab:** Identification of metal and non metal using sensors, Calculation of range of sensors.
7.	Development of hydraulic circuits using sensors	**Hydraulic Lab:** Hydraulic circuits using sensors
8.	Pressure Switches	**Hydraulic Lab:** Hydraulic circuits using Pressure switch
9.	Development of hydraulic circuits by Combination of two cylinders	**Hydraulic Lab:** Sequential hydraulic circuits using two cylinders
10.	Introduction about Pneumatics	Basic Pneumatics and Pneumatics equipments such as Pumps, motor, Cylinders, Check valves, Direction control valves
11.	Basic Pneumatics and Pneumatics equipments: Pilot operated check valves, throttle valves, solenoid valves, etc.,	**Pneumatics Lab**: Simple Pneumatics circuits using Pneumatics equipments, cylinder and motor by manual operation
12.	Development of Pneumatics circuits using Check valves, direction control valves, Pilot operated check valves, throttle valves etc.,	**Pneumatics Lab**: Pneumatics circuits using Check valves, throttle valve, meter in and meter out circuits
13.	Working principles of solenoid valves, Relay and development of relay logic circuits	**Pneumatics Lab**: Pneumatics circuits using relay logic
14.	Timers : Switch On delay and Switch off delay	**Pneumatics Lab:** Pneumatics circuits using on delay and off delay
15.	Sensors: Different types of Proximate sensors	**Sensoric Lab:** Identification of metal and non metal using sensors, Calculation of range of sensors.
16.	What is PLC?	Basic concepts of PLC *Graphical Symbols of Pneumatics Circuits,* Working of PLC & General Applications
17.	Indra control PLC's – Technical Details	Hardware Details of L10/L20 Documentation provided in CD Related Software for PLC
18.	Related Software for PLC	**Detailed presentation on inline products,** Technical & hardware details on -digital I/O -analog I/o

		-Bus couplers -Function modules
19.	Indra works Software Installation	Indraworks Software features explanation in detail , Indralogic standard settings, Project development in Indraworks Hardware Configuration
20.	Project Development in Indra logic	Logic Development - Ladder Diagram - Addressing of Digital I/O's Creating Parallel Paths (Network) - Programming Language Selection/Conversion
21.	Logic Development - Variable Declaration (Local/Global) - Declaration in Tabular Format	- Function Blocks (Timers, Counters etc.) - Exercises Segregation of programs based on functionality or application
22.	Set ,Reset concepts - Exercises	**Communication parameters settings**
23.	Logic Development - Addressing Digital I/O's	Working with Digital I/O's, Configuring Digital I/O's , - Exercises
24.	Exercise	Exercise
25.	Exercise	TesT And feedback session
26.	Introduction to Sensorics What are Sensors? Classification of Sensors Different types of sensors used in Automation Technologies Characteristics of Inductive, Capacitive, Ultrasonic, Photo electric and Magnetic proximity sensors Comparison of sensors	Experiment 01 : Behavior of the capacitive sensor
27.	Behavior of resistive sensors	Behavior of inductive sensor
28.	Role of the Sensors in Mechatronixcs, Robotics and Automation	Real time problems and solutions
29.	Exercise	Experiment 01 : Behavior of the capacitive sensor
30.	Test And feedback session	

Semester	**VII**
Subject Name	**Automation in manufacturing**
Subject Code	**XME702**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 0 – 0– 3	**3:0:0**	**3–0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	Define automation and classify different types of automation along with recent trends of automation in manufacturing.	C (Rem), C(U)
CO2	Classify and describe computer aided technologies in manufacturing.	C (Rem), C(U)
CO3	Classify and explain different automation technologies and building blocks of systems.	C (Rem), C(U)
CO4	Describe product modelling and simulation techniques in manufacturing	C (Rem), C(U)
CO5	Define additive manufacturing and explain the recent advancements in additive manufacturing.	C (Rem), C(U)

Objectives

1. To understand the importance of automation in the of field machine tool based manufacturing

2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC

3. To understand the basics of product design and the role of manufacturing automation

COURSE CONTENT

UNIT I	**BASIC CONCEPTS AND PROPERTIES OF FLUIDS**	**9 hrs**

Introduction: Why automation- Current trends-CAD, CAM, CIM- Rigid automation- Part handling, Machine tools- Flexible automation- Computer control of Machine Tools and Machining Centers-NC and NC part programming, CNC-Adaptive Control- Automated Material handling. Assembly-Flexible fixturing.

UNIT II	**COMPUTERS IN MANUFACTURING**	**9hrs**

Computer Aided Design- Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base-Geometric modelling for downstream applications and analysis methods- Computer Aided Manufacturing- CNC technology- PLC- Micro-controllers-CNC-Adaptive Control

UNIT III	**AUTOMATION**	**9 hrs**

Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

UNIT IV	**MODELLING AND SIMULATION**	**9 hrs**

Introduction to Modelling and Simulation-Product design- process route modelling-Optimization techniques-Case studies & industrial applications.

UNIT V	**Additive Manufacturing**	**9 hrs**

Additive Manufacturing-3Dprinting-Classification of 3D printers-components of basic 3D printer-Preparation of geometry for 3D printing-STL, STEP file generation-Managing of

inter exchangeable formats for 3D printing, open source resources for 3D printing.

L = 45 hrs Total = 45 hrs

TEXT BOOKS

1. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition,Pearson

REFERENCES

1. Yoram Koren, Computer control of manufacturing system, 1st edition.
2. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

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Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	1	-	-	-	1	-	-	-	3	
CO2	3	2	-	2	1	-	-	-	1	-	1	1	3	
CO3	3	1	-	1	1	-	-	1	1	-	1	1	3	
CO4	3	2	-	2	1	-	-	-	1	-	-	-	3	
CO5	3	3	3	3	2	-	-	2	1	-	3	3	3	
	15	10	3	10	6			3	5		5	5	15	

1 - Low, 2 – Medium, 3- High

Semester	**VII**
Subject Name	**Cyber Security**
Subject Code	**XUM706**

L –T –P –C	**C:P:A**	**L –T –P –H**
3 – 0 – 0– 0	**3:0:0**	**3–0– 0 – 3**

Course Outcome		**Domain/Level C or P or A**
CO1	Able to ***understand*** the Cyber Security Policy, Laws and Regulations	C(Remember)
CO2	Able to ***discuss*** the Cyber Security Management Concepts	C(Understand)
CO3	Able to ***understand*** the Cyber Crime and Cyber welfare	C(Understand)
CO4	Able to ***discuss*** on issues related to Information Security Concepts	C(Understand)
CO5	Able to ***understand*** various security threats	C(Understand)

COURSE CONTENT

UNIT I INTRODUCTION 9 hrs

Cyber Security – Cyber Security policy – Domain of Cyber Security Policy – Laws and

Regulations – Enterprise Policy – Technology Operations – Technology Configuration - Strategy Versus Policy – Cyber Security Evolution – Productivity – Internet – E commerce – Counter Measures – Challenges

UNIT II	CYBER SECURITY OBJECTIVES AND GUIDANCE	9hrs

Cyber Security Metrics – Security Management Goals – Counting Vulnerabilities – Security Frameworks – E Commerce Systems – Industrial Control Systems – Personal Mobile Devices – Security Policy Objectives – Guidance for Decision Makers – Tone at the Top – Policy as a Project– Cyber Security Management – Arriving at Goals – Cyber Security Documentation – The Catalog Approach – Catalog Format – Cyber Security Policy Taxonomy.

UNIT III	CYBER SECURITY POLICY CATALOG	9 hrs

Cyber Governance Issues – Net Neutrality – Internet Names and Numbers – Copyright and Trademarks – Email and Messaging - Cyber User Issues - Malvertising - Impersonation – Appropriate Use – Cyber Crime – Geo location – Privacy - Cyber Conflict Issues – Intellectual property Theft – Cyber Espionage – Cyber Sabotage – Cyber Welfare

UNIT IV	INFORMATION SECURITY CONCEPTS	9 hrs

Information Security Overview: Background and Current Scenario - Types of Attacks - Goals for Security - E-commerce Security - Computer Forensics – Steganography

UNIT V	SECURITY THREATS AND VULNERABILITIES	9 hrs

Overview of Security threats -Weak / Strong Passwords and Password Cracking - Insecure Network connections - Malicious Code - Programming Bugs - Cyber crime and Cyber terrorism - Information Warfare and Surveillance

L = 45 hrs **Total = 45 hrs**

REFERENCES

1. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss “Cyber Security Policy Guidebook” John Wiley & Sons 2012.
2. Rick Howard “Cyber Security Essentials” Auerbach Publications 2011.
3. Richard A. Clarke, Robert Knake “Cyberwar: The Next Threat to National Security & What to Do About It” Ecco 2010
4. Dan Shoemaker Cyber security The Essential Body Of Knowledge, 1st ed. Cengage Learning 2011
5. Rhodes-Ousley, Mark, “Information Security: The Complete Reference”, Second Edition, McGraw-

E REFERENCE

1. https://www.coursera.org/specializations/cyber-security
2. www. nptel.ac.in
3. http://professional.mit.edu/programs/short-programs/applied-cybersecurity

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	2	2	3	0	1	2	0	1	0	1	1
CO 2	3	2	1	3	0	1	2	0	1	0	1	1
CO 3	3	2	1	3	0	1	2	1	1	0	1	1
CO 4	3	2	1	2	0	1	2	1	1	0	1	1
CO 5	3	2	1	2	0	1	2	0	1	0	1	1
Tot	15	10	6	13	0	5	10	2	5	0	5	5

1 - Low, 2 – Medium, 3- High

Semester	**VII**	
Subject Name	**Mechanical engineering laboratory (Manufacturing) III**	
Subject Code	**XME707**	
L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 4– 2	**0:2:0**	**0- 0– 4 – 4**

Course Outcome	**Domain/Level C or P or A**
Experiment and ***Measure*** various machining operations and its cutting forces involved.	Coginitive (Remembering) (Applying) Psychomotor (Guided response) (Perception)
Create and **choose** the CNC suitable part programming for the corresponding job.	Coginitive (Understanding) Psychomotor (Guided response)
Experiment the sample with EDM.	Coginitive (Understanding) Psychomotor (Perception)
Understand the operation of pick and place robot.	Coginitive (Understanding) Psychomotor (Guided response)
Explain the basic principles of measurements classify the various linear and angular measuring equipments and **distinguish** their principle of operation and applications.	Coginitive (Evaluating) Psychomotor (Perception)

Objectives

1. To provide an understanding of advanced manufacturing methods.
2. To get an idea of the dimensional & form accuracy of products

COURSE CONTENT

		CO Relation
1.	Taper turning and external thread cutting using lathe	CO1
2.	Contour milling using vertical milling machine	CO1
3.	Spur gear cutting in milling machine	CO1
4.	Measurement of cutting forces in Milling/ Turning process	CO1
5.	CNC part programming	CO2
6.	Drilling of a small hole using wire EDM	CO3
7.	Microprocessor controlled pick & place robot	CO4
8.	Use of Tool Maker's Microscope	CO5
9.	Comparator and sine bar	CO5
10.	Surface finish measurement equipment	CO5
11.	Bore diameter measurement using micrometer and telescopic gauge	CO5
12.	Use of Autocollimator	CO5

TEXT BOOKS

1. Hajra Choudhury S.K and Hajra Choudhury. A.K., "Elements of Workshop Technology, Volume I and II", Media Promoters and Publishers Private Limited, Mumbai.
2. HMT – "Production Technology", Tata McGraw-Hill, 1998.Dr. B.C.Punmia, "Surveying – Volume I", Laxmi Publications, New Delhi, 2005
3. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005
4. Mikell. P. Groover, Automation Production Systems, and Computer Integrated Manufacturing, Prentice Hall of India Ltd., New Delhi, 1998.
5. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES

1. Paul Degarma E, Black J.T. and Ronald A. Kosher, Materials and Processes, in Manufacturing Prentice – Prentice Hall of India.
2. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd.,
3. Milton C.Shaw, 'Metal Cutting Principles', Oxford University Press, Second edition,2005.
4. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2003.
5. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005
6. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, (1994).
7. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.

E-REFERENCES

1.http://nptel.iitm.ac.in/courses

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	2	1	1	-	-	1	-	-	1	3	
CO2	2	3	-	2	1	1	-	-	-	-	-	1	3	
CO3	2	3	-	2	1	1	-	-	1	-	-	1	3	
CO4	2	3	2	1	1	1	-	-	1	-	-	1	3	

CO5	2	3	-	2	1	1	-	-	-	-	-	1	3	
Tot	10	15	2	9	5	5			3			5	15	

1 - Low, 2 – Medium, 3- High

Semester	**VII**
Subject Name	**Project phase – I**
Subject Code	**XME708**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 8– 4	**0:8:0**	**0- 0– 8 – 8**

Course Outcome	**Domain/Level**
	C or P or A

Objectives:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

Semester	**VII**
Subject Name	**Inplant Training - III**
Subject Code	**XME709**

L –T –P –C	**C:P:A**	**L –T –P –H**
0- 0 – 4– 2	**0:4:0**	**0- 0– 4 – 4**

Course Outcome	**Domain/Level**
	C or P or A

Objectives:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Total hrs – 90

XMEM03 **Non Destructive Testing** **L T P C**
0 0 2 0

Introduction and Radiography

Introduction to NDT – need – advantages and limitations Radiography – Sources – IR192, cobalt 60 – X-ray film – processing – testing methods – film interpretation

Ultrasonic testing

A,B,C scan, immersion Testing, Normal and Angle Probe Testing

Magnetic particle

Testing Methods – particles - wet, dry and fluorescent

Dye penetrant testing

Surface preparation –Testing procedure - types of penetrant.

Other NDT methods

Thermography, Image processing TOFD and Phased Array - leak testing – Halogen, Helium

Semester	**VIII**		
Subject Name	**Project phase – II**		
Subject Code	**XME804**		
L –T –P –C		**C:P:A**	**L –T –P –H**
0- 0 – 6– 6		**0:6:0**	**0- 0– 12 – 12**
Course Outcome			**Domain/Level** **C or P or A**

Objectives:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

SYLLABUS FOR

M.Tech Renewable Energy (FT) – 2021-22 – ACADEMIC YEAR

YRE 103- PROCESS MODELLING AND SIMULATION IN ENERGY SYSTEMS

3 0 0 3

UNIT – I 6

Introduction to modeling, a systematic approach to model building, classification of models. Modeling Techniques-Response function and Numerical methods- Conservation principles, thermodynamic principles of process systems

UNIT-II 9

Introduction to development of steady state and dynamic lumped and distributed parameters models based on first principles, Analysis of ill-conditioned systems, Block diagrams and computer simulation, Modeling of process elements consisting of Mechanical (translational and rotational) electro- Mechanical ,fluid flow, thermal and chemical reaction system elements

UNIT-III 9

Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

UNIT-IV 12

Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method. shooting method,fnite difference methods. Solving problems using MATLAB/ SCILAB

UNIT- V 9

Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

L:45; T:15; Total:60

TEXT BOOKS

1. K.M. Hangos and I.T Cameron," Process Modelling and Model analysis".academic Press 2001.
2. W. L Luyben, " Process Modelling, Simulation and control for chemical Engineers" 2nd Edn, McGraw Hill Book Co, New York,1990
3. W.F Ramirez " Computational Methods for Process Simulation" Butterworths,1995

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1. 1.Mark E. Davis," Numerical Methods and Modelling for Chemical Engineers" JohnWiley & Sons,1984.
2. 2.Singiresu S. Rao "Applied Numerical Methods for Engineers and Scientists" Prentice hall, Upper saddle River , NJ 2001
3. 3.Francis vanek, Louis D. Albright," Energy systems Engineering" McGraw- Hill book Company, N.Y 2008
4. "Power System Engineering" 2nd Ed.D.P Kothari, I.J. Nagrath, Tata MaGraw- Hill Co 2008.

YRM107 Research Methodology and IPR (MC) 2 0 0 0

UNIT 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

UNIT 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007. Mayall , "Industrial Design", McGraw Hill, 1992.
5. Niebel , "Product Design", McGraw Hill, 1974.
6. Model Curriculum of Engineering & Technology PG Courses [Volume -II] 125 Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

YEGOE1- ENGLISH FOR RESEARCH PAPER WRITING

UNIT 1:- Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity andVagueness **4**

UNIT 2:- Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction **4**

UNIT 3:- Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. **4**

UNIT 4:- key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, **4**

UNIT 5:- Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions **4**

UNIT 6:- useful phrases, how to ensure paper is as good as it could possibly be the first- time submission **4**

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .

4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

YRE 202 - COMPUTATIONAL FLUID DYNAMICS 3 1 0 4

UNIT - I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD 10

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT - II CONDUCTION HEAT TRANSFER 8

Steady one-dimensional conduction, Two and Three-dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT - III INCOMPRESSIBLE FLUID FLOW 7

Governing Equations, Stream Function - Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite deference approach.

UNIT - IV CONVECTION HEAT TRANSFER AND FEM 10

Steady One-Dimensional and Two-Dimensional Convection - Diffusion, Unsteady one-dimensional convection -Diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - Solution of steady heat conduction by FEM - Incompressible flow - Simulation by FEM.

UNIT - V TURBULENCE MODELS **10**

Algebraic Models - One equation model, K-I Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

L:45; T:15; Total :60

TEXT BOOK

1. Anderson ,D.A Tannehill, I I and Pletcher , R,H "Computational Fluid Mechanics and Heat transfer" Narosa Publication House, NewYork, USA,1984

REFERENCES:

1. Muralidhar, K.,and Sundararajan,T., "Computational Fluid Flow and Heat Transfer", Narosa PublishingHouse ,New Delhi1995.
2. Ghoshdasdidar, P.S.,"Computer Simulation of flow and heat transfer" Tata McGraw-Hill PublishingCompany Ltd., 1998.
3. Anderson, D.A.,Tannehill, I.I., and Pletcher, R.H., "Computational Fluid Mechanics and Heat Transfer",Hemishphere Publishing Corporation, New York, USA, 1984.
4. Flectcher, C.A.J., "Computational Techniques for Different Flow Categories, Springer-Verlage 1987.

YRE207 MINI PROJECT **0 0 1 2**

Syllabus contents:-

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Semester	Course name	Course Code	`L	T	P	C
II	Constitution of India	YPSOE1	-	-	-	0

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States

8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19

Scope of the Right to Life and Personal Liberty under Article 21

YRE301 Project phase - I 0 0 10 10

Guidelines:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

YRE401 Project Phase - II 0 0 16 16

Guidelines:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of

the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

SYLLABUS FOR

M.Tech Renewable Energy (PT) – 2021-22-ACADEMIC YEAR

QRE 102 - WIND ENERGY, TIDAL ENERGY AND OTEC 3 0 0 3

UNIT - I MEASUREMENT TECHNIQUES 12

(Use of approved data book permitted in the examination)

Introduction-measurement and instrumentation-Beau fort number Guest parameters-wind type-power law index betz constant Terrain value.Wind speed characterization-site survey and site analysis - Energy in wind-Highest, lowest wind speeds-wind speed for return periods-study of wind applicable Indian standards-steel Tables, Structrual Engineering.

UNIT – II WINDMILL AND WIND TURBINE 10

Wind mill characteristics – types of wind mills- performance analysis -Merits and limitation-variables in wind energy conversion system-wind power density-power in a wind stream-wind turbine efficiency-power of a wind turbine for given in-coming wind velocity - forces on the blades of a propeller-examples of wind farm site-mean wind velocity-wind velocity duration curve-energy pattern factor-wind power duration characteristics - Tip speed ratios - Solidity curves.

Terms-study of all types of turbines (HAWT, VAWT)-typical large capacity wind turbines-sizing-tower design-power duration curves-wind rows diagrams –study of characteristics-actuator theory – analysis of Hourly, daily, monthly, annual, wind behavior-control and instrumentations. syncln & power stabilization synchronization & power stabilization.

UNIT - III POWER GENERATION AND HYBRIDISATION 10

Types of wind energy system-alternatives-Grid-combination of diesel generator, Battery storage-wind turbine circuits-wind map of India-Wind farm-indefinitely developed wind turbine-study of various wind turbines manufactured indigenously - kilowatt rating-retrofits-R&M-OP & FC-speed limitation-fatigue stress.

UNIT - IV WAVE AND TIDAL ENERGY 7

Wave energy -Tidal changes – Ecological changes – Types Tidal Power – Energy from Sea – Tidal Turbines – Tidal Power Generation – Recent Trends and Developments – Problems and solutions – Case Studies.

UNIT - V OTEC 6

The concepts- construction and operational problems – history of OTEC development Alternative energy technology – Ocean thermal energy conversion – Techniques – Problems and solutions – Case Studies-ecological and environmental aspects.

A compulsory seminar / assignment on design / case study/analysis /application in any one of the Wind energy,Tidal and OTEC **L:45; Total:45**

TEXT BOOKS;

1.E.L Wakil ”Power plant technology”, McGrawGill Publishers,New York
2.G. D Rai “Non Conventional Energy sources” Khanna publishers. New Delhi

REFERENCES:

1.S.Rao & B.B.Parulekar,”Energy Technology”, 3rd edition,Khanna publishers,1995.
2.Anna Mani & Dr.Nooley,”wind Energy Data for India”, 1983.

QRE202 – Research Methodology and IPR **2 0 0 2**

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

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4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007. Mayall , "Industrial Design", McGraw Hill, 1992.
5.. Niebel , "Product Design", McGraw Hill, 1974.
6.Model Curriculum of Engineering & Technology PG Courses [Volume -II] 125 Asimov, "Introduction to Design", Prentice Hall, 1962.
7.Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8.T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

PYRE 301 - COMPUTATIONAL FLUID DYNAMICS **3 0 0 3**

UNIT - I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD **10**

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT - II CONDUCTION HEAT TRANSFER **8**

Steady one-dimensional conduction, Two and Three-dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT - III INCOMPRESSIBLE FLUID FLOW **7**

Governing Equations, Stream Function - Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite deference approach.

UNIT - IV CONVECTION HEAT TRANSFER AND FEM **7**

Steady One-Dimensional and Two-Dimensional Convection - Diffusion, Unsteady one-dimensional convection -Diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - Solution of steady heat conduction by FEM - Incompressible flow - Simulation by FEM.

UNIT - V TURBULENCE MODELS **10**

Algebraic Models - One equation model, K-I Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

L:45; T:15; Total :45

TEXT BOOK

1. Anderson ,D.A Tannehill, I I and Pletcher , R,H “Computational Fluid Mechanics and Heat transfer” Narosa Publication House, NewYork, USA,1984

REFERENCES:

1. Muralidhar, K.,and Sundararajan,T., "Computational Fluid Flow and Heat Transfer", Narosa PublishingHouse ,New Delhi1995.
2. Ghoshdasdidar, P.S.,"Computer Simulation of flow and heat transfer" Tata McGraw-Hill PublishingCompany Ltd., 1998.
3 .Anderson, D.A.,Tannehill, I.I., and Pletcher, R.H., “Computational Fluid Mechanics and Heat Transfer”,Hemishphere Publishing Corporation, New York, USA, 1984.
4. Flectcher, C.A.J., "Computational Techniques for Different Flow Categories, Springer-Verlage 1987.