KUMARAGURU COLLEGE OF TECHNOLOGY
COIMBATORE – 641 049
(An Autonomous Institution Affiliated to Anna University, Chennai)

Department of Mechanical Engineering

REGULATIONS – 2015 (R2015)

(CBCS)

CURRICULUM AND SYLLABUS FOR III to VIII SEMESTERS

From Academic year 2016-2017

B.E - MECHANICAL ENGINEERING

B.E - MECHANICAL ENGINEERING

SEMESTER – III

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15MA*T*304	Partial differential equations and Fourier Analysis	BS	5	3	2	0	4
2.	U15ME*T*301	Fluid Mechanics and Machinery	PC	5	3	2	0	4
3.	U15ME*T*302	Strength of Materials	ES	5	3	2	0	4
4.	U15ME*T*303	Engineering Thermodynamics	PC	5	3	2	0	4
5.	U15ME*T*304	Manufacturing Technology- I	PC	4	3	0	0	3
6.	U15MET306	Engineering Metallurgy	PC	4	3	0	0	3
Practical								
7.	U15ME*P*301	Strength of Materials & Fluid Mechanics and Machines Laboratory	ES	3	0	0	2	1
8.	U15ME*P*302	Manufacturing Technology Laboratory -I	PC	3	0	0	2	1
9.	U15GH*P*301	Family Values	HS	1	1	0	0	1
TOTAL				35				25

SEMESTER – IV

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15MA*T*401	Numerical Methods	BS	5	3	2	0	4
2.	U15ME*T*402	Kinematics of Machinery	PC	5	3	2	0	4
3.	U15ME*T*403	Manufacturing Technology-II	PC	4	3	0	0	3
4.	U15ES*T*003	Environmental Science and Engineering	ES	4	3	0	0	3
5.	PE-1	Professional Elective- PE1	PE	4	3	0	0	3
Practical								
6.	U15ME*P*401	Manufacturing Technology Laboratory- II	PC	3	0	0	2	1
7.	U15CSP405	Problem solving Techniques Laboratory	EEC	3	0	0	4	2
8.	U15EN*P*401	Communication Skill Laboratory	EEC	3	0	0	2	1
9.	U15GH*P*401	Professional Values	HS	1	1	0	0	1
TOTAL				32				22

SEMESTER – V

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15ME*T*501	Dynamics of Machinery	PC	5	3	2	0	4
2.	U15ME*T*503	Thermal Engineering	PC	5	3	2	0	4
3.	U15MET504	Design of Machine Elements	PC	3	3	0	0	3
4.	U15GS*T*004	Operations Research	PC	4	3	0	0	3
5.	PE-2	Professional Elective-PE2	PE	4	3	0	0	3
6.	OE-1	Open Elective- OE1	OE	4	3	0	0	3
Practical								
7.	U15ME*P*501	Mechanism and Dynamics Laboratory	PC	3	0	0	2	1
8.	U15ME*P*502	Thermal Engineering Laboratory	PC	3	0	0	2	1
9.	U15GH*P*501	Social Values	HS	1	1	0	0	1
TOTAL				32				23

SEMESTER – VI

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15ME*T*601	Heat and Mass Transfer	PC	5	3	2	0	4
2.	U15ME*T*602	Finite Element Analysis	PC	5	3	2	0	4
3.	U15ME*T*605	Design of Transmission Systems	PC	5	3	2	0	4
4.	U15GS*T*006	Product design and development	PC	4	3	0	0	3
5.	OE-2	Open Elective- OE2	OE	4	3	0	0	3
Practical								
6.	U15ME*P*601	Heat Transfer Laboratory	PC	3	0	0	2	1
7.	U15MC*P*607	Mechatronics Laboratory	PC	3	0	0	2	1
8.	U15GH*P*601	National Values	HS	1	1	0	0	1
TOTAL				30				21

SEMESTER – VII

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15ME*T*701	Computer Integrated Manufacturing	PC	4	3	0	0	3
2.	U15ME*T*702	Engineering Metrology and Quality Control	PC	4	3	0	0	3
3.	U15GS*T*005	Engineering Economics and Financial Management	HS	4	3	0	0	3
4.	PE-3	Professional Elective- PE3	PE	4	3	0	0	3
5.	OE-3	Open Elective- OE3	OE	4	3	0	0	3
Practical								
6.	U15ME*P*701	Computer Aided Engineering Laboratory	PC	3	0	0	2	1
7.	U15ME*P*702	Metrology and Metallurgy Laboratory	PC	3	0	0	2	1
8.	U15GH*P*701	Global Values	HS	1	1	0	0	1
Project								
9.	U15ME*P*703	Project work – phase I	EEC	4	0	0	4	2
TOTAL				31				20

SEMESTER – VIII

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	PE-4	Professional Elective- PE4	PE	4	3	0	0	3
2.	PE-5	Professional Elective- PE5	PE	4	3	0	0	3
3.	PE-6	Professional Elective- PE6	PE	4	3	0	0	3
Project								
4.	U15ME*P*801	Project work – phase II	EEC	25	0	0	24	10
TOTAL				37				19

CREDIT BREAK UP :

III and IV semester : 25+ 22 = 47
V and VI semester : 23 + 21 = 44
VII and VIII semester : 20 + 19 = 39
Total credits : = 182 (Including I & II semesters of 52credits)

PROFESSIONAL ELECTIVES

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15MEPE01	Design of Jigs, Fixtures and Press Tools	PE	4	3	0	0	3
2.	U15MEPE02	Design for Manufacture and Environment	PE	4	3	0	0	3
3.	U15MEPE03	Vibration and Noise Control	PE	4	3	0	0	3
4.	U15MEPE04	Micro Electro Mechanical Systems	PE	4	3	0	0	3
5.	U15MEPE05	Design of Material Handling equipment	PE	4	3	0	0	3
6.	U15MEPE06	Composite Materials	PE	4	3	0	0	3
7.	U15MEPE07	Robotics	PE	4	3	0	0	3
8.	U15MEPE08	Refrigeration and Air Conditioning	PE	4	3	0	0	3
9.	U15MEPE09	Gas dynamics and Jet propulsion	PE	4	3	0	0	3
10.	U15MEPE10	Energy Conservation and Management	PE	4	3	0	0	3
11.	U15MEPE11	Automobile Engineering	PE	4	3	0	0	3
12.	U15MEPE12	Power Plant Engineering	PE	4	3	0	0	3
13.	U15MEPE13	Nuclear Engineering	PE	4	3	0	0	3
14.	U15MEPE14	Solar Energy Engineering	PE	4	3	0	0	3
15.	U15MEPE15	Production planning and control	PE	4	3	0	0	3
16.	U15MEPE16	Lean Manufacturing	PE	4	3	0	0	3
17.	U15MEPE17	Advanced Machining Processes	PE	4	3	0	0	3
18.	U15MEPE18	Advanced Welding Processes	PE	4	3	0	0	3
19.	U15MEPE19	Hydraulics and Pneumatics	PE	4	3	0	0	3
20.	U15MEPE20	Sustainable Development	PE	4	3	0	0	3
21.	U15MEPE21	Additive Manufacturing	PE	4	3	0	0	3
22.	U15MEPE22	Total Productive Maintenance	PE	4	3	0	0	3
23.	U15MEPE23	Ergonomics	PE	4	3	0	0	3
24.	U15MEPE24	Plant Layout and Material Handling	PE	4	3	0	0	3
25.	U15MEPE25	Supply Chain Management	PE	4	3	0	0	3
26.	U15MEPE26	Marketing Management	PE	4	3	0	0	3
27.	U15MEPE27	Entrepreneurship Development	PE	4	3	0	0	3
28.	U15MEPE28	Computational Fluid	PE	4	3	0	0	3

		Dynamics						
29.	U15MEPE29	Mechatronics	PE	4	3	0	0	3
30.	U15GS*T*002	Total Quality Management	PE	4	3	0	0	3
31.	U15GS*T*003	Principles of Management	PE	4	3	0	0	3
32.	U15GS*T*007	Professional Ethics	PE	4	3	0	0	3

OPEN ELECTIVES

	Course Code	**Course Title**	**Category**	**Contact Hours**	**Hrs/Week& Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15MEOE01	Computer Aided Design	OE	4	3	0	0	3
2.	U15MEOE02	Renewable Energy Sources	OE	4	3	0	0	3
3.	U15MEOE03	Industrial Safety	OE	4	3	0	0	3

ONE CREDIT COURSES

	Course Code	**Course Title**	**Category**	**Contact Hours**	**Hrs/Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15MEI001	Geometrical Dimensioning and Tolerancing	EEC	1	0	0	2	1
2.	U15MEI002	Implementation of statistical process and control	EEC	1	0	0	2	1
3.	U15MEI003	Lean for world class manufacturing	EEC	1	0	0	2	1
4.	U15MEI004	Good shop floor practices for manufacturing excellence	EEC	1	0	0	2	1
5.	U15MEI005	Team Dynamics	EEC	1	0	0	2	1
6.	U15MEI006	Lean management tools	EEC	1	0	0	2	1
7.	U15MEI007	Value stream mapping	EEC	1	0	0	2	1
8.	U15MEI008	Value analysis and value engineering	EEC	1	0	0	2	1

SEMESTER – III

U15MA*T*304 PARTIAL DIFFERENTIAL EQUATIONS AND FOURIER ANALYSIS

L	T	P	C
3	2	0	4

Course Outcomes (COs):

CO1: Form partial differential equations and solve certain types of partial differential equations.

CO2: Determine the Fourier Series and half range Fourier Series of a function given explicitly or to find Fourier Series of numerical data using harmonic analysis

CO3: Solve one dimensional wave equation and one dimensional heat equation in steady state using Fourier series.

CO4 : Apply Fourier Series to solve the steady state equation of two dimensional heat equation in Cartesian coordinates.

CO5: Use Fourier series to solve the steady state equation of Circular and Semi-circular disks.

CO6: Apply Fourier transform, sine and cosine transform to certain functions and use Parseval's identity to evaluate integrals.

Pre-requisite:

1. Basic concept of Ordinary differentiation, Partial differentiation and Integration.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M				
CO2	S	S							M	M				
CO3	S	S							M	M				
CO4	S	S							M	M				
CO5	S	S							M	M				
CO6	S	S							M	M				

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

PARTIAL DIFFERENTIAL EQUATIONS **9+3 Hrs**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES **9+3Hrs**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS 9+3Hrs

Classification of second order quasi linear partial differential equations – Fourier series solutions of one dimensional wave equation – One dimensional heat equation: Problems with temperature and temperature gradients.

BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS 9+3Hrs

Steady state solution of two-dimensional heat equation in Cartesian coordinates: Infinite and finite plates – Steady state solution of two-dimensional heat equation in Polar coordinates: Circular and Semicircular disks – Fourier series solutions.

FOURIER TRANSFORM **9+3Hrs**

Infinite Fourier transform pair – Infinite Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

References:

1. Grewal B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill, New Delhi (2001)
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company ltd., New Delhi, 1996.
4. Ian Sneddon., "Elements of partial differential equations" , McGraw – Hill, New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2009.
6. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, Wiley India, 2013.

U15ME*T*301 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	2	0	4

Course outcomes

After successful completion of the course, the student would be able to

CO 1: State and explain various fluid properties.

CO 2: Apply the knowledge of fluid statics for solving the problems in buoyancy and manometers.

CO 3: Solve problems in mass, momentum and energy balance equations in fluid dynamics

CO 4: Analyse the fluid flow problems through pipes.

CO 5: Analyse the performance of turbines and pumps

CO 6: Illustrate the various tools for solving fluid dynamic problems.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M										M	S	
CO2	S	M							M	M			M	
CO3	S	S							S	S			M	
CO4	S	M							M	M		M	M	
CO5	S	S							M	M		M	M	
CO6	W				M								W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

FLUID PROPERTIES, STATICS AND KINEMATICS 11+3Hrs

Fluid Properties: Importance & applications of fluid mechanics. Solid vs Fluid - Units and Dimensions – Properties of fluids (Definition only)-Mass density – Specific weight – Specific volume – Specific gravity – Viscosity – Compressibility – Surface tension – Capillarity – Vapor pressure.

Fluid Statics: Hydrostatic equation – Forces on plane and curved surfaces – Buoyancy – Metacentre – Simple and differential manometers. Fluid Kinematics: Path line – Stream line – Streak line – Stream and Potential functions – Flownets.

FLUID DYNAMICS **11+3Hrs**

Fluid Element and properties - Lagrangian vs Eulerian description – Governing equations: Mass balance (Continuity equation) – Newton's second law (momentum equation- statement only) – First law of thermodynamics (Energy equation-statement only). Non-viscous flows (Euler's equation) – Frictionless flows (Bernoulli's equation), Introduction to CFD.

Case study (not for exam): Demonstration of solving Euler's and Navier-Stokes equation using analysis tools like ANSYS, HyperWorks etc.

FLUID FLOW AND DIMENSIONAL ANALYSIS **9+3Hrs**

Laminar and turbulent flows through pipe – Hagen-Poiseuille equation – Darcy-Weishbach equation – Major and Minor losses – Pipes in series and in parallel.

Dimensional Analysis- Buckingham's π theorem- Discharge and velocity measurements- venture meter and pitot tube.

HYDRAULIC TURBINES **7+3Hrs**

Force exerted on moving plate/ vanes- Definition and classifications- Pelton, Francis, Propeller and Kaplan turbine: Working principles- Velocity triangle – Work done – specific speed – efficiencies – Performance curve for turbines

HYDRAULIC PUMPS **7+3Hrs**

Definition and classifications- Centrifugal and Reciprocating Pumps: Working principles- Indicator diagram – Specific speed – efficiency and performance curves - Cavitations in pumps.

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

REFERENCES:

1. P.N. Modi & S.M. Seth, "Hydraulics and fluid mechanics including hydraulic machines", Standard book house, 2005.
2. R.K. Bansal,"Fluid mechanics and hydraulic machines", Laxmi Publications (P) Ltd, 2006.
3. K.L. Kumar,"Engineering fluid mechanics", Eurasia publishing house, 2001.
4. V.L. Streeter – "Fluid mechanics", McGraw-Hill, 2002.
5. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 2003.
6. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Pearsons, 2007.

U15ME*T*302 STRENGTH OF MATERIALS

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of the course, the student would be able to

CO 1: Make use of fundamental concepts to determine stress and strain in structural members..
CO 2: Apply the relationships between elastic constants and determine strain energy
CO 3: Construct the shear force and bending moment diagram for diverse beams under various loading conditions.
CO 4: Utilize various methods to determine the deflection in beams and buckling of columns.
CO 5: Solve problems on shafts and springs subjected to torsion.
CO 6: Apply various methods to solve problems in complex stress systems.

Pre-requisite:1.U15ME*T*202- Engineering Mechanics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M				W		W	W				S	
CO2	M											M	M	
CO3	S	W							M	S			W	
CO4	M	W								S			S	
CO5	M	M								M		M	M	
CO6	M	W							M			W	W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

STRESSES AND STRAINS 11+3 Hrs

Stress and strain - Elastic limit - Hooke's law - Stress-strain diagrams - Ultimate stress-Yield Stress-Factor of safety – Stresses and strains in stepped bars and uniformly varying sections – Stresses in composite bars due to axial loads and temperature. Elastic constants and their relationship - Strain energy due to axial force - Resilience – Stresses due to impact and suddenly applied load. Hoop and longitudinal stresses in thin cylinders and shells.

SHEAR AND BENDING IN BEAMS 9+3Hrs

Shear force and bending moment diagrams for statically determinate beams with concentrated load, UDL, uniformly varying load. Theory of simple bending - Stress distribution along length and in beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

DEFLECTION OF BEAMS AND COLUMNS 9+3Hrs

Slope and deflection in determinate beams - Double integration method, Macaulay's methods, Area moment method. Columns – End conditions – Euler's formula – Rankine's formula.

TORSION 9+3Hrs

Torsion of circular and hollow shafts - Elastic theory of torsion - Stresses and Deflection in Circular solid and hollow shafts - stepped shaft - Power transmitted by a shaft- Shaft in series and parallel. Springs - closed and open coiled helical springs.

COMPLEX STRESSES 7+3 Hrs

State of stress at a point - Normal and Shear stresses on any plane - Principal stresses and strains in two dimension – Analytical method, Mohr's circle method. Strain energy in bending and torsion.

Theory :45 Hrs Tutorial :15 Hrs Total:60Hrs

REFERENCES:

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 2007.
2. Rajput R. K, "A Textbook of Strength of Materials", S. Chand, 2007.
3. Subramanian R., "Strength of materials", Oxford University Press, New Delhi,2005
4. Premalatha J,"Mechanics of solids", Vignesh Publications, Coimbatore,2009.
5. Bansal R.K,"Strength of materials", Laxmi Publications, New Delhi,2007.
6. William A.Nash, "Theory and Problems of Strength of materials, Schaum's Outline series",Tata McGraw-Hill, New Delhi,2007.

U15ME*T*303 ENGINEERING THERMODYNAMICS

L	T	P	C
3	2	0	4

(Use of standard Steam table and Mollier diagram, Psychrometric Chart and Gas Tables are permitted)

Course outcomes

After successful completion of the course, the student would be able to

CO 1: Illustrate basic concepts for solving problems in open and closed system.
CO 2: Apply second law concepts to heat engine and heat pumps
CO 3: Apply concepts of entropy.
CO 4: Compare the performance of various vapour power cycles
CO 5: Illustrate the significance of thermodynamics relations
CO 6: Solve problems in various psychrometric processes

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								S	M		W	M	
CO2	S	W							S	S		M	M	
CO3	S	W							M	M			M	
CO4	S	M							S	S		W	S	
CO5	M									S			M	
CO6	M								M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

BASIC CONCEPTS AND FIRST LAW **12+3Hrs**

Basic concepts - concept of continuum, macroscopic approach: thermodynamic systems - closed, open and isolated: Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – SFEE - Application to closed and open systems

SECOND LAW AND ENTROPY **12+4Hrs**

Second law of thermodynamics – Kelvin's and Clausius statements of second law, Heat Engines, Refrigerator and Heat Pump, Coefficient of Performance, Reversibility Carnot cycle - reversed Carnot cycle, efficiency, Carnot theorem, Thermodynamic temperature scale. Clausius theorem, Clausius inequality, concept of entropy, entropy of ideal gas, change of entropy for different non flow processes, principle of increase of entropy – absolute entropy, Availability and irreversibility

STEAM AND VAPOUR CYCLES **10+3Hrs**

Formation of steam at constant pressure, types of steam, steam tables and uses, external work done during evaporation, internal energy of Steam, dryness fraction of steam, entropy of steam – Mollier diagram steam power cycles, standard Rankine cycle, modified Rankine cycle. Reheat and regenerative cycle, Air standard otto cycle, Process making of the cycle, Cycle thermal efficiency, Compression expansion ratio and cycle efficiency, Deviation of real spark ignition engine from ideal cycle engines.

IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS **7+2Hrs**

Properties ideal and real gases, equation state, VanderWall's equation of state, compressibility factor, compressibility chart- Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule-Thomson coefficient.

PSYCHROMETRY **4+3Hrs**

Avagadro's Law, equation state, Gas mixtures, Dalton's law, Psychrometry and psychrometric charts, property calculations of air vapour mixtures.

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

REFERENCES:

1. Nag, P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2008.
2. Cengel Y., "Thermodynamics An Engineering Approach", Tata McGraw-Hill, NewDelhi, 2008.
3. Holman.J.P. "Thermodynamics",Tata MC Graw Hill, 2006.
4. Arora, C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2004.
5. Merala, C. Pother, Craig, W., Somerton, "Thermodynamics for Engineers", Schaum Outline Series, McGraw-Hill, 2008.
6. Rogers and Mayhew, "Engineering Thermodynamics", Work and Heat Transfer, Pearson education, 1992.

U15ME*T*304 MANUFACTURING TECHNOLOGY – I

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the student would be able to

CO 1: Apply the knowledge of various metal casting processes that are useful in designing system components or processes and create appropriate techniques and apply modern tools and research to model complex design and making processes of components

CO 2: Discuss the various welding techniques with their equipment, process capabilities and principle of operations that match specific manufacturing needs with considerations for public health, safety and social issues

CO 3: Apply the knowledge of metal working processes understanding and studying the physics behind it and focus on typical forging operations

CO 4: Identify various rolling, piercing and extrusion operations and study and make use of them in solving complex design needs through specific manufacturing tools and methods

CO 5: Understand the various sheet metal forming processes

CO 6: Study the formability, characteristics, test methods and working principle of sheet metals by applying the knowledge of engineering and make use of sheet metal processing knowledge in practical engineering applications.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S		S				W	M				S
CO2			S	M	S	W			W	M				S
CO3	M		S						W	M				S
CO4	M		S						W	M				S
CO5			S		M					M				S
CO6	M		S							M				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End semester exam	Course end survey

METAL CASTING PROCESSES **12Hrs**

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines – Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Pressure die casting – Centrifugal casting – Sand Casting defects – Inspection methods, Runner, Riser and Gating Design, Solidification

FABRICATION PROCESS **11Hrs**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Gas cutting opeartions – Flux cored – Submerged arc welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Weld defects – Brazing and soldering process – Methods and process capabilities.

FORGING PROCESSES **5Hrs**

Hot working and cold working of metals – Forging processes – Open and close die forging – Characteristics of the process – Typical forging operations –

ROLLING PROCESSES **7Hrs**

Rolling of metals – Flat strip rolling – Types of Rolling mills – Shape rolling operations – Tube piercing – Defects in rolled parts – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion – Principle of rod and wire drawing.

METAL FORMING PROCESSES **10Hrs**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Explosive forming – Magnetic pulse forming – Super plastic forming – Process characteristics.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Hajra Choudhury, “Elements of Workshop Technology”,Media Promotors Pvt.Ltd., Mumbai, 2001.
2. Serope Kalpajian and Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, 2002.
3. B.S. Magendran Parashar and R.K. Mittal,“Elements of Manufacturing Processes”, Prentice Hall of India, New Delhi,2003.
4. P.N.Rao,“Manufacturing Technology”,Tata McGraw-Hill,2002.
5. P.C. Sharma, “Production Technology”, S. Chand,New Delhi,2007.
6. Begman, “Manufacturing Process”,John Wilely & Sons,2004.

U15ME*T*306 ENGINEERING METALLURGY

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the student would be able to

CO 1: Apply the knowledge of metallurgy in phase diagrams
CO 2: Apply the types of heat treatment processes for specific applications
CO 3: Apply the ferrous materials in various applications
CO 4: Apply the non ferrous materials in various applications
CO 5: Apply the different nonmetallic materials in various applications
CO 6: Apply the different testing methods to test the materials

Pre-requisite:1. U15PH*T*202- Materials Science

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								S	M				M
CO2									S					M
CO3									S					M
CO4									S					M
CO5									S					M
CO6										M				M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End semester exam	Course end survey

INTRODUCTION AND CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9Hrs

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

HEAT TREATMENT 9Hrs

Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalising, hardening and Tempering of steel. TTT diagram - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

FERROUS AND NON FERROUS METALS **9Hrs**

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – High strength Low Alloy steels (HSLA) – Dual phased steel – Micro alloyed steels – maraging steels – Alloyed cast –Irons, Ni-hard and Ni-resist cast irons. Copper and Copper alloys - properties and applications of Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys + Alloys of Ti, Zn, Mg and Ni.

NON-METALLIC MATERIALS **9Hrs**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PEEK, PTFE Polymers – Urea and Phenol formaldeliydes – Engineering Ceramics – Properties and applications of Al2O3, SiC, SI3 - N4.

TESTING OF MATERIALS **9Hrs**

Properties Evaluated by tensile testing procedure, Engineering stress strain curve Vs true stress strain curve, stress strain curve for typical materials, Hardness testing, Impact testing, Fracture toughness, Fatigue testing: creep testing

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Kenneth, G., Budinski and Michael K.Budinski, “Engineering Materials”, Prentice- Hall of India Private Limited,2002.
2. Donald, R., Askeland and Pradeep, P., Pbule, “The Science and Engineering of Thomson Engineering”, 2002.
3. Suriyanarayana, A.V.K, “Testing of metallic materials”, Tata Mcgraw-Hill, 2001.
4. William D Callsber, “Material Science and Engineering”, John Wiley and Sons, 2005.
5. Raghavan,V., “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd, 2008.
6. Sydney H.Avner, “Introduction to Physical Metallurgy”, McGraw-Hill Book Company, 2004.
7. Vanvlack,L.H., “Materials Engineering: concepts and applications”, 2005.
8. Paul Dr. Garmo. E., Black, J.T., and Ronald A. Kohser, “Materials and Processes in Manufacturing”, Prentice Hall of India, 2005.

U15ME*P*301 STRENGTH OF MATERIALS &FLUID MECHANICS AND MACHINES LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the student would be able to

CO 1: Perform tensile and torsion test for mild steel (MS) specimen
CO 2: Conduct hardness test for different metals and carry out impact test for MS specimen
CO 3: Determine deflection in beams and calculate the stiffness of spring.
CO 4: Determine the discharge coefficient for Venturi and Orifice meter
CO 5: Calculate the frictional loss through pipes and draw the characteristic curves for pumps
CO 6: Evaluate the performance of turbines and verify Bernoulli's theorem

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								S				S	
CO2	S							S					S	
CO3	S						M	S					M	
CO4	M						M		S				M	
CO5	M						M			M			M	
CO6	M									M			M	

Course Assessment methods:

Direct	Indirect
1. Lab Exercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

a) LIST OF EXPERIMENTS: STRENGTH OF MATERIALS LABORATORY:

1. Tension test on a mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metals – Brinell and Rockwell Hardness
4. Deflection test on beams
5. Compression test on helical springs
6. Impact Test.

b) LIST OF EXPERIMENTS:FLUID MECHANICS & MACHINES LABORATORY

1. Determination of the Coefficient of discharge of a given Orifice meter.
2. Determination of the Coefficient of discharge of a given Venturi meter.
3. Determination of friction factor for a given set of pipes.
4. Characteristic curves of centrifugal / reciprocating pump
5. Performance characteristics of Pelton wheel.
6. Performance characteristics of Francis turbine.
7. Verification of Bernoulli's theorem
8. Study on Wind tunnel

Practical :45 Hrs **Total:45Hrs**

U15ME*P*302 MANUFACTURING TECHNOLOGY LABORATORY – I

L	T	P	C
0	0	2	1

Course outcome:

After successful completion of the course, the student would be able to

CO 1: Practice making molds using different types of patterns and core and acquire practical knowledge involved in designing prototypes/components

CO 2: Learn how to make internal geometries in castings using core

CO 3: Know and practice the skill of smithy and learn to modify the shapes of hard metal rods physically

CO 4: Do different types of joints and understand how they are applied in machine structures/mechanisms

CO 5: Know how to perform welding operations and how to join different metals.

CO 6: Practice TIG and MIG welding techniques and learn how they are useful in industrial operations.

Pre-requisite:1.U15ME*P*101- Engineering Practices Laboratory

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S		S				S	W	M			S
CO2			S						S	W	W			S
CO3					S			S	S	W	W			S
CO4					S				S	M	M			S
CO5					S			S	S	W	W			S
CO6					S			S	M	M	W			S

Course Assessment methods:

Direct	Indirect
1. Lab Exercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS:

1. Mould with solid and split patterns
2. Mould with loose-piece pattern
3. Mould with Core
4. Conversion of round rod in to square rod
5. Conversion of round rod in to rectangular rod
6. Conversion of round rod in to hexagonal headed rod
7. SMAW of different types of joints
8. TIG welding of metal plate
9. MIG Welding of different types of joints

Practical :45 Hrs **Total:45Hrs**

U15GH*P*301 FAMILY VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Course outcomes:
After successful completion of the course, the student would be able to:

1. The students shall understand the importance of a family
2. The students shall acquire skills in simplified Kundalini yoga for sound health.
3. The students shall learn about greatness of womanhood
4. The students shall learn about the importance of Blessings and relationship
5. The students shall know about simplified Kundalini yoga, its methodology and its benefits

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M		M	S	W		M		
CO2						S	M		W			S		
CO3						W						M		
CO4						M			M			S		
CO5						M						M		

Course Assessment methods:

Direct	Indirect
1. Individual Assignment 2. Group Assignment 3. Presentation 4. Surprise Test 5. Practical Assessment 6. End Semester Assessment	1. Attendance and Behavioural Assessment

Introduction to Family Life – An Overall Perspective	1 Periods
Personal & Spiritual development through good Family life	1 Periods
Importance of Relationships & Blessings	3 Periods
Food as Medicine – Quantum Healing	3 Periods
Greatness of womanhood	2 Periods
Simplified Physical Exercises (Kundalini Exercises)	5 Periods

Theory: 10 Periods **Practical: 5 Periods** **Total Periods: 15**

References Books:

1. Vethathiri's Maharishi's, ***"Yoga for Modern Age"***, The World Community Service Centre, Vedhathiri Publications,2009.
2. Swami Vivekananda, "***The Man Making Message"*** The Ramakrishna Tapovanam, Published 1972.
3. Vethathiri's Maharishi's, ***"Manavalakalai part 1,2&3"*** 1^{1th} edition, The World Community Service Centre, Vethathiri Publications,2005.
4. Brian L Weiss, **" *Only Love is Real* "** by Grand Central Publishing, Published 1997.

SEMESTER – IV

U15MA*T*401 **NUMERICAL METHODS**

L	T	P	C
3	2	0	4

Course outcomes

After successful completion of the course, the student would be able to:

CO 1: Solve a set of algebraic equations representing steady state models formed in engineering problems

CO 2: Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables

CO 3: Find the trend information from discrete data set through numerical differentiation.

CO 4: Estimate integrals from discrete data through numerical methods.

CO 5: Predict the system dynamic behaviour through solution of ODEs modeling the system

CO 6: Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

Pre-requisite:

Basic knowledge in differentiation, integration and numerical operations.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M				
CO2	S	S							M	M				
CO3	S	S							M	M				
CO4	S	S							M	M				
CO5	S	S							M	M				
CO6	S	S							M	M				

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS **9+3**

Solution of nonlinear equations: False position method, Fixed point iteration method, Newton Raphson method for a single equation and a set of non- linear equations - Solution of linear

system of equations: Gaussian elimination method, Gauss Jordan method and Gauss Seidel method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.

CURVE FITTING AND INTERPOLATION 9+3

Curve fitting: Method of least squares – Interpolation: Newton's forward and backward difference formulae – Divided differences – Newton's divided difference formula - Lagrange's interpolation – Inverse interpolation.

NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Numerical differentiation by using Newton's forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules– Truncation error – Evaluation of double integrals.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION 9+3

Single step methods: Taylor's series method, Euler and Improved Euler methods, Fourth order Runge – Kutta method – Multistep method: Milne's predictor - corrector method.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain– Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.

Theory : 45 Hrs Tutorial : 15 Hrs Total: 60 Hrs

REFERENCES:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2007.
2. Steven C.Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", McGraw-Hill, 2004.
3. Gerald C. F. and Wheatley P.O, "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 2002.
4. Sastry S.S, "Introductory Methods of Numerical Analysis", Prentice Hall of India Pvt Ltd, New Delhi, 2003.

U15ME*T*402 **KINEMATICS OF MACHINERY**

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of the course, the student would be able to
CO 1: Apply the fundamental concepts in developing various mechanisms
CO 2: Make use of different methods to determine the velocity and acceleration in planar mechanisms.
CO 3: Construct the cam profile for specific follower motion.
CO 4: Identify appropriate gears and gear trains for particular application
CO 5: Solve problems in frictional mechanisms.
CO 6: Apply the concepts of friction to solve problems in flexible drives

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					W			M	S	M	W	M	W	
CO2	M	M			W				M	M	W	W	M	
CO3	S	W						M	S	M	W	W	S	
CO4	S	W											W	
CO5	M	W						M					M	
CO6	M	W											W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

BASICS OF MECHANISMS **6+1Hrs**

Terminology and Definitions- Degree of freedom, mobility-Kutzbach criterion- Grashoff's law-Gruebler’s criterion - Mechanical Advantage -Transmission angle - Kinematic Inversions of 4-bar chain and slider crank chains - Description of common mechanisms -- Ratchets and pawl mechanisms- Indexing mechanisms - Rocking mechanisms - Straight line generators

KINEMATICS OF PLANE MECHANISMS 12+5Hrs

General plane motion - Relative velocity method – Displacement, velocity and acceleration analysis in simple mechanisms - Instantaneous center method, Kennedy theorem – Coincident points – Coriolis component of acceleration - Analytical method of kinematic analysis – Computer applications in the kinematic analysis of simple mechanisms.

KINEMATICS OF CAM 9+3Hrs

Classifications - Displacement diagrams - Uniform velocity, simple harmonic, uniform acceleration and retardation and cycloidal motions – Graphical layout of plate cam profiles - Derivatives of follower motion - High speed cams - circular arc and tangent cams – unbalance and wind up - Pressure angle and undercutting – spring surge, jump speed analysis of cam.

GEARS AND GEAR TRAINS 10+3Hrs

Introduction – Types – Terminology – Law of toothed gearing – Velocity of sliding – Involute and cycloidal tooth profiles – Interchangeable gears – Length of path and arc of contact – contact ratio – Interference and under cutting – Minimum number of teeth to avoid interference in pinion and gear – Non standard gear teeth. Gear trains –Simple, compound, reverted and epicyclic gear trains – Differentials.

FRICTION 8+3Hrs

Friction in screw threads - Friction in pivots and collars – Plate clutches - Belt and rope drives .

Theory :45 Hrs Tutorial :15 Hrs Total:60Hrs

REFERENCES:

1. Rattan, S.S.,“Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd.,New Delhi, 2009.
2. Uicker, J.J., Pennock, G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press,New Delhi, 2009.
3. Thomas Bevan, “Theory of Machines”,CBS Publishers and Distributors, 2005.
4. Ghosh, A., and Mallick, A.K., “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 2006.
5. Rao, J.S., and Dukkipati, R.V, “Mechanism and Machine Theory”, New Age International (P) Ltd Publishers. New Delhi, 2007.
6. Khurmi, R.S., and Gupta, J.K., “Theory of Machines”, S.Chand & Company, 2009.
7. Norton L Robert, “Kinematics and Dynamics of Machinery”,Tata McGraw Hill, Higher Education, 2008.

U15ME*T*403 MANUFACTURING TECHNOLOGY – II

L	T	P	C
3	0	0	3

Course outcomes
After successful completion of the course, the student would be able to
CO 1: Apply the fundamentals of metal cutting and cutting tool materials
CO 2: Study the types of machine tools and working principles of machine tools
CO 3: Apply the different manufacturing processes to manufacture the components
CO 4: Apply the principles of surface integrity principles in finishing processes
CO 5: Apply the techniques for gear manufacturing
CO 6: Apply the knowledge of economics in tool life calculation in machining

Pre-requisite:1. U15ME*T*304- Manufacturing Technology-I

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							S	S				S
CO2	M								S	S				S
CO3	M								S	S				S
CO4	S								S	S				S
CO5	S								S	S				S
CO6	S	S							S	S				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End semester exam	Course end survey

THEORY OF METAL CUTTING 9Hrs

Introduction to Metal Cutting Methods – Mechanics of Metal Cutting – Orthogonal – Oblique – Merchants' Circle Diagram – Details of Derivation – Chip Details – Heat Generation – Cutting Tool Life – Cutting Tool Nomenclature – Cutting tool Materials - Cutting fluids – Recent Developments and Applications (Dry Machining and High Speed Machining)

MACHINE TOOLS **9Hrs**

Introduction to Lathe – Shaper – Planing – Milling – Drilling – Boring – Grinding – Honing – Working Principles – Operations – Working Holding Devices.

MANUFACTURING COMPONENTS **9Hrs**

Production of Axi-symmetrical components – Shafts – Hubs – Pins – Production of Prismatic Components– Housing – Lathe Beds – Gear Boxes – Machine Columns – Hole Production in Components using drilling – boring.

SURFACE FINISHING PROCESSES AND GEAR MANUFACTURING **9Hrs**

Grinding Machines – Grinding wheel Specifications – Honing – Lapping – Tapping – Burnishing – Super Finishing – Surface Integrity concepts – Gear Manufacturing Processes – Gear cutting – Gear Hobbing – Gear Shaping Machines – Manufacture of Spur – Helical – Bevel – Worm and Worm Wheel – Gear Finishing, Honing

ECONOMICS OF MACHINING **9Hrs**

Calculations of Machining Time – Turning – Drilling – Shaping – Milling – And Drilling – Cost estimation – General Principles of Economics in Machine usage and Machining – Economics of Tool Life – Optimal Cutting Speed for Productivity – Estimation of Machine hour rate and Machining Cost Computation.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Jain, R.K., and Gupta, S.C., "Production Technology", Khanna Publishers, New Delhi, 2004.
2. Sharma P.C., "A Text Book of Production Technology", S.Chand & Company Ltd., New Delhi,2010.
3. Hajra Choudhry, S.K., and Bose, S.K., "Workshop Technology", Media Promoters and Publishers Pvt. Ltd., Bombay, 2004.
4. Suresh Dalela, and Shankar, R., " A Text book of Production Engineering", Galgotia Publications (P) Ltd., New Delhi, 2000.
5. Rajput, R.K., "Manufacturing Technology", Laxmi Publications (P) Ltd, New Delhi, 2007.
6. HMT, "Production Technology", 2006.
7. Singh.D.K., " Manufacturing Technology", 2004.

U15ES*T*003 **ENVIRONMENTAL SCIENCE AND ENGINEERING**

L	T	P	C
3	0	0	3

(Common to Automobile/Aeronautical/Mechanical/Mechatronics Engineering)

Course Outcomes

After successful completion of the course, the student would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context

CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems

CO 3: Highlight the importance of ecosystem and biodiversity

CO 4: Ability to consider issues of environment and sustainable development in his personal and professional undertakings

CO 5: Paraphrase the importance of conservation of resources.

CO 6: Play a important role in transferring a healthy environment for future generations

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M					S		M					M
CO2						M				M				
CO3							M							
CO4						M	S							
CO5							S							
CO6			W				S					M		

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End semester exam	Course end survey

Course Content

OBJECTIVES

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful

environment for the future generations and how to maintain ecological balance and preserve bio-diversity.

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

14 Hrs

Definition, scope and importance – Need for public awareness – Forest resources: Use and overexploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams benefits and problems - Water conservation, rain water harvesting, watershed management Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources

ECOSYSTEMS AND BIODIVERSITY **9 Hrs**

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids - Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem
(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

BIODIVERSITY : Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **10 Hrs**

Definition – Causes, effects and control measures of: (a) Air pollution - Organic and inorganic pollution - cyclone separator, electrostatic precipitator(b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards -

Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries - waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hrs**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights

HUMAN POPULATION AND THE ENVIRONMENT **5 Hrs**

Population growth and explosion – Welfare Programme - Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory : 45 Hrs **Total:45Hrs**

REFERENCES:

1. Miller T.G, "Environmental Science", Wadsworth Publishing Co, 2013.
2. Masters G.M., and Ela W.P., "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd.
3. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India, 2002.
4. Trivedi R.K and Goel P.K., "Introduction to Air pollution". Techno-science Publications. 2003.
5. Trivedi R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Enviro Media, 1996.
6. Cunningham, W.P., Cooper, T.H.., & Gorhani E., "Environmental Encyclopedia", Jaico Publication House, Mumbai, 2001
7. Wager K.D., "Environmental Management", W.B. Saunders Co., USA, 1998
8. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science Publishing Co., 2003
9. Syed Shabudeen, P.S. "Environmental chemistry", Inder Publishers, Coimbatore, 2013

U15ME*P*401 **MANUFACTURING TECHNOLOGY LABORATORY -II**

L	T	P	C
0	0	2	1

Course outcome:

After successful completion of the course, the student would be able to

CO 1: Modify the shape of the given work piece using Milling machine
CO 2: Modify the shape of the given work piece using shaper
CO 3: Modify the shape of the given work piece using slotting machine
CO 4: Create holes in the given component using drilling operations
CO 5: Create a finished work piece using grinding machine
CO 6: Modify the shape of the given work piece using lathe operations

Pre-requisite:1.U15ME*P*302-Manufacturing Technology Laboratory-I

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S											S
CO2			S											S
CO3			S											S
CO4			S											S
CO5			S											S
CO6			S											S

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS:

1. Spur Gear cutting using Milling machine
2. Contour profile milling
3. External keyway machining using milling machine
4. Dove tail machining using shaper machine
5. Internal keyway machining using vertical slotting machine
6. Drilling, reaming and tapping for a given dimension of hole
7. Cylindrical grinding of a shaft
8. Surface grinding of a rectangular block
9. Facing, plain and step turning.
10. Taperturning using compound rest method.
11. Single start V-Thread cutting and knurling.
12. Boring and internal thread cutting.

Practical :45 Hrs **Total:45Hrs**

U15EN*P*401 COMMUNICATION SKILL LABORATORY
(Common to all branches of Engineering and Technology)

L	T	P	C
0	0	2	1

Method of End Semester Evaluation: Practical: 60 marks, Online Exam: 40 marks

Course outcomes
After successful completion of the course, the student would be able to
CO 1: Imparting the role of communicative ability as one of the soft skills needed for placement
CO 2: Developing communicative ability and soft skills needed for placement
CO 3: Making students Industry-Ready through inculcating team-playing capacity

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	M			S		M		
CO2						M	M		S	S	M	M		
CO3						M	M		S	S	M	M		
CO4						M	M		S	S	M	M		
CO5						M	M		S	S	M	M		
CO6						M	M		S	S	M	M		
CO7						M	M		S	S	M	M		
CO8							M		S	S	M	-		
CO9						M	M		S	S	M	M		
CO10						M	M		S	S	M	M		
CO11				M		M	M		S	S	M	M		
CO12				M		M	M		S	S	M	M		
CO13				M		M	M		S	S	M	M		
CO14				M		M	M		S	S	M			
CO15						M	M		S	S	M	S		

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

GRAMMAR IN COMMUNICATION **9Hrs**

Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension –Listening and Ear training.

ASSERTIVE COMMUNICATION **9Hrs**

Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases.

CORPORATE COMMUNICATION **9Hrs**

Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication Etiquette.

PUBLIC SPEAKING **9Hrs**

Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication.

INTERVIEW & GD TECHNIQUES **9Hrs**

Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices.

Experiments beyond the syllabus to be conducted

Practical :45 Hrs **Total:45Hrs**

REFERENCES:

1. Bhatnagar R.P. & Rahul Bhargava, “English for Competitive Examinations”, Macmillian Publishers, India, 1989.
2. Devadoss K. & Malathy P., “Career Skills for Engineers”, National Book Publishers, Chennai, 2013.
3. Aggarwal R.S., “A Modern Approach to Verbal & Non–Verbal Reasoning”, S.Chand Publishers, India, 2012.

U15GH*P*401/ PROFESSIONAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	1	0	0	1

Course outcomes:
After successful completion of the course, the student would be able to:

1. The Students shall acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional
2. The Students shall understand the concept of Karma Yoga and lead his/her life accordingly
3. The Students shall understand the importance of ethics in ones profession and practice it
4. The Students shall get acquainted with leadership theories and use them in his/her profession appropriately
5. The Student shall learn how to be an empowered professional and how to empower colleagues

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M	W			W	M	M	M			M		
CO2		W				M	S	M	M			S		
CO3					M		S	S	W	W		M		
CO4		W				M	M	M	S	W		M		
CO5		W				M	M	W	M			M		

Course Assessment methods:

Direct	Indirect
1. Individual Assignment 2. Group Assignment 3. Presentation 4. Surprise Test 5. Practical Assessment 6. End Semester Assessment	1. Attendance and Behavioural Assessment

Introduction to Professional Values	1 Period
Concept of Integral Karma Yoga	3 Periods
Professional Ethics	3 Periods
Eastern and Western Leadership Theories	2 Periods
Empowerment of a Professional	4 Periods
Advanced Contemplative Practices with Demonstrations	2 Periods

Theory: 13 Periods **Practical: 2 Periods** **Total Periods: 15**

References Books:

1. Rishabhchand, ***"Integral Yoga of Sri Aurobindo"*,** Sri Aurobindo Ashram Publication Department, Pondicherry, Published 2001.
2. Charles E Harris, **"*Engineering Ethics: Concepts and Cases*",** 4th edition, Western Michigan University, Published 2009.
3. Devdas Menon, **"*Spirituality at Work*",** professor of structural engineering at IIT Madras.
4. Ameeta Mehra, **"*Karma Yoga: Perfection in Work*",** The Gnostic Centre, New Delhi, Published 2000.
5. Winthrop Sargeant,"***The Bhagavad Gita"***, State University of New York, Published 1994.
6. D.R Kiran, ***"Professional Ethics& Human Values"***, The Mc Graw Hill/BSP Books, Published 2013.
7. S. Bhaskar, ***"Professional Ethics& Human Values"***, The Aunradha Agencies, Chennai, Published 2005.
8. Keith Ward & Cliff Bowman, ***"Extraordinary performance from ordinary people",*** Routledge, Published 2007.
9. Stephen Robbins, "Organization Behavior", The Prentice Hall; 15 editions, 2012.

SEMESTER – V

U15ME*T*501 DYNAMICS OF MACHINERY

L	T	P	C
3	2	0	4

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Analyze the static and dynamic force in mechanical systems.
CO 2: Evaluate the fluctuation of energy stored in flywheel.
CO 3: Determine the unbalanced force in reciprocating and rotating mass..
CO 4: Apply the fundamental concepts of vibrating system to predict the natural frequency.
CO 5: Estimate the frequency of damped and forced vibrating systems.
CO 6: Calculate the speed range of governors and determine the gyroscopic couple.

Pre-requisite:1. U15ME*T*402- Kinematics of Machinery

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M		M									M	
CO2		M							W				W	
CO3	S	M		M		W		W					S	
CO4	S			M		W							S	
CO5	S			M					W				S	
CO6		W				W		M					M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

FORCE ANALYSIS AND FLYWHEELS 10 + 4Hrs

Static force analysis of mechanisms – D' Alembert's principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft torque – Engine shaking forces. Turning moment diagrams – Fluctuation of energy, speed - Flywheels of engines and punching press

BALANCING **8 + 3Hrs**

Static and dynamic balancing – Balancing of rotating masses - Balancing of reciprocating masses in a single cylinder engine – Primary and secondary unbalanced forces - Balancing in multi-cylinder engines – Firing order – Balancing machines.

FREE VIBRATION **9 + 3Hrs**

Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - Natural frequency - Whirling of shafts and critical speed - Torsional vibration of two and three rotor systems, torsionally equivalent shaft.

DAMPED AND FORCED VIBRATIONS **9 + 2Hrs**

Damped vibration - Types of damping – Logarithmic decrement - Response to periodic forcing - Harmonic Forcing – Forced vibration caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation.

MECHANISMS FOR CONTROL **9 + 3Hrs**

Governors - Types - Centrifugal governors – Porter & Proell governer, Hartnell, Hartung – Characteristics - Effect of friction - Controlling Force

Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in aeroplanes, ships and automobiles.

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

REFERENCES:

1. Rattan S.S., “Theory of Machines”,Tata McGraw-Hill Publishing Company, New Delhi, 2009.
2. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2005.
3. Ghosh A. and Mallick A.K.,“Theory of Mechanisms and Machines”, Affiliated East- West Press Pvt. Ltd., New Delhi, 2006.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press,New Delhi, 2009.
5. Rao J.S. and Dukkipati R.V.,“Mechanism and Machine Theory”, New International Limited Publishers, New Delhi, 2007.
6. John Hannah and Stephens R.C.,“Mechanics of Machines”, Viva low-Priced Student Edition, 2006.
7. Sadhu Singh “Theory of Machines” Pearson Education India, 2006.

STANDARDS:

1. IS 11717: 2000, Vocabulary on Vibration and Shock
2. IS 13301: 1992, Guidelines for vibration isolation for machine foundations
3. IS 10000: Part 7: 1980, Methods of tests for internal combustion engines: Part 7 Governing tests for constant speed engines and selection of engines for use with electrical generators
4. IS 13274: 1992, Mechanical vibration - Balancing – Vocabulary
5. IS 13277: 1992, Balancing machine - Description and evaluation

U15ME*T*503 THERMAL ENGINEERING

L	T	P	C
3	2	0	4

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted in the examination*)*

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explain the working principle and combustion characteristics of IC Engines..
CO 2: Calculate the Air standard efficiency and MEP of various Gas power cycles.
CO 3: Analyse the performance parameters of IC Engines..
CO 4: Explain the performance characteristics of steam nozzles.
CO 5: Discuss the importance od compounding in Turbines.
CO 6: Calculate the various efficiencies of the air compressors.
CO 7: Explain the working principle of VCR & VAR systems.

Pre-requisite:1. U15ME*T*303- Engineering Thermodynamics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								M	M			S	
CO2	S	W							M	M			S	
CO3	S	M				W	W		M	M			S	
CO4	S								M	M			M	
CO5	S								M	M			S	
CO6	S						W		M	M			S	
CO7	S								M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

INTERNAL COMBUSTION ENGINES 9+1 Hrs

Classification of IC engine, engine components and functions - timing diagram.Fuel supply systems, Ignition Systems - Combustion phenomenon – Knocking and Detonation – Octane, Cetane numbers- Air-fuel ratio calculation, Lubrication system and cooling system, CRDI, MPFI.

GAS POWER CYCLES & ENGINE PERFORMANCE 9+5 Hrs

Otto, Diesel, Dual, Brayton cycles (Air standard efficiency derivation only), Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of Four stroke engines, Actual and theoretical PV diagram of two stroke engines. Engine testing - Performance – Heat balance – Frictional Power – Retardation Test - Morse Test -Exhaust gas analysis, pollution control norms.

STEAM NOZZLES AND TURBINES 9+3 Hrs

Flow of steam through nozzles, shapes of nozzles, effect of friction – Nozzle efficiency- General relationship between area, velocity and pressure in nozzle flow.Critical pressure ratio - Impulse and reaction principles, compounding, and velocity diagrams for simple turbines, speed regulations – governors.Reheating the steam- Bleeding.

AIR COMPRESSOR 9+3 Hrs

Classification - Reciprocating Air Compressor - working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling (Descriptive treatment only), Rotary Compressors – Centrifugal Compressor and axial flow compressor (Descriptive treatment only), Screw Compressors.

REFRIGERATION AND AIR CONDITIONING 9+3 Hrs

Fundamentals of refrigeration and air conditioning - Vapour compression refrigeration cycle- super heat, sub cooling- Performance calculations- working principle of vapour absorption system, Ammonia- Water, Lithium boride- water systems (Description only) – Alternate refrigerants- comparison between vapour compression and absorption systems- Air conditioning systems: types, working principles- Psychrometry - Cooling Load calculations – Concept of RSHF, GSHF, ESHF.

Theory :45 Hrs Tutorial :15 Hrs Total:60Hrs

REFERENCES:

1. Sarkar, B.K, “Thermal Engineering”, Tata McGraw-Hill Publishers, 2007.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar.A.V., “A course in thermal Engineering”, Dhanpat Rai&sons,2002.
3. Arora, C.P., “Refrigeration and Air conditioning”, Tata McGraw-Hill Publishers,2007.
4. Ganesan.V., “Internal Combustion Engines”,Tata McGraw-Hill,2007.

U15ME*T*504 DESIGN OF MACHINE ELEMENTS

(Use of approved Design Data Book is permitted in the Examination)

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the concept of steady stresses in design of machine elements..
CO 2: Solve problems in machine elements subjected to varying loads
CO 3: Design shafts and couplings for various applications
CO 4: Select bearings, seals and gaskets for specific applications.
CO 5: Design temporary and permanent joints.
CO 6: Identify the dimensions of various energy storing elements.

Pre-requisite:1.U15ME*T*302- Strength of Materials

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M				W		W				M	S	
CO2		M				W	W	W				M	S	
CO3	S		M	S					M	W	W		M	
CO4	S		M										W	
CO5	S		M	S					M	W	W		M	
CO6	S		M										W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9+3Hrs

Introduction to the design process – Product development cycle- factors influencing machine design, selection of materials based on mechanical properties -- Preferred numbers– Direct, Bending and Torsional stress – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety -theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

DESIGN OF SHAFTS AND COUPLINGS **9+3Hrs**

Design of shafts based on strength, rigidity and critical speed – Design of keys, key ways and splines - Design of rigid and flexible couplings - Design of levers

DESIGN OF BEARINGS, SEALS AND GASKETS **9+3Hrs**

Sliding contact and rolling contract bearings – Design of hydrodynamics journal bearings – selection of rolling contact bearings – Design of hydro static bearing – Design of seals and gaskets.

DESIGN OF TEMPORARY AND PERMANENT JOINTS **9+3Hrs**

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter joints – Design of welded joints, riveted joints for structures.

DESIGN OF ENERGY STORING ELEMENTS **9+3Hrs**

Design of various types of springs, helical springs, leaf springs - Design of flywheels considering stresses in rims and arms, for engines and punching machines.

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

REFERENCES:

1. Shigley J.E and Mischke C.R.,"Mechanical Engineering Design",Tata McGraw-Hill , 2003.
2. Bhandari V.B, "Design of Machine Elements",Tata McGraw-Hill Book Co, 2007.
3. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
4. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
5. Ugural A.C, "Mechanical Design – An Integral Approach", McGraw-Hill Book Co, 2004.

U15GS*T*004 **OPERATIONS RESEARCH**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply linear programming model and assignment model to domain specific situations

CO2: Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results

CO3: Apply the concepts of PERT and CPM for decision making and optimally managing projects

CO4: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

CO5: Analyze and apply appropriate inventory techniques in domain specific situations.

CO6: Analyze and apply appropriate queuing theories in domain specific situations

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S		S										
CO2	S	S		S										
CO3	S	S		S										
CO4	S	S		S										
CO5	S	S		S										
CO6	S	S		S										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End semester exam	Course end survey

LINEAR MODEL9 Hrs

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex

TRANSPORTATION AND ASSIGNMENT PROBLEM **9 Hrs**

Transportation model – Initial solution by North West corner method – least Cost method – VAM. Optimality test – MODI method and stepping stone method. Assignment model – formulation – balanced and unbalanced assignment problems

PROJECT MANAGEMENT BY PERT & CPM **9 Hrs**

Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT Cost

REPLACEMENT AND SEQUENCING MODELS **9 Hrs**

Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies).

Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem

INVENTORY AND QUEUING THEORY **9 Hrs**

Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management.
Queuing system and its structure – Kendall's notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m

Theory :45 Hrs **Total: 45 Hrs**

REFERENCES:

1. Taha H.A., "Operation Research", Pearson Education,2011.
2. Hira and Gupta "Introduction to Operations Research", S.Chand and Co.2007.
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co.2008
4. Wagner, "Operations Research", Prentice Hall of India, 2000
5. Bhaskar, S., "Operations Research", Anuradha Agencies,2015.

U15ME*P*501 MECHANISMS AND DYNAMICS LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Illustrate characteristic curves for governors and draw cam profile

CO 2: Determine the effect of gyroscopic couple and calculate moment of inertia

CO 3: Experiment with given Epicyclic gear trains

CO 4: Perform experiments on balancing of masses and determine the unbalanced force

CO 5: Conduct experiments on vibrating bodies for predicting natural frequency

CO 6: Demonstrate the working of simple bar and link mechanisms

Pre-requisite:1. U15ME*T*402- Kinematics of Machinery

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S							M	S	M			S	
CO2	S					W			S	M		W	S	
CO3	M					W			S			W	S	
CO4	S							M	S	M		W	W	
CO5	M					M		M	M			W	W	
CO6	W								S	M			S	

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS:

1. Study of the characteristics curves and sensitivity of various types of governors
2. Determination of jump speed and construction of cam profile.
3. Determination of gyroscopic couple and its verification.
4. Determination of Moment of Inertia of Rod using Bifilar Suspension and Compound Pendulum.
5. Determination of Moment of Inertia of Disc and Ring using Turn Table.
6. Determination of Gear Ratio and friction torque in Epicyclic Gear Train Apparatus.
7. Balancing of reciprocating masses.
8. Static and dynamic balancing of rotating masses.

9. a) Determination of Natural Frequency of Longitudinal Vibrations in Helical Spring.
   b) Verification of Dunkerley's Rule in Transverse Vibrations.
10. Determination of Natural Frequency of Torsional Vibrations in single and double Rotor Systems.
11. a) Determination of Critical Speed using Whirling of Shaft apparatus.
    b) Determination of transmissibility ratio in vibrating table.
12. Study on simple bar and link mechanisms

Experiments beyond the syllabus to be conducted

LIST OF EQUIPMENTS:

1. Cam analyzer.
2. Motorised gyroscope.
3. Governor apparatus - Watt, Porter, Proell and Hartnell governors.
4. Whirling of shaft apparatus.
5. Dynamic balancing machine.
6. Static and dynamic balancing machine.
7. Vibrating table
8. Vibration test facilities apparatus
9. Gear Model.

Practical :45 Hrs **Total:45Hrs**

U15ME*P*502 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Examine the performance parameters of internal combustion engines.
CO 2: Estimate the fuel properties like Viscosity, flash point & fire point..
CO 3: Determine the performance characteristics of reciprocating air compressor.
CO 4: Illustrate the Valve timing and port timing diagrams of CI & SI Engines.
CO 5: Interpret the emission characteristics of IC Engines.
CO 6: Explain the Data acquisition system used in IC Engines.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				S	W			S	M			M	
CO2	M				M				S	M			M	
CO3	M				M				S	M			M	
CO4	W								S	S			W	
CO5	M				M		M		M	M			M	
CO6	W								W	M			W	

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exams 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS:

1. Valve Timing and Port Timing Diagrams.
2. Performance and emission Test on Diesel Engine by Hydraulic loading.
3. Heat Balance Test on Diesel Engine by Electrical loading.
4. Morse Test on Multi cylinder Petrol Engine.
5. Performance and emission Test on single cylinder petrol engine.
6. Determination of Frictional Power by retardation test.
7. Determination of Viscosity of given oil.
8. Determination of Flash Point and Fire Point.
9. Performance test on reciprocating air compressor.
10. Study on CRDI and MPFI engines.
11. Study of data acquisition system for engine experiments.

Experiments beyond the syllabus to be conducted

Practical :45 Hrs **Total:45Hrs**

U15GH*P*501/ SOCIAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Course outcomes:
After successful completion of the course, the student would be able to:

1. The students shall acquire knowledge about how societies are formed and social values are created
2. The students shall understand and empathize various social issues and contribute towards finding a solution
3. To understand the causes of disparity among human beings
4. To know about social welfare organizations and to use social media effectively
5. To understand various social parameters that influences individual and society at large

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W				M	W	M	W			M		
CO2		W	W			W	M	M		W		M		
CO3		W				M	W	S				M		
CO4		W				S		M	W	M		S		
CO5			W		W	M	W			W		M		

Course Assessment methods:

Direct	Indirect
1. Individual Assignment 2. Group Assignment 3. Presentation 4. Surprise Test 5. Practical Assessment 6. End Semester Assessment	1. Attendance and Behavioural Assessment

Introduction to Social Values – Society	2 Periods
Development of Science, Education, Politics & Economics	3 Periods
Disparity among human beings	3 Periods
Social Issues & Welfare	3 Periods
Social Welfare Organizations	2 Periods
Yogasanas & Meditation	2 Periods

Theory: 13 Periods **Practical: 2 Periods** **Total Periods: 15**

References Books:

1. Swami Vivekananda, "***Prosperous India"*** 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
2. Fritz Schumacher, ***"Small is Beautiful",*** The Blond & Briggs, Published 1973.
3. Vethathiri Maharishi***, "Logical Solutions for the Problems of Humanity",*** The World Community Service Centre, Vethathiri Publications, 1999.
4. Sarvepalli Radhakrishnan, ***"The Source Book on Indian Philosophy"***, Princeton, N.J. : Princeton University Press, 1957.
5. Sarvepalli Radhakrishnan, ***"Religion, Science and Culture",*** The Orient Paperbacks, India, Published 1994.
6. Vethathiri's Maharishi's, ***"Vethathirian Principles of Life"*** The World Community Service Centre, Vethathiri Publications, 2003.

SEMESTER – VI

U15ME*T*601 HEAT AND MASS TRANSFER

(Use of Standard Heat and Mass Transfer Data Book is permitted)

L	T	P	C
3	2	0	4

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply steady state heat conduction problems for composite systems and fins.
CO 2: Solve transient heat conduction problems.
CO 3: Solve problems in natural and forced convection for internal and external flows.
CO 4: Calculate the effectiveness of heat exchanger using LMTD and NTU methods.
CO 5: Illustrate radiation shape factors for various geometries.
CO 6: Explain the phenomenon of diffusion and convective mass transfer.

Pre-requisite:1. U15ME*T*303 – Engineering Thermodynamics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								M	M			S	
CO2	S								M	M			S	
CO3	S	M							M	M			M	
CO4	S	S		W					M	M			S	
CO5	M								W	W			W	
CO6	M								W	W			W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. Tutorial 6. End semester exam	Course end survey

CONDUCTION **12 + 4 Hrs**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – Fourier Law of Conduction - General Differential Conduction equation in Cartesian and Cylindrical Coordinate systems – One Dimensional Steady State Heat Conduction through Plane Wall, Cylindrical and Spherical systems – Composite Systems – Critical thickness of insulation - Conduction with Internal Heat Generation – Extended Surfaces – Numerical Methods of One dimensional Heat conduction- Unsteady Heat Conduction – Lumped Analysis, Infinite and semi Infinite solids using Heislers Chart.

CONVECTION **10 + 4Hrs**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar, Turbulent and Combined flows – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical, Horizontal and Inclined Plates, Cylinders and Spheres.

PHASE CHANGE AND HEAT EXCHANGERS **8 + 3HRS**

Nusselts theory of condensation - Regimes in boiling - Correlations in condensation and boiling - Types of Heat Exchangers- compact heat exchanger – Overall Heat Transfer Coefficient – Fouling Factors - LMTD and Effectiveness – NTU methods of Heat Exchanger Analysis.

RADIATION **9 + 3 HRS**

Basic Concepts, Laws of Radiation – Black Body Radiation – Grey body radiation –radiation shield - Shape Factor Algebra (Plates, parallel, perpendicular, parallel circular disc) – Gas radiations (qualitative study).

MASS TRANSFER **6 + 1HRS**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

REFERENCES:

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer", New Age International,2008.
2. Yunus Cengal, "Heat and Mass Transfer", Tata McGraw Hill,2008.
3. Holman J.P, "Heat Transfer" Tata Mc Graw Hill,2007.
4. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co,2001.
5. Nag P.K, "Heat Transfer", Tata McGraw-Hill, New Delhi, 2002.
6. Eckert, E.R.G, 'Heat and mass transfer " Mc Graw hill, 1959.
7. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, March 2006.

U15ME*T*602 **FINITE ELEMENT ANALYSIS**

L	T	P	C
3	2	0	4

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Solve problems by applying standard finite element techniques.
CO 2: Analyze 1-D finite elements and to build the stiffness matrix..
CO 3: Examine 2-D finite element continuum for structural applications.
CO 4: Solve 1-D and 2-D heat transfer problems using finite element approach..
CO 5: Applyaxisymmetric formulation for specific applications.
CO 6: Make use of finite element principles in isoparametric applications.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S			M						M			W	
CO2				W	M				M				M	
CO3		S	M						W	M			W	
CO4	S	S	M		M				M				S	
CO5	M	M			M					W			S	
CO6	S		M	W									W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. Tutorial 6. End semester exam	Course end survey

INTRODUCTION **9 + 3Hrs**

Historical background– Matrix approach – Application to the continuum – Discretisation – Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Rayleigh Ritz method

ONE DIMENSIONAL PROBLEMS **9 + 3 Hrs**

Finite element modeling – Coordinates and shape functions- Potential energy approach – Galarkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shapefunctions – Applications to plane trusses- One dimensional steady state conduction heat transfer problems.

TWO DIMENSIONAL CONTINUUM 9 + 3Hrs

Introduction – Finite element modeling – Scalar valued problem – Poisson's equation –Laplace equation –Triangular elements – Element stiffness matrix – Force vector – Galarkin approach - Stress calculation – Temperature effects – Two dimensionalheat transfer problems

AXISYMMETRIC CONTINUUM 9 + 3Hrs

Axisymmetric formulation – Element stiffness matrix and force vector – Galarkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures.

ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM9 + 3Hrs

The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness– Stress calculations – Four node quadrilateral for axisymmetric problems.

Theory :45 Hrs Tutorial :15 Hrs Total:60Hrs

REFERENCES:

1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering",Prentice Hall, 2011.
2. David V Hutton "Fundamentals of Finite Element Analysis" McGraw-Hill Int. Edition, 2005.
3. Rao S.S., "The Finite Element Method in Engineering", Pergammon Press, 2005.
4. Reddy J.N.,"Finite Element: An Introduction to Finite Element Method", McGraw-Hill education,2005.
5. O.C.Zienkiewicz and R.L.Taylor, "The Finite Element Methods",Butterworth Heineman,2005.
6. Logan D.L, "A first course in the Finite Element Method",Thomson Learning, 2010.

U15ME*T*605 DESIGN OF TRANSMISSION SYSTEMS

(Use of approved Design Data Book is permitted in the End semester examination)

L	T	P	C
3	2	0	4

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Choose suitable flexible drive for specific application.
CO 2: Design spur and helical gear by considering strength and life..
CO 3: Estimate the dimensions of bevel and worm gears
CO 4: Construct the gear box for suitable application.
CO 5: Apply the uniform pressure and wear theories to design the various clutches.
CO 6: Design braking system for various applications.

Pre-requisite: 1.U15ME*T*401- Design of Machine Elements
2. U15ME*T*402 – Kinematics of Machinery

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S	M					W					W	
CO2	S		M	S					M	W		W	S	
CO3	M		M	S					M	W			S	
CO4	S	M	M	S					M	W		M	M	
CO5	S	W				W						M	M	
CO6		W				W		W				M	S	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. Tutorial 6. End semester exam	Course end survey

DESIGN OF FLEXIBLE ELEMENTS 9+3Hrs

Selection of V belts and pulleys-selection of Flat belts and pulleys-Wire ropes and pulleys – Selection of Transmission chains and Sprockets.Design of pulleys and sprockets.

SPUR GEARS AND HELICAL GEARS **9+3Hrs**

Gear Terminology-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Helical Gears – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces and stresses. Estimating the size of the spur andhelical gears.

BEVEL AND WORM GEARS **9+3Hrs**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: terminology, Merits and demerits. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

DESIGN OF GEAR BOXES **9+3Hrs**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Constant mesh gear box. – Design of multi speed gear box.

DESIGN OF CAM AND CLUTCHES **9+3Hrs**

Design of plate clutches, cone clutches – jaw clutches - internal expanding rim clutches. Design of Brakes

Theory :45 Hrs **Tutorial :15 Hrs** **Total:60Hrs**

REFERENCES:

1. Shigley J.E and Mischke C.R., “Mechanical Engineering Design”,Tata McGraw-Hill Education, 2014.
2. Sundararajamoorthy T.V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai,2015.
3. Maitra G.M., Prasad L.V., “Hand book of Mechanical Design”,Tata McGraw-Hill, 1995.
4. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Education ,2010.
5. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
6. Hamrock B.J., Jacobson B., Schmid S.R., “Fundamentals of Machine Elements”, McGraw-Hill Book Co., 2013.
7. Ugural A.C,"Mechanical Design,AnIntegrated Approach",McGrawHillEducation,2003.

STANDARDS:

1. IS 4460: Parts 1 to 3: 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles : Dimensions
4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 1 Flat Belt Drives.
5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2 V-Belt Drives.

U15GS*T*006 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand the basic concepts of product design and development.
- Know the implications in product architecture and the importance of industrial design.
- Understand prototyping basics and influence of diverse factors on project success.

COURSE OUTCOMES:

CO1: Apply concepts of product development and outline product planning process
CO2: Apply relative importance of customer needs in establishing product specifications
CO3: Identify concept generation activities and summarize the methodology involved in concept selection and testing
CO4: Outline supply chain considerations in product architecture and understand the industrial design process
CO5: Apply design for manufacturing concepts in estimating manufacturing costs
CO6: Apply principles of prototyping in product development economics and highlight importance of managing projects

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M		M					W			M	
CO2			M										M	
CO3	M		M										S	
CO4			S			W				M	M		M	
CO5			S		M	M								S
CO6					M				M		S			S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End semester exam	Course end survey

INTRODUCTION - DEVELOPMENT PROCESSES AND ORGANIZATIONS – PRODUCT PLANNING **9 Hrs** Characteristics of successful product development to Design and develop products, duration and cost of product development, the challenges of product development.

A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization. The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS 9 Hrs

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizing the needs into a hierarchy, establishing the relative importance of the needs and reflecting on the results and the process. Specifications, establish specifications, establishing target specifications setting the final specifications.

CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING 9 Hrs

The activity of concept generation clarify the problem search externally, search internally, explore systematically, reflect on the results and the process, Overview of methodology, concept screening, concept scoring, caveats. Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING 9 Hrs Meaning of product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, is assessing the quality of industrial design. Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS - MANAGING PROJECTS 9 Hrs

Prototyping basics, principles of prototyping, technologies, planning for prototypes, Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis. Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

Theory: 45 Hrs **Total: 45 Hrs**

REFERENCES:

1. Karl Ulrich,T, Steven Eppinger, D, “Product Design and Development”, McGrawHill, 2015.
2. Chitale, AK, Gupta, RC, “Product Design and Manufacturing” PHI, 2013.
3. Timjones, “New Product Development:An Introduction to a multifunctional process”, Butterworth-Heinemann, 1997.
4. Geoffery Boothroyd, Peter Dewhurst and Winston Knight,A, “Product Design for Manufacture and Assembly”, CRC Press, 2011.

U15ME*P*601 HEAT TRANSFER LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Estimate the thermal conductivity of a material in guarded hot plate and lagged pipe apparatus.

CO 2: Determine the heat transfer coefficient in natural and forced convection.

CO 3: Determine the working of a concentric tube heat exchanger for various flow modes..

CO 4: Calculate the emissivity of the given grey surfacesurfaces

CO 5: Estimate the performance of refrigeration and air conditioning test rigs

CO 6: Explain the humidification and various psychrometric process.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				M				M	M			M	
CO2	M				M				M	M			M	
CO3	M				M				M	M			M	
CO4	M				M				M	M			M	
CO5	M				M					W			W	
CO6	M									W			W	

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS:

CONDUCTION HEAT TRANSFER

1. Thermal conductivity measurement using a two slab guarded hot plate apparatus.
2. Thermal conductivity measurement of an insulation using lagged pipe apparatus.

CONDUCTION HEAT TRANSFER

1. Determination of convective heat transfer coefficient and rate of Heat transfer of a vertical cylinder using free convection apparatus.
2. Determination of convective heat transfer and rate of Heat transfer in a tube using forced convection apparatus.

3. Determination of rate of Heat transfer from pin-fin in natural convection mode.
4. Determination of rate of Heat transfer from pin-fin in forced convection mode.
5. Estimation of effectiveness of tube – in – tube parallel flow heat exchanger mode by using LMDT method.
6. Estimation of effectiveness of tube – in – tube counter flow heat exchanger mode by using NTU method.

RADIATION HEAT TRANSFER

1. Determination of emissivity and radiation factor for the given test specimen using Stefan-Boltzman emissivity apparatus.
2. Study on emissivity of grey surfaces.

REFRIGERATION AND AIR CONDITIONING

1. Determination of COP of the given VCR test rig.
2. Determination of COP of the given air conditioning test rig.
3. Study on Humidification and dehumidification process in HVAC.

LIST OF EQUIPMENTS (for a batch of 30 students)

1. Guarded plate apparatus – 1 No.
2. Lagged pipe apparatus – 1 No.
3. Natural convection-vertical cylinder apparatus – 1 No.
4. Forced convection inside tube apparatus – 1 No.
5. Pin-fin apparatus – 1 No.
6. Stefan-Boltzmann apparatus – 1 No.
7. Emissivity measurement apparatus – 1 No.
8. Parallel/counter flow heat exchanger apparatus – 1 No.
9. Refrigeration test rig – 1 No.
10. Air-conditioning test rig – 1 No.

Experiments beyond the syllabus to be conducted

Practical :45 Hrs **Total:45Hrs**

U15MC*P*607 MECHATRONICS LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Simulate Hydraulic, Pneumatic and using software tool.
CO 2: Simulate Electro pneumatic circuits using trainer kits.
CO 3: Design and test various fluid power circuits.
CO 4: Interface stepper motor with 8051micro controller
CO 5: Conduct experiments using servo controller and stepper motor.
CO 6: Conduct experiments PID Controller interfacing

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					S									
CO2					S									
CO3			S											
CO4			W											
CO5			W											
CO6			M											

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS:

1. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
2. Design and testing of circuits using basic pneumatic trainer kits.
3. Design and testing of circuits with logic sequence using Electro pneumatic trainer kits
4. Design and testing of sequential circuits in Electro pneumatic kit using PLC.
5. Design and testing of fluid power circuits to control
    (i) Velocity (ii) direction and (iii) force of single and double acting actuators
6. Study of sequential and hydraulic motor circuit using hydraulic systems.
7. Servo controller interfacing for open loop
8. Servo controller interfacing for closed loop
9. PID controller interfacing
10. Stepper motor interfacing with 8051 Micro controller
    (i) Full step resolution (ii) half step resolution

Experiments beyond the syllabus to be conducted

LIST OF EQUIPMENTS

1. Basic Pneumatic Trainer Kit - 1 Number
2. Electro pneumatic trainer kit - 2 Numbers
3. Electro Pneumatic Trainer Kit with PLC control - 1 Number
4. Hydraulic Trainer kit - 2 numbers
5. H Simulator & P Simulator Software / Automation studio -10 Licenses
6. 8051 - Microcontroller kit with stepper motor and drive circuit - 1 number
7. PID Controller kit - 1 number
8. Servo controller kit with servo motor - 1 number

Practical :45 Hrs **Total:45Hrs**

U15GH*P*601 NATIONAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Course outcomes:
After successful completion of the course, the student would be able to:

1. The Students shall acquire knowledge on the Enlightened Citizenship.
2. The Students shall know skills the greatness of India and Indian Culture.
3. The students shall be aware of the messages of India to the world
4. The Students shall be aware of the uniqueness of India
5. The students shall know about the inspiring Indian personalities and emulate them

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W				M		M				M		
CO2		W				S	W	S	M	M		M		
CO3		W	W		W	M	W	M	M	M		M		
CO4		W				M	W	M	W	W		M		
CO5						W	M	W	W	W		S		

Course Assessment methods:

Direct	Indirect
1. Individual Assignment 2. Group Assignment 3. Presentation 4. Surprise Test 5. Practical Assessment 6. End Semester Assessment	1. Attendance and Behavioural Assessment

Enlightened Citizenship	2 Periods
Greatness of India & Indian Culture	2 Periods
Uniqueness of India	2 Periods
Famous Indian Personalities	2 Periods
India's messages to the world	3 Periods
Meditation & Yogasanas	4 Periods

Theory: 11 Periods **Practical: 4 Periods** **Total Periods: 15**

References Books:

1. Gurcharan Das, "***India Grows at Night***", Penguin **Books** India, Published September 2012.
2. Swami Vivekananda, "***Prosperous India"*** 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
3. Sarvepalli Radhakrishnan, ***"The Source Book on Indian Philosophy"***, Princeton, N.J. : Princeton University Press, 1957.
4. Amartya Sen, ***"The Argumentative Indian",*** Allen Lane, Published 2005.

SEMESTER – VII

U15ME*T*701 COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the manufacturing activities inter relation with computers for plant operations
CO 2: Apply the concept of Group Technology in computer aided manufacturing.
CO 3: Apply the knowledge of process planning through computers
CO 4: Apply the concept of shop floor control and FMS.
CO 5: Apply the system modeling tools in CIM and the fundamental concepts of data communications
CO 6: Apply the principles of open System and data base for computer integrated manufacturing

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M						M							S
CO2	M						M		M	M				S
CO3	M						M		M	M				S
CO4	M								M	M				S
CO5	M				M		M		M	M				S
CO6	M				M		M		M	M				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **8 Hrs**

The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 10 Hrs

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. -benefits of G.T. – Lean and cellular manufacturing.

Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning -variant approach and generative approaches - CAPP and CMPP process planning systems.

SHOP FLOOR CONTROL AND INTRODUCTION OF FMS 9 Hrs

Shop floor control-phases - factory data collection system - automatic identification methods-Bar code technology-automated data collection system.

FMS-components of FMS - types - FMS workstation -material handling and storage systems-FMS layout -computer control systems-application and benefits.

CIM IMPLEMENTATION AND DATA COMMUNICATION 9 Hrs

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram - CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture - Product data management-CIM implementation software.

Communication fundamentals- local area networks -topology - LAN implementations - network management and installations.

OPEN SYSTEM AND DATABASE FOR CIM 9 Hrs

Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP)

Development of databases -database terminology- architecture of database systems-data modeling and data associations -relational data bases - database operators - advantages of data base and relational database.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Mikell.P.Groover,“Automation,Production Systems and computer integrated manufacturing”, Pearson Education,2007.
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”,New Age International (P) Ltd, New Delhi,. 2004.
3. Yorem koren,“Computer Integrated Manufacturing system”, McGraw-Hill, 2002.
4. Ranky, Paul G.,“Computer Integrated Manufacturing”, Prentice Hall International, 2003.
5. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe “Computer Integrated Design and Manufacturing”, McGraw-Hill Inc, 2004.
6. Roger Hanman “Computer Intergrated Manufacturing”, Addison –Wesley, 2007.
7. Mikell.P.Groover and Emory Zimmers Jr.,“CAD/CAM", Prentice hall of India Pvt. Ltd., New Delhi, 2003.
8. Kant Vajpayee S, “Principles of computer integrated manufacturing”, Prentice Hall India, 2007.

U15ME*T*702 **ENGINEERING METROLOGY AND QUALITY CONTROL**

L	T	P	C
3	0	0	3

Course outcomes

After successful of the course, the student would be able to:

CO 1: Apply knowledge of linear and angular measurements and effective communication for engineering practice

CO 2: Apply knowledge of form measurements with effective communication for engineering application

CO 3: Apply the working principle of advanced measurements used in metrology

CO 4: Examine the variability of process using control charts.

CO 5: Examine the attributes of process using control charts.

CO 6: Apply knowledge of various sampling methods,concepts and reliability.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					M				M				M
CO2	S					M				M				M
CO3	M					M				M				M
CO4	S	M		M					M	M				S
CO5	S	M		M					M	M				S
CO6	s	W							M	M				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

LINEAR AND ANGULAR MEASUREMENTS **9 Hrs**

Length Standards- Length Measuring instruments - Vernier instruments - micrometer, height gauge, dial indicators, Bore gauges, Slip gauges, Comparators -Mechanical, Electrical, Optical and Pneumatic, Optical Projector. Angle measuring instruments - Bevel protractor, Spirit level, Sine bar, Autocollimator, Angle dekkor, Interferometry.

FORM MEASUREMENT **9 Hrs**

Screw thread terminology- Measurement of effective diameter by two wire and three wire methods - errors in threads- Measurement of pitch, profile errors and total composite errors, Gear tooth terminology-Methods of measurements of runout, pitch, profile, lead, backlash,tooth thickness-composite method of inspection - Parkinson gear tester, Measurement of surface finish - Stylus probe instruments - profilometer-Tomlinson and Talysurf instrument-Straightness, Flatness and Roundness measurement.

ADVANCES IN METROLOGY **9Hrs**

Precision instruments based on Laser – principles - laser interferometer –Universal Measuring Machine- Tool maker's microscope- Coordinate Measuring Machine (CMM): need, construction, types, applications- Computer Aided Inspection, Machine Vision - Introduction to Nano – metrology

PROCESS CONTROL FOR VARIABLES AND ATTRIBUTES **9 Hrs**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart.

Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

ACCEPTANCE SAMPLING **9Hrs**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans,Reliability.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Jain R.K., "Engineering Metrology", Khanna Publishers,2005.
2. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
4. Douglas C. Montgomery, "Introduction to Statistical Quality Control",Johnwiley& sons, 2005.

U15GS*T*005 ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful of the course, the student would be able to:

CO1: Evaluate the economic theories, cost concepts and pricing policies

CO2: Analyze the market structures and integration concepts

CO3: Apply the concepts of national income and understand the functions of banks and concepts of globalization

CO4: Apply the concepts of financial management for project appraisal and working capital management

CO5: Understand accounting systems

CO6: Analyze financial statements using ratio analysis

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M				M					M			M
CO2				M		M					M			M
CO3						M					M			M
CO4				M							S			M
CO5											S			M
CO6		M		M							S			M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

ECONOMICS, COST AND PRICING CONCEPTS 9 Hrs

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation

of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods.

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES 9 Hrs

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT 9 Hrs

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT 9 Hrs

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS 9 Hrs

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Theory :45 Hrs **Total: 45 Hrs**

References:

1. Prasanna Chandra, " Financial Management (Theory & Practice) ,"TMH
2. Weston & Brigham, " Essentials of Managerial Finance"
3. Pandey, I. M., "Financial Management"
4. Fundamentals of Financial Management- James C. Van Horne.
5. Bhaskar S. "Engineering Economics and Financial Accounting", (2003) Anuradha Agencies, Chennai
6. Financial Management & Policy -*J*ames C. Van Horne
7. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain
8. Management Accounting Principles & Practice -P. Saravanavel
9. Ramachandra Aryasri.A., and Ramana Murthy V.V.,"Engineering Economics & Financial Accounting"-Tata McGraw Hill, New Delhi, 2006.
10. Varshney R.L., and Maheswari K.L.,"Managerial Economics" – Sultan Chand & Sons, New Delhi, 2001
11. Samvelson and Nordhaus,"Economics"-Tata McGraw Hill, New Delhi, 2002

U15ME*P*701 COMPUTER AIDED ENGINEERING LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Utilize the analysis software for stress analysis of Mechanical components.
CO 2: Estimate the natural frequency of 2D component
CO 3: Predict the dynamic characteristics of 2D components and piping system
CO 4: Analyze the mode of heat transfer in piping system
CO 5: Make use of CAD software to simulate mechanical systems
CO 6: Solve simple problems in CFD

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S		S				M	M		M	S	
CO2			M		M					M			M	
CO3									M	M			W	
CO4	S	S			S							M	S	
CO5					M					M		M	W	
CO6	S	M			W				M			M	W	

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS: (ANY 10 Experiments)

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
5. Modal analysis of a 2 D component
6. Modal analysis of beams (Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D/piping system
8. Thermal stress analysis of a 2D/piping system
9. Conductive heat transfer analysis of a 2D/piping system

10. Convective heat transfer analysis of a 2D/piping system
11. Convert of simple mechanical model (flange, screw jack, etc) into IGES file, and analysis.
12. Simulation of Hydraulic / Pneumatic cylinder using CAD software.
13. Simulation of cam and follower mechanism using CAD software.
14. Simple problems using CFD

Experiments beyond the syllabus to be conducted

LIST OF EQUIPMENTS:

1. Computer System with 17" VGA Color Monitor and Pentium IV Processor - 30 Nos.
2. 40 GB HDD
3. 1 GB RAM
4. Color Desk Jet Printer - 1 No.
5. Software: Suitable analysis software ANSYS /NATRAN 30 licenses
6. MATLAB, 5 licenses

Practical :45 Hrs **Total:45Hrs**

U15ME*P*702 METROLOGY AND METALLURGY LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Identify and Perform linear and angular measurements.
CO 2:.Demonstrate the measurement of force, torque and vibration parameters.
CO 3: Perform surface roughness measurement.
CO 4: Analyze the microstructure of various materials the microstructures.
CO5 : Execute the various heat treatment process for at different stages.
CO 6: Conduct the experiment and measure the wear resistance of given samples.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S		M	M				M	M				S
CO2		M							M	M				M
CO3		M		M	M				M	M				S
CO4	M			M						M		M		M
CO5	M			M						M		M		M
CO6	M			M						M		M		M

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

a) LIST OF EXPERIMENTS:ENGINEERING METROLOGY LABORATORY

1. Study of linear measuring instruments.
2. Linear Measurement using vernier height gauge and slip gauge.
3. Measurements of gear tooth dimensions using gear tooth vernier and error of composite gear tooth using gear roll tester.
4. Angular measurement using sine bar and bevel protector.
5. Measurement of screw thread parameters using Tool Makers Microscope and Profile Projector.
6. Measurement of Force and Torque using load cell.
7. Measurement of Vibration / Shock using vibration pick up
8. Measurement of surface roughness of machined components.
9. A study of co-ordinate measuring machine.

Experiments beyond the syllabus to be conducted.

b) LIST OF EXPERIMENTS: METALLURGY LABORATORY

1. Study the construction and working principle of metallurgical microscope.
2. Study the procedure of specimen preparation for metallographic
3. Identification of microstructure
   i) Ferrous materials, EN8 and mild steel
   ii) Non-ferrous materials and aluminium
4. Heat treatment comparision
   i) Unhardened specimen
   ii) Quenched specimen, annealed, normalized and
5. Conduct wear test on non ferrous materials (Aluminium)

Practical :45 Hrs **Total:45Hrs**

U15GH*P*701 GLOBAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Course outcomes:
After successful completion of the course, the student would be able to:

1. The Students shall understand importance of ecology and its preservations
2. The Students shall understand the various global issues and their causes and solutions
3. The Students shall approach any problem holistically as against giving a reductionist solution
4. The Students shall learn impact of globalization on various factors such as environment, local population etc
5. The Students shall learn to integrate and understand how an Individual peace impacts world peace

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W					M	M	M	M		M		
CO2		W				M	S	S	M	M		M		
CO3		W	W		W	M	M	M	W	W		M		
CO4		W				S	M	M	W	W		M		
CO5						W	W	W				S		

Course Assessment methods:

Direct	Indirect
1. Individual Assignment 2. Group Assignment 3. Presentation 4. Surprise Test 5. Practical Assessment 6. End Semester Assessment	1. Attendance and Behavioural Assessment

Introduction to Global Values	1 Period
Introduction to Systems Thinking	1 Period
Ecology, ecological imbalances and its solution	3 Periods
Globalisation Vs Localisation – an economic and Spiritual Perspective	3 Periods
Global Issues & Solutions	3 Periods
Advanced Contemplative Practices	4 Periods

Theory: 11 Periods **Practical: 4 Periods** **Total Periods: 15**

References Books:

1. Vethathiri's Maharishi's, ***"World peace"*** The World Community Service Centre, Vethathiri Publications,1957.
2. Fritz Schumacher, ***"Small is Beautiful",*** The Blond & Briggs, Published 1973.
3. Noam Chomsky, ***"Profit over People",*** Seven Stories Press, Published 1999.
4. Vethathiri's Maharishi's, ***"Atomic Poison"*** The World Community Service Centre, Vethathiri Publications, 1983.

U15ME*P*701 **PROJECT WORK – PHASE I**

L	T	P	C
0	0	4	2

Course Objectives

- To identify problem in the mechanical engineering field.
- To analyse/simulate/design a component or process and mechanical engineering systems.

Course outcomes

After successful completion of the course, the students should be able to

CO 1 : Identify aproblem in mechanical engineering field through survey.
CO 2 : Develop methodology to find the solution for the problem.
CO 3 : Learn suitable modern tools.

Course Content

- The objective of Project Work–Phase I is to enable students to identify a problem in mechanical engineering field using literature or industry survey. The work can be an innovative improvement of existing system in the mechanical engineering/interdisciplinary areas and shall include modeling, design, experimentation, evaluation, fabrication or analysis.
- The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design, manufacture of a device, experimentation, simulation of mechanical systems.
- Suitable methodology to be arrived by evaluating existing solutions. Suitable modern tools shall be used to find the solution.
- Every project work shall have a guide who is the member of the faculty of the institution.
- For industrial projects, supervisor from the organization will be a co-guide.
- Each project work will be carried out by a batch of maximum three students.
- The project period allotted shall be utilized by the students to receive directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present periodical seminars on the progress made in the project.
- The continuous assessment shall be made as prescribed in the regulations.
- The review committee will be constituted by the Head of the Department.
- The progress of the project is evaluated based on a minimum of three reviews.
- Each student shall finally submit a report covering background information, literature survey, problem statement, methodology and use of modern tools with in stipulated date.

SEMESTER – VIII

U15ME*P*801 PROJECT WORK – PHASE II

L	T	P	C
0	0	24	10

Course Objectives

- To apply engineering principles for the problems in the mechanical field.
- To analyse/simulate/design a component or process and mechanical engineering systems.
- To find appropriate solution and compile a report on the project work.

Course outcomes

After successful completion of the course, the students should be able to

CO 1 : Perform methodology using appropriate tools for the problem.
CO 2 : Analyze data and interpret the results obtained.
CO 3 : Summarizethe results and submit a report.

Course Content

- Create a model/fabricate a model/conduct experiment/simulate mechanical system/implement improved ideas for the project work carried in Phase-I. Analyze data, evaluate the results and conclude the appropriate solution, suggestion for feature work.
- The continuous assessment shall be made as prescribed in the regulations.
- The review committee may be constituted by the Head of the Department.
- The progress of the project is evaluated based on a minimum of three reviews.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- This final report shall be typewritten form as specified in the guidelines.

PROFESSIONAL ELECTIVES

U15MEPE01DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

(Use of approved design data book is permitted in the End semester examination)

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Choose the appropriate jigs and fixtures.
CO 2: Develop suitable jigs based on manufacturing conditions.
CO 3: Identify suitable fixtures for given component.
CO 4: Make use of press working terminologies for die design.
CO 5: Estimate effective material utilization for strip layout.
CO 6: Identify appropriate types of press tool dies.

Pre-requisite:1.U15ME*T*304-Manufacturing Technology-I

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M											M	
CO2	S		S						M			W	S	
CO3	S	S	S									W	S	
CO4		S				M				M		W	W	
CO5						M				M			M	M
CO6			S						M	M			W	S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

TYPES AND FUNCTIONS OF JIGS AND FIXTURES 9 Hrs

Tool design objectives - Production devices - Inspection devices –Purpose and types of Jigs and Fixtures - Materials used in Jigs and Fixtures - Principles of location and clamping- Mechanical actuation-pneumatic and hydraulic actuation -Analysis of clamping force-Tolerance and error analysis.

JIGS **9 Hrs**

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs, Design and development of Jigs for given components.

FIXTURES **9 Hrs**

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- Modular fixtures.Design and development of fixtures for given component**.**

PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT **9 Hrs**

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block-die shoe. Bolster plate-punch plate-punch holder-guide pins and bushes – strippers – knockouts-stops – pilots-Selection of standard die sets strip lay out-strip lay out calculations

DESIGN AND DEVELOPMENT OF DIES **9 Hrs**

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Edward G Hoffman, “Jigs & Fixture Design”, Delmar publishers,2011.
2. Donaldson. C, “Tool Design”, Tata McGraw-Hill,2012.
3. Kempster, “An Introduction to Jigs & Fixtures Design”, The English Language Book Society”,2004.
4. Joshi, P.H., “Jigs & Fixtures”,Tata McGraw-Hill Publishing CompanyLimited, New Delhi, 2010.
5. Hiram E Grant, “Jigs and Fixture”, Tata McGraw-Hill, New Delhi, 1989.
6. “Fundamentals of Tool Design”, CEEE Edition, ASTME, 1998.
7. “PSG Design Data Faculty of Mechanical Engineering”, PSG College of Technology, Coimbatore.

U15MEPE02 DESIGN FOR MANUFACTURE AND ENVIRONMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Illustrate the basic of design for manufacture.

CO 2: Outline casting, weldment, forming, nonmetallic and machined component design for manufacture.

CO 3: Understand and explain the design considerations for formed metal components

CO 4: Discuss the considerations for the design of machine components

CO 5: Model the design for assembly.

CO 6: Model the design for assembly.

Pre-requisite:1. U15ME*T*304 -Manufacturing Technology-I
2.U15ME*T*403 – Manufacturing Technology - II

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	S				M		M					M
CO2	M	M	S				M		M					M
CO3	M	M	S				M		M					M
CO4	M	M	S				M		M					M
CO5	M	M	S				S		M					M
CO6	M	M	S				M		M					M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **10 Hrs**

Economics of Process selection, process capability and process capability metrics – General design principles of manufacturability – Proper material selection – Strength and Mechanical factors- geometric tolerances, surface finish, cumulative effect of tolerances - Worst case method ,Root sum square method.

FACTORS INFLUENCING FORM DESIGN **10 Hrs**

Working principle, Material, Manufacture, Design-, Production method, size,surface property Influence of materials on form design - castings, aluminium casting ,pressure die casting, Plastic molding ,form design of welded members

COMPONENT DESIGN – MACHINING AND CASTING CONSIDERATION **10 Hrs**

Design features to facilitate machining –Twist drill –Drill entry and run out counter sunk head screws-Redesign of casting based on parting line consideration-pattern, mould, parting line, cast holes-cored holes, machined holes, identify the possible and probable parting line, special sand core.

DESIGN FOR THE ENVIRONMENT **10Hrs**

Introduction to Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

CASE STUDIES **5Hrs**

Application concepts of design for manufacture in real time conditions- Exposure on DFM software.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. James G. Bralla,"Design for Manufacturability handbook", McGraw Hill Book Co.,1990
2. Henry Peck,"Design for manufacture", Pitman Publishers., 1983.
3. Matousek "Engineering Design", Blackie & sons, 1974.

U15MEPE03 VIBRATION AND NOISE CONTROL

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Develop the mathematical models for vibrating systems.
CO 2: Solve problems in vibrating systems with single degree of freedom.
CO 3: Explain two degree of freedom vibrating systems and solve simple problems.
CO 4: Examine the multi degree of freedom systems.
CO 5: Make use of proper instruments for vibrationmeasurement.
CO 6: Explain about engineering noise and control.

Pre-requisite:1.U15ME*T*402 – Kinematics of Machinery
2. U15ME*T*501 – Dynamics of Machinery

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2	M	S		S									S	
CO3	M	S		M									M	
CO4		S		S									S	
CO5	S		W			M	M		M	M			M	
CO6	S		W			M	M		M	M			S	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

FUNDAMENTALS OF VIBRATION **9 Hrs**

Introduction -Sources of vibration-Mathematical models-Types of vibration. Review of Single degree freedom systems with and without damping –Types of Damping- Dynamics of rotating and reciprocating engines– Critical speed of industrial rotors with specific reference to rigid and flexible rotors – Influence of type of bearings – Vibration isolation – Nonmetallic isolators.

TWO DEGREE FREEDOM SYSTEM **9 Hrs**

Introduction- Free vibration of Undamped and damped system. Torsional system-Spring coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration

with harmonic Excitation – Dynamic Vibration Absorber – Torsional Vibration Absorber- Vibration control.

MULTI-DEGREE FREEDOM SYSTEM 9 Hrs

Longitudinal, Transverse, Torsional systems, Geared systems Complexities – Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – Orthogonal properties – Energy methods of Rayleigh, Ritz and Drunkenly

EXPERIMENTAL VIBRATION ANALYSIS 9 Hrs

Need for the experimental methods in Vibration analysis. Vibration Measuring Devices: seismometer, accelerometer and velometers-Vibration exciters: mechanical, hydraulic, electromagnetic and electrodynamic –Frequency measuring instruments: single reed, multi reed and stroboscope. Vibration meters and sound level meter. Signal conditioning devices: Filters, Amplifiers, Modulators/Demodulators, ADC/DAC. Signal analysis devices. Vibration recording and display devices.Experimental modal analysis. System Identification from frequency response

ENGINEERING NOISE AND ITS CONTROL 9 Hrs

Introduction-Sound Power, Sound Intensity and Sound pressure level. Sound spectra.The decibel scale-Decibel addition, subtraction and averaging- Loudness, Weighting networks, Equivalent sound level. Noise: Effects, Ratings and Regulations. Noise: Sources, Isolation and control-Industrial noise sources-Industrial noise control strategies-Noise control at the source, along the path and at the receiver.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Ambekar.A.G. “Mechanical Vibrations and Noise Engineering”, Prentice Hall of India, New Delhi, 2006
2. Thomson, W.T, “Theory of Vibration with Applications”, Nelson Thomas Ltd,1998.
3. Rao, S.S.,” Mechanical Vibrations,” Printice hall,2011.
4. Den Hartog, J.P, “Mechanical Vibrations,” Read books, 2008.
5. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa, New Delhi, 2000.
6. William.w.Seto, “Theory and problems of Mechanical Vibrations,”Schaum Outline Series, Mc Graw Hill Inc., Newyork,1990.

U15MEPE04 MICRO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Identify the various matrices, reinforcements and their combinations in composite materials.

CO 2: Select composite materials for suitable applications.

CO 3: Develop suitable Metal Matrix Composites.

CO 4: Identify perfect Ceramic Matrix Composites for high temperature applications.

CO 5: Choose various combinations of fibres and resins.

CO 6: Select an appropriate manufacturing technique for composite materials.

Prerequisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								M					M
CO2	M								M					M
CO3	M								M					M
CO4	M		M						M					S
CO5	M								M					S
CO6	M		M						M					S

Course Assessment methods

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION 9 Hrs

Overview-Microsystems and microelectronics -definition-MEMS materials-scaling laws scaling in geomentry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics- scaling in heat transfer.

MICRO SENSORS AND ACTUATORS 9 Hrs

Working principle of Microsystems - micro actuation techniques - micro sensors-types Microactuators – types – micropump – micromotors – micro – valves – microgrippers -micro Accelerometers

FABRICATION PROCESS **9 Hrs**

Substrates-single crystal silicon wafer formation-Photolithography-Ion implantation- Diffusion – Oxidation-CVD-Physical vapor deposition-Deposition by epitaxy-etching process

MICRO SYSTEM MANUFACTURING **9 Hrs**

Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA-Micro system packaging-materials-die level-device level-system level-packaging techniques-die preparation-surface bonding-wire bonding-sealing

MICRO SYSTEM DESIGN **9 Hrs**

Design considerations-process design-mask layout design- mechanical design-applications of micro system in -automotive industry-bio medical –aero space-telecommunications.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC press 2002.
2. Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim, “Microsensors MEMS and Smart Devices” , John Wily & sons Ltd.,2001.
3. S.Fatikow,U.Rembold, “Microsystem Technology and Microrobotics”,Springer-Verlag Berlin Heidelberg ,1997.
4. Francis E.H Tay and W.O Choong, “Microfludics and BioMEMS Applications”, Springer, 2002.
5.Tai-Ran Hsu,MEMS& Microsystems Design and Manufacture,Tata McGraw-Hill,2006.

U15MEPE05 DESIGN OF MATERIAL HANDLING EQUIPMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Make use of various principles of material handling for different applications
CO 2: Select a specific material handling equipment for a particular application
CO 3: Identify the various design aspects of material handling equipments
CO 4: Infer the different components used for material handling
CO 5: Illustrate the automation concepts in material handling equipments
CO 6: Apply the safety standards to be considered in material handling

Pre-requisite:1. U15ME*T*401- Design of Machine Elements

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M			W							S	
CO2		M	S						M				S	
CO3	S	M						M					S	W
CO4	S	W	S						M				M	
CO5						M				M			W	
CO6						M		M		M			W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **9 Hrs**

Elements of Material Handling System-Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other organizational functions; Classification of Material Handling Equipment.

SELECTION OF MATERIAL HANDLING EQUIPMENT 9 Hrs

Selection of Material Handling Equipment-Factors affecting for selection; Material Handling Equation; Choices of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications ; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.

DESIGN ASPECTS OF MATERIAL HANDLING EQUIPMENT 9 Hrs

Design of Mechanical Handling Equipment- Design of Hoists, Drives for hoisting, components, and hoisting mechanisms; rail travelling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms. Design of Cranes, Hand-propelled and electrically driven E.O.T. overheat Travelling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius ; fixed post and overhead travelling cranes; Stability of stationary rotary and travelling rotary cranes.

MATERIAL HANDLING COMPONENTS 9 Hrs

Design of load lifting attachments- Load chains and types of ropes used in Material Handling System; Forged, Standard and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments.

Study of systems and Equipment used for Material Storage- Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc.

AUTOMATION OF MATERIAL HANDLING 9 Hrs

Material Handling / Warehouse Automation and Safety considerations-Storage and warehouse planning and design; computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; which function, when and How to automate; Levels and Means of Mechanizations. Safety and design; Safety regulations and discipline.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Rudenko, N, “Material Handling Equipments”, Peace Publishers, Moscow.
2. James M. Apple, “Material Handling System Design”, John-Wisley and Sons Publication, New York.
3. John R. Immer, “Material Handling”, McGraw Hill Co. Ltd., New York.
4. Colin Hardi, “Material Handling in Machine Shops”,Machinery Publication Co. Ltd., London.
5. Nexandrn, M .P. “Material Handling Equipment”, MIR Publication, Moscow.
6. Cock C. R. and Mason, J. Bulk “Solid Handling”, Leonard Hill Publication Co. Ltd., U.S.A.
7. Spivakovsy, A.O. and Dyachkov, V.K., “Conveying Machines”,JohnWisley Publication, New York.

U15MEPE06 COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Identify the various matrices, reinforcements and their combinations in composite materials.

CO 2: Select composite materials for suitable applications.

CO 3: Develop suitable Metal Matrix Composites.

CO 4: Identify perfect Ceramic Matrix Composites for high temperature applications.

CO 5: Choose various combinations of fibres and resins.

CO 6: Select an appropriate manufacturing technique for composite materials.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							S						W	
CO2	S						M	W		M			M	
CO3	M											M	W	
CO4	M							W				M	W	
CO5	M									W		M	W	
CO6	S						S	W						S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION TO COMPOSITES 12Hrs

Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix and their role- Metal matrix composites (MMC), Ceramic matrix composites (CMC),Polymer matrix composites (PMC)-Reinforcement – Particle reinforced composites-Fibre reinforced composites- Rule of mixtures- Applications of various types of composites- Introduction to nano materials.

METAL MATRIX COMPOSITES 11Hrs

Metal Matrix, Reinforcements – particles – fibres, Effect of reinforcement - Volume fraction. Various types of Metal Matrix Composites, Characteristics of MMC, Alloy vs. MMC,

Advantages and limitations of MMC –Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

CERAMIC MATRIX COMPOSITES **11Hrs**

Engineering ceramic materials – Properties – Advantages – Limitations – Monolithic ceramics - Need for CMCs – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – Non oxide Ceramics – Aluminium oxide – Silicon nitride – Reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

POLYMER MATRIX COMPOSITES **11Hrs**

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – Various types of fibres. Methods for producing PMC - Hand lay up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre Reinforced Plastics (FRP), Glass fibre Reinforced Plastics (GRP).

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Mathews F.L. and Rawlings R.D., “Composite materials: Engineering and Science”, Chapman and Hall, London, England, 2006.
2. Chawla K.K., “Composite materials”,Springer –Verlag, 2012.
3. Clyne T.W. and Withers P.J., “Introduction to Metal Matrix Composites”, Cambridge University Press, 2003.
4. Strong A.B., “Fundamentals of Composite Manufacturing”, SME, 2008.
5. Sharma S.C., “Composite materials”, Narosa Publications, 2004.
6. “Short Term Course on Advances in Composite Materials, Composite Technology Centre, Department of Metallurgy”, IIT- Madras, December 2001.
7. Autar.K.Kaw, “Mechanics of Composite Materials”, CRC Press, 2006.

U15MEPE07 ROBOTICS

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explain the fundamentals of robot
CO 2: Apply the working of various robot drive systems and end effectors
CO 3: Apply the working principle of various sensors
CO 4: Explain the kinematics of manipulators
CO 5: Write robot programming for specific applications
CO 6: Apply the knowledge of implementation of robotics in industries

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								M	M				M
CO2	M								M	M				M
CO3	M								M	M				M
CO4	M								M	M				M
CO5	M		M						M	M				S
CO6	M		M						M	M				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

FUNDAMENTALS OF ROBOT 9Hrs

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification, Micro robot – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot parts and their functions – Different applications.

ROBOT DRIVE SYSTEMS AND END EFFECTORS 9Hrs

Pneumatic Drives – Hydraulic Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors, Linear Motors – Salient Features, Applications of all these Drives, End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

SENSORS AND MACHINE VISION **9Hrs**

Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors, Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction: Edge detection, Feature Extraction and object Recognition – Algorithms.

ROBOT KINEMATICS AND ROBOT PROGRAMMING **9Hrs**

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional). Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands.

IMPLEMENTATION AND ROBOT ECONOMICS **9Hrs**

Implementation of Robots in Industries –Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Groover, M.P. “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, 2005
2. Yoram Koren, “Robotics for Engineers”, McGraw-Hill Book Co., 2001
3. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 2008
4. Janakiraman.P.A., “Robotics and Image Processing”, Tata McGraw-Hill, 2005
5. Deb, S.R. “Robotics Technology and Flexible Automation” Tata McGraw Hill, 2003.

U15MEPE08 REFRIGERATIONANDAIRCONDITIONING
(Use of Psychrometric chart and Refrigeration Table is permitted.)

L	T	P	C
3	0	0	3

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Classify the refrigeration systems and outline the refrigerant characteristics.
CO 2: Illustrate the performance improvement methods in VCR systems.
CO 3: Explain the working principle of VAR systems.
CO 4: Discuss the various non conventional methods of refrigeration.
CO 5: Explain the various components in air conditioning system.
CO 6: Estimate the cooling load for various conditions.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M						W		M	M			M	
CO2	S	M							M	M			M	
CO3	M								M	M			M	
CO4	M								M	M			M	
CO5	M								M	M			M	
CO6	S	M							M	M			S	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION TO REFRIGERATION **9 Hrs**
Refrigeration and second law of thermodynamics-Engine, refrigerator and heat pump- Methods of Refrigeration- Evaporative refrigeration, Refrigeration by expansion of air, Refrigeration by throttling of gas, Ice refrigeration, Steam jet refrigeration, Dry ice refrigeration, Refrigeration by using liquid gases- refrigerants- Properties & selection- System components- Compressors- Evaporators- Condensers- Thermostatic Expansion devices- Cooling towers.

VAPOUR COMPRESSOR REFRIGERATION SYSTEM 9Hrs

Simple vapour compression refrigeration cycle- T-S, s-S and p-h charts for VCR system- presentation of different process on p-h chart- COP from T-S chart- Advantages and Disadvantages of VCR over air compression refrigeration- Methods for improving COP – Single load and multi load systems.Methods for Defrosting- air refrigeration- Bell Coleman Air refrigerator- Simple cooling and simple evaporative type- Boot strap and boot strap evaporative type.

ABSORPTION REFRIGERATION SYSTEM 9Hrs

Introduction- Basic absorption system- Actual ammonia absorption system- Lithium Bromide absorption refrigeration system- Electrolux refrigerator – Actual Electrolux refrigerator- COP of absorption refrigeration system.

Non conventional refrigeration – Vortex tube – Thermo Electric refrigeration- Pulse tube refrigeration- Cooling by adiabatic demagnetization.

AIRCONDITIONING SYSTEM 9Hrs

Methods of air conditioning – Direct expansion- All water systems- All air systems- Combined systems- Heat pump systems- Air conditioning equipments – Air filters – Humidifiers- Dehumidifiers- fans and blowers- cooling towers and spray ponds- Air distribution system. Types of air conditioners- Window, split type and central air conditioning – Applications.

COOLING LOAD CALCULATIONS 9Hrs

Different heat sources- Types of load- Conduction heat load, radiation heat load, radiation load of sun, Occupants load, Equipment load, Infiltartion load, Fresh air load- By pass factor- Effective sensible heat factor- Design of space cooling load- Basics of Air duct design.

Heat pump – Types-Working fluids for heat pumps- Heat pump circuit- Performance of Heat pump.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International (P) Ltd, 2015.
2. Arora. C.P., "Refrigeration and Air Conditioning", Tata McGraw-Hill New Delhi,2007.
3. Roy.J Dossat, “Principles of Refrigeration”, Prentice Hall, 2001
4. Stoecker N.F and Jones, "Refrigeration and Air Conditioning", MCG raw Hill Education, Asia,2001.
5. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International (P) Ltd, 2013.

U15MEPE09 GAS DYNAMICS AND JET PROPULSION

(Use of approved gas tables is permitted in the examination)

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explain the effect of Mach Number on compressibility.
CO 2: Solve the area ratio for nozzle and diffuser for subsonic and supersonic flow conditions.
CO 3: Solvethe problems in Rayleigh and Fanno flow for constant area sections.
CO 4: Explain the concept of normal and oblique shock for an isentropic flow.
CO 5: Discuss the performance of turbo jet, ram jet and pulse jet engines.
CO 6: Calculate the performance of rocket propulsion systems.

Pre-requisite: 1.U15MET301 -Fluid Mechanics and Machinery
2. U15MET303-Engineering Thermodynamics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M							M	M			S	
CO2	S	M							M	M			S	
CO3	S	M							M	M			S	
CO4	S	M		W					M	M			S	
CO5	M	M							M	M			M	
CO6	M	M							M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5.Tutorial 6. End semester exam	Course end survey

COMPRESSIBLE FLOW – FUNDAMENTALS **9Hrs**

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility- Use of Gas tables.

FLOW THROUGH VARIABLE AREA DUCTS **9 Hrs**

Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles- Phenomenon of chocking – Pressure valves for nozzles- Diffuser.

FLOW THROUGH CONSTANT AREA DUCTS **9 Hrs**

Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length.

Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer- Applications.

NORMAL SHOCK **9 Hrs**

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock- Use of tables and charts.

PROPULSION **9 Hrs**

Aircraft propulsion – types of jet engines – study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines.

Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants- Terminal and characteristics velocity.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Yahya. S.M., “Fundamental of compressible flow with Aircraft and Rocket propulsion”, New Age International (p) Ltd., New Delhi, 2009.
2. Patrich.H. Oosthvizen, William E.Carscallen, “Compressible fluid flow”, McGraw-Hill, 2006.
3. Cohen.H., Rogers R.E.C and Sravanamutoo, “Gas turbine theory”, Addison Wesley Ltd., 2005.
4. Ganesan. V., “Gas Turbines”, Tata McGraw-Hill, New Delhi, 2003
5. Rathakrishnan. E., “Gas Dynamics”, Prentice Hall of India, New Delhi, 2001.
6. Babu.V. “Fundamentals of Gas Dynamics”, ANE Books India, 2008.
7. Somasundaram Pr.S.L,“Gas Dynamics and Jet Propulsions” New age International Publishers, 1996.

U15MEPE10 ENERGY CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1 : Discuss the various energy policies, consumption patterns and energy auditing.
CO 2 : Describe the various energy conservation techniques of electrical systems.
CO 3 : Identify the different energy conservation techniques for thermal systems.
CO 4 : Discuss the energy conservation opportunities in pumps, fans blowers and waste heat recovery systems.
CO 5 : Outline the importance of energy management information systems.
CO 6 : Describe the terms involved in energy economics.

Prerequesite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				W	S	M		M	M			M	
CO2	M						W		M	M			M	
CO3	M						W		M	M			M	
CO4	M						W		M	M			M	
CO5	M				W				M	M			M	
CO6	M						W	W	M	M			M	

Course Assessment methods

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT 9 Hrs

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing : methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

ELECTRICAL SYSTEMS 9 Hrs

AC / DC current systems, Demand control, power factor correction, load management, Motor drives : motor efficiency testing, energy efficient motors, motor speed control – Lighting : lighting levels, efficient options, daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion.

THERMAL SYSTEMS **9 Hrs**

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, target settling, problem table approach.

ENERGY CONSERVATION **9 Hrs**

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

ENERGY MANAGEMENT ECONOMICS **9 Hrs**

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

Theory :45Hrs **Total:45 Hrs**

REFERENCES:

1. Witte, L.C. Schmidt, P.S. Brown, D.R. "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden, I.G.C. "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner W.C., "Energy Management Hand book" Wiley, New York, 1982.
5. Murphy W.R. and KAY, G. M, "Energy Management" Butterworths, London 1987

U15ME*PE*11 AUTOMOBILE ENGINEERING

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1 : Explain the vehicle structures, lubrication, cooling and emission control systems**..**

CO 2 : Summarise the various fuel injection, ignition and electrical systems of an automobile.

CO 3 : Describe the working principle of various components in transmission systems.

CO 4 : Discuss the various steering mechanisms and suspension systems.

CO 5 : Compare the conventional and antilock braking systems.

CO 6 : Discuss the usage of various alternate energy sources in automobiles.

Prerequisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M						M		M	M			M	
CO2	M								M	M			M	
CO3	M								M	M			M	
CO4	M								M	M			M	
CO5	W								M	M			M	
CO6	M					W	W		M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

VEHICLE STRUCTURE AND ENGINES 9 Hrs

Types of Automobiles - Vehicle Construction – Chassis – Frame and Body – Aerodynamic forces.Engine components, Materials and functions - Cooling and Lubrication systems in engines – Turbo Chargers – Engine Emission Control by three way Catalytic converter – Electronic Engine Management System.

ENGINE AUXILIARY SYSTEMS 9 Hrs

Carburetor–working principle - Electronic fuel injection system – Mono-point and Multi - Point Injection Systems – Construction, Operation and Maintenance of Lead Acid Battery - Electrical systems – Battery generator – Starting Motor and Drives – Lighting and Ignition (Battery, Magneto Coil and Electronic Type) - Regulators-cut outs.

TRANSMISSION SYSTEMS **10 Hrs**

Clutch – Types and Construction – Gear Boxes, Manual and Automatic – Floor Mounted Shift Mechanism – Over Drives – Fluid flywheel - Torque converters– Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive – Introduction to rear wheel drive.

STEERING, BRAKES AND SUSPENSION **9 Hrs**

Wheels and Tyres – Wheel Alignment Parameters - Steering Geometry and Types of steering gear box– Power Steering – Types of Front Axle – Suspension systems – Braking Systems – Types and Construction – Diagonal Braking System – Antilock Braking System.

ALTERNATIVE ENERGY SOURCES **8 Hrs**

Use of Natural Gas, LPG, Biodiesel, Alcohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells – Introduction to off road vehicles.

Theory :45Hrs **Total:45 Hrs**

REFERENCES:

1. Ed May, “Automotive Mechanics”, Tata McGraw-Hill,2003
2. Kirpal Singh “Automobile Engineering”, Standard Publishers, New Delhi, 2009.
3. William H.Crouse and Donald L.Angline “Automotive Mechanics”, Tata McGraw-Hill, 2007.
4. Srinivasan, “Automotive Mechanics”,Tata McGraw-Hill, 2003.
5. Joseph Heitner, “Automotive Mechanics”,East-West Press, 1999.
6. Halderman, “Automotive Engines:Theory and Servicing”,Pearson, 2009.
7. Ramalingam, K.K, “Automobile Engineering”, Scitech publications, 2008

U15MEPE12 POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explain the working principle of various power plants and High pressure boilers.

CO 2: Illustrate the various circuits in steam power plant.

CO 3: Summarize the various nuclear reactors and waste disposal methods.

CO 4: Outline the steps involved in site selection and working principle of hydroelectric power plants.

CO 5: Discuss the working of diesel and gas turbine power plants.

CO 6: Explain the working of renewable power plants and discuss the economics of powerplants.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M	W		M	M			M	
CO2	M					W			M	M			M	
CO3	M					M	M		M	M			M	
CO4	M						W		M	M			M	
CO5	M								M	M			M	
CO6	M					W			M	M	W		M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION TO POWER PLANTS & BOILERS 9Hrs

Layout of Steam, Hydel, Diesel, Nuclear and Gas Turbine Power Plants - Combined Power Cycles – Comparison and Selection, - Steam Boilers – High Pressure and Super Critical Boilers – Fluidized Bed Boilers.

STEAM POWER PLANT 9Hrs

Fuel handling yard,- Conveyors- Mechanical stokers- Pulveriser – Boiler- FD fan- ID fan- Multi stage pump- Ash handling – ESP- Bag filters – Types of draught- Heat exchangers- Cooling towers- Regeneration.

NUCLEAR AND HYDEL POWER PLANTS 9Hrs

Nuclear Energy – Types of Reactors, pressurized water reactor, Boiling Water Reactor, Liquid Metal fast breeder reactor, CANDU type reactors - Waste Disposal and safety - Hydel power plant – Selection of site for a Hydroelectric Power Plant, Hydrological cycle, Hydro graphs, Essential Elements, Selection of turbines, Governing of hydraulic Turbines.

DIESEL AND GAS TURBINE POWER PLANT 9Hrs

First law of thermodynamics-Types of Diesel Plants, Components, and Selection of Engine Type, Applications Gas Turbine Power Plant – Fuels - Gas Turbine Types – Open and Closed Cycles, advantage and disadvantages – Reheating Regeneration and Intercooling- Combined Cycle.

OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS 9Hrs

Geo thermal – OTEC- Tidal – Pumped storage – Solar thermal power plants. Load curves - Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing – Variable load operation - Comparison of economics of various power plants.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. EI- Wakil M.M, “Power Plant Technology”, Tata McGraw-Hill,2001.
2. Arora S.C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, 2001.
3. Nagpal, G.R. “Power Plant Engineering”, Kanna Publishers,2008.
4. Rai, G.D. “Introduction to Power Plant Technology”, Khanna Publishers, 2009.
5. Nag P.K, “Power plant Engineering”, Tata McGraw-Hill,2008

U15MEPE13 NUCLEAR ENGINEERING

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explain the concepts of nuclear physics..
CO 2: Describe the mechanisms of nuclear fission and fusion reactions.
CO 3: Explain the various nuclear fuel cycles and its characteristics.
CO 4: Discuss the reprocessing methods of nuclear spent fuel.
CO 5: Explain the design and construction of FBR.
CO 6: Describe the various safety systems and disposal methods of nuclear wastes.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								M	M			M	
CO2	M								M	M			M	
CO3	M					W			M	M			M	
CO4	M								M	M			M	
CO5	M								M	M			M	
CO6	M					M	M		M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

NUCLEAR PHYSICS 9 Hrs

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

NUCLEAR REACTIONS AND REACTION MATERIALS 9 Hrs

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

REPROCESSING **9 Hrs**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

NUCLEAR REACTORS **9 Hrs**

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

SAFETY AND DISPOSAL **9 Hrs**

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Thomas J.Cannoly, “Fundamentals of nuclear Engineering”, John Wisley, 2002.
2. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemispherepublishing, New York, 2002.
3. Wakil M.M.El., “Power Plant Technology”, McGraw-Hill International, 2006.
4. P.K. Nag, “Power Plant Technology”, Tata McGraw Hill, 2010.

U15MEPE14 SOLAR ENERGY ENGINEERING

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explain the working principle of various instruments used for measuring solar radiation.
CO 2: Describe the working principle and performance of solar flat plate collectors.
CO 3: Discuss the factors to be considered to design a solar concentrator for variousapplications.
CO 4: Discuss the working principle of various solar devices.
CO 5: Explain the photo voltaic cells with their construction details..
CO 6: Describe the various solar thermal energy storage systems.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								M	M			M	
CO2	M								M	M			M	
CO3	M								M	M			M	
CO4	M						W		M	M			M	
CO5	M								M	M			M	
CO6	M						W		M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **9 Hrs**

Source of radiation – solar constant– solar charts – Measurement of diffuse, global and direct solar radiation: pyrheliometer, pyranometer, pyregeometer, net pyradiometer-sunshine recorder

COLLECTOR AND ITS PERFORMANCE **9 Hrs**

Solar Non-Concentrating Collectors- Design considerations – Classification- air, liquid heating collectors –Derivation of efficiency and testing of flat plate collectors –Analysis of concentric tube collector - Solar green house.

CONCENTRATOR **9 Hrs**

Design – Classification– Concentrator mounting –Focusing solar concentrators- Heliostats. Solar powered absorption A/C system, water pump, chimney, drier, dehumidifier, still, cooker.

PHOTO-VOLTAIC CELL **9 Hrs**

Photo-voltaic cell – characteristics- cell arrays-power electric circuits for output of solar panels-choppers-inverters-batteries-charge regulators, Construction concepts.

APPLICATIONS **9 Hrs**

Energy Storage - Sensible, latent heat and thermo-chemical storage-pebble bed etc. materials for phase change-Glauber's salt-organic compounds. Solar ponds.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Yogi Goswami, . D. Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003
2. Edward E. Anderson, "Fundamentals for solar energy conversion", Addison Wesley Publ. Co., 2001.
3. Duffie J. A and Beckman, W .A., "Solar Engineering of Thermal Process", John Wiley,2003.
4. Tiwari G. N. and Ghosal, M. K. "Fundamentals of Renewable energy Sources", Narosa Publishing House, New Delhi, 2007.
5. W. Shepherd and D. W. Shepherd, "Energy Studies" Imperial College Press, London, 2004.

U15MEPE15 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

Course outcomes
After successful completion of the course, the students should be able to

CO 1: Apply fundamentals of production planning and breakeven analysis in complex problems
CO 2: Apply the work measurement techniques for improvement
CO 3: Apply the method study principles for betterment of manufacturing process
CO4: Apply the principles of product planning and process planning
CO5: Apply the techniques of inventory control in an industry
CO 6: Apply the knowledge of recent advancements in production systems

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2	S	M	M						M	M			S	
CO3	S		M						M					S
CO4	S	M							M					S
CO5	S	M								M				S
CO6	S								M	M				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **9 Hrs**

Definition of PPC- Objectives, Functions, Benefits of PPC-Types of production-job, batch and continuous-Product design and development –Aspects in product design- Functional aspects, Operational aspect-Durability and dependability aspect, Aesthetic aspect, Marketing aspect-Economic analysis of product design-Profit consideration-Standardization, Simplification & Specialization-Break even analysis- Problems.

WORK MEASUREMENT **9 Hrs**

Work measurement-Techniques-Time study-Time study procedure-Equipments-Allowances-Computation of Normal time, Standard time-Components of manufacturing time-Basic work content-Ineffective time-Techniques for productivity improvement–Relationship between productivity, economic growth and standard of living.

METHOD STUDY **9 Hrs**

Method study-Procedure-Recording techniques-Outline process chart, Flow process chart,Two handed process chart,Travel chart,Micro motion analysis,Models, Flow diagram, String diagram-Principles of motion economy-Therbligs-Influence of working conditions on work study.

PRODUCT PLANNING AND PROCESS PLANNING **9 Hrs**

Product planning-Extending the original product information- Problems in lack of Product planning-Value analysis-types, Steps in value analysis- Process planning - Steps in process planning -Pre requisite information needed for process planning- Routing -Machine capacity - Measures of capacity-Capacity balancing– Line balancing.

INVENTORY CONTROL AND RECENT TRENDS IN PPC **9 Hrs**

Inventory control - Purpose of holding stock - Effect of demand on inventories- Ordering Procedures-Fixed quantity system, Fixed period system-Costs associated with inventory-Selective inventory control policies- ABC analysis.
Fundamentals of Just In Time systems, MRP I, MRP II, ERP and lean manufacturing.

Theory: 45 Hrs **Total:45 Hrs**

ReferenceS:

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand and Company,2006.
2. S.K. Hajra Choudhury, Nirjhar Roy and A.K. Hajra Choudhury, “Production Management”, Media Promoters and Publishers Pvt. Ltd., 2002.
3. Samson Eilon, “Elements of production planning and control”,Universal Publishing Corporation, 2007.
4. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, John Wiley and Sons, 2011.
5. K.C.Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers,2002.
6. N.G. Nair, “Production and Operations Management”, Tata McGraw-Hill, 2003.
7. S.N.Chary, “Theory and Problems in Production & Operations Management”, Tata McGraw Hill,2013.

U15ME*P*E16 LEAN MANUFACTURING

L	T	P	C
3	0	0	3

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Apply the basic concepts of lean manufacturing
CO 2: Applyforecasting systems and supply chain management concept for effective operational decision making
CO 3: Apply capacity planning for managing multistage production system
CO 4: Apply the concepts of pull production systems for better manufacturing performance
CO 5: ApplyJIT philosophy to improve product flow
CO 6: Apply theory of constraints for shop scheduling and shop floor control

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M						M							M
CO2	M								M	M				S
CO3	M					M				M				S
CO4	M									M				S
CO5	M				M				M	M				S
CO6	M									M				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

LEAN MANUFACTURING - OVERVIEW 9 hrs
Measures of competitiveness, Functional areas of firm , Product design, manufacture, delivery, Principles of Production system –Learning curves- Product demand life cycle-Capacity balancing, Role of inventory and information.

MANUFACTURING STRATEGY AND SUPPLY CHAIN 9 hrs
Forecasting systems – Purposes and uses of forecasts, manufacturing strategy – Dimensions, Aggregate planning – Planning tradeoffs.

Supply chain management concepts –Logistic information systems-Product design and customization-Vendor selection and contracting-Operational decisions in distribution systems.

MULTI STAGE PRODUCTION SYSTEMS 9 hrs

Materials requirement planning, Capacity planning-Rough cut capacity planning-Capacity requirement planning-Load reports-Incorporating Stochastic behaviour, Lot sizing decisions, Managing change, Limitations of MRP, Introduction to multi stage product structures, Types of inventory, Inventory costs.

DECENTRALIZED PULL SYSTEMS& JIT PHILOSOPHY 9 hrs

Kanban systems –Single and dual systems-Scheduling rules, Environmental regulations, Constant work in process pull alternative (CONWIP)-Performance

JIT production systems,Improving the production environment towards JIT– Improving product flow– The transition to lean

SHOP SCHEDULING & SHOP FLOOR CONTROL 9 hrs

Scheduling system requirements, goals and measures of performance – Theory of constraints-Flowshop scheduling

Shop FloorControl system architecture – Manufacturing execution system – Toolmanagement system – Flexible manufacturing systems.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Michael L George, David T Rowlands, Bill Kastle, “What is Lean Six Sigma”, McGraw-Hill, New York, 2007.
2. Askin R G and Goldberg J B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons Inc., 2003.
3. Micheal Wader, “Lean Tools: A Pocket guide to Implementing Lean Practices”, Productivity and Quality Publishing Pvt Ltd, 2002.
4. Kenichi Sekine, “One-piece flow”, Productivity Press, Portland, Oregon, 2005.
5. Joseph A De Feo, William W Bearnard “ Juran Institute’s Six Sigma Break Through and Beyond”, Tata McGraw-Hill Edition, New Delhi, 2004.
6. Richard B ChaseF. Robert Jacobs and Nicholas J Aquilano, “Operations Management for Competitive Advantage”, McGraw Hill, 2006.
7. Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 2004.
8. Alan Robinson “Continuous Improvement in Operations”, Productivity Press, Portland, Oregon, 2003.

U15MEPE17 ADVANCED MACHINING PROCESSES

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the appropriate advanced machining components recognizing the industrial requirements

CO 2: Apply the knowledge of advanced machining process using mechanical energy

CO 3: Apply the principle of material removal by electrical discharge machining

CO 4: Apply the principle of material removal by Chemical and electro chemical energy based processes

CO 5: Apply the fundamentals of radian energy processes

CO 6: Apply the knowledge and concepts in micro machining process

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M												
CO2	S								M			M		M
CO3	S								M			M		M
CO4	S								M			M		M
CO5	S								M			M		M
CO6	M								W			W		W

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **9 Hrs**

Need for Modern Advanced Machining Processes - Classification based on Materials – Machining Methods – Energy – Processes Selection – Physical Parameters – Cost of Production – Volume of Production – Shapes of Product – Process Capability – Economical Production

MECHANICAL ENERGY BASED PROCESSES **9 Hrs**

Ultrasonic Machining – Principles – Transducer Type – Concentrators – Abrasive Slurry – Process Parameters – Tool Feed Mechanisms – Advantages – Limitations – Applications – Abrasive Jet Machining – Process – Principle – Process Variables – Material Removal Rate –

Advantages and Disadvantages – Applications – Water Jet Machining – Principle Process Variables – Advantages and Disadvantages – Applications.

ELECTRICAL DISCHARGE MACHINING AND ELECTRICAL DISCHARGE WIRE CUT MACHINING 9 Hrs

Electrical Discharge Machining – Mechanism of Material Removal – Dielectric Fluid – Electrodes Materials – Spark Erosion Generators – Electrode Feed System – Material Removal Rate – Process Parameters – Tool Electrodes Design – Characteristics of Spark Eroded Surfaces – Advantages and Disadvantages – Applications – Electrical Discharge Wire Cut and Grinding – Principle – Wire Feed System – Advantages and Disadvantages – Applications.

CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES9 Hrs

Chemical Machining – Fundamentals – Principle – Classification – Selection of Etchant – Chemical Milling – Engraving – Blanking – Drilling – Trepanning - Advantages – Disadvantages – Applications – Electro Chemical Machining – Electro Chemistry Process – Electrolytes – Properties – Material Removal Rate – Tool Materials – Tool Feed Systems – Design of Electrolyte Flow – Process Variables – Advantages – Disadvantages – Applications – Electro Chemical Grinding – Honing – Cutting Off – De burring – Turning.

ELECTRON BEAM – LASER BEAM – ION BEAM PLASMA ARC MACHINING AND MICRO MACHINING 9 Hrs

Electron Beam Machining – Principle – Generation – Control of Electron Beam – Advantages – Disadvantages – Applications – Laser Beam Machining – Principle – Solid – Gas – Laser Methods – Applications – Thermal Features – LBM – Advantages – Disadvantages – Applications – Ion Beam Machining – Equipment – Process Characteristics – Advantages – Disadvantage – Applications – Plasma Arc Machining – Principle – Gas Mixture – Types of Torches – Process Parameters – Advantages – Disadvantages – Applications – Introduction – Definition – Micro Machining – Classification of Micro Machining – Nano Machining – Nano Finishing - Mechanical – Thermal Micro Machining –Electro Discharge – Electron Beam – Laser Beam –Electro Chemical – Nano Finishing

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Vijay.K. Jain “Advanced Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2002.
2. Pandey P.C., and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2001.
3. Mc Geough, “Advanced Methods of Machining” Chapman and Hall, London, 2002.
4. Paul De Garmo, Black, J.T.and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., New Delhi, 2001.
5. Benedict. G.F.,“Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 2003.
6. Amitadha Bhattacharyya, “New Technology”, The Institution of Engineers,India.
7. “Production Technology” HMT Bengaluru, Tata McGraw Hill Publishing company Limited, New Delhi, 2006

U15MEPE18 ADVANCED WELDING PROCESSES

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the knowledge solid state welding process for engineering applications
CO 2: Apply the principles of radiant energy metal joining process.
CO 3: Apply the fundamental principles of special arc welding process
CO 4: Apply the knowledge of plasma arc in metal joining and cutting process
CO 5: Apply the knowledge of design principles in weld joints
CO 6: Apply the concept of quality control and testing of weldments in industrial environment

Pre-requisite:1. U15ME*T*304- Manufacturing Technology-I

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								M	M				M
CO2	S								M	M				M
CO3	S								M	M				M
CO4	S								M	M				M
CO5	M								M	M				M
CO6	M								M	M				M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

SOLID STATE WELDING PROCESSES 9Hrs

Fundamental principles, survey of the various pressure welding processes and their applications. Friction, friction stir, explosive, diffusion, and Ultrasonic welding – principles of operation, process characteristics and application.

ELECTRON AND LASER BEAM WELDING 9Hrs

Heat generation and regulation, equipment details in typical set-up, electron beam welding in different degrees of vacuum, advantages and disadvantages, applications.Laser Welding: Principles of operation, advantages, and limitations, applications.

ELECTRO SLAG WELDING 9Hrs

Heat generation, principles of operations, wire and consumable guide techniques, selection of current, voltage and other process variables, nature of fluxes and their choice. Electro-gas welding: Principle and applications. Narrow gap welding, Under Water welding. Rapid Arc Welding, Welding Automation

PLASMA WELDING 9Hrs

Special features of plasma arc- transferred and non transferred arc, key hole and puddle-in mode of operation, micro low and high current plasma arc welding and their applications, plasma cutting, surfacing and applications.

TESTING AND DESIGN OF WELDMENT 9 Hrs

Design and quality control of welds. Edge preparation types of joints, welding symbols. Stresses in butt and fillet welds – weld size calculations. Design for fatigue. Testing – tensile, bend hardness. Impact, notch and fatigue tests.Life assessment of weldments.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Schwartz M.M, “Metals Joining Manual”,McGraw Hill Books, 2001.
2. Tylecote R.F,“The Solid Phase Welding of Metals”,Edward Arnold Publishers Ltd, London, 2000.
3. Parmer R.S., “Welding Engineering and Technology”, Khanna Publishers,2002.
4. Carrry B., “Modern Welding Technology”, Prentice Hall Pvt Ltd., 2002.
5. Nadkarni S.V., “Modern Arc Welding Technology”, Oxford IBH Publishers, 1996.
6. Schwariz, M.M., “Source book on innovative welding processes”,American Society for Metals (OHIO), 2004.
7. Christopher Davis. “Laser Welding- Practical Guide”. Jaico Publishing House, 2002.

U15MEPE19 HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1 : Draw and explain the working of various pumps
CO 2 : Illustrate different types of hydraulic motors and cylinders**.**
CO 3 : Select a suitable control components for specific applications
CO 4 : Construct hydraulic and pneumatic circuits for various industrial applications
CO 5 : Explain the fundamentals of pneumatic systems and working of pneumatic components
CO 6 : Draw ladder logic diagrams and explain about low cost automation.

Prerequisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S			M							S	
CO2		M							M				M	
CO3	S		S				M						S	
CO4		M				M				M			M	
CO5	S		S				M						S	
CO6	W					M			M	M			M	

Course Assessment methods

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

FUNDAMENTALS OF FLUID POWER SYSTEMS 9 Hrs

Introduction to fluid power - properties of hydraulic fluids - Selection of hydraulic fluids- comparison between hydraulics and pneumatics – Fluid power symbols. Pumps and motors - types - Gear, vane and piston – construction and working. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting and special cylinders like tandem, Rodless and Telescopic cylinder, cylinder cushioning mechanism.

HYDRAULIC SYSTEM CONTROL COMPONENTS 9 Hrs

Construction of Control Components : Direction control valve – DCV 3/2 , DCV 2/2 DCV 4/2 and DCV 5/2 Rotary DCV, Shuttle valvecheck valve – pressure control valve – Simple pressure relief valve, pressure reducing valve, pressuresequencing valve, counter balance valve – Flow control valve – Fixed and adjustable-Electrical control solenoid valves, Relays, ladder diagram.

HYDRAULIC SYSTEM DESIGN AND INDUSTRIAL APPLICATION 9 Hrs

Power pack–elements, design. Pipes - material, pipe fittings. seals and packing. Maintenance of hydraulic systems Selection criteria for cylinders, valves, pipes. Accumulators and intensifiers: Types of accumulators- Accumulators circuits, sizing of accumulators, Intensifiers – Application of intensifier – Intensifier circuit. Circuits for deceleration, regenerative circuits, differential circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits.

PNEUMATIC SYSTEMS AND COMPONENTS 9 Hrs

Properties of air, pneumatic components – Compressors, Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves and pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, fail- safe circuit, Pneumo hydraulic circuit.

DESIGN OF PNEUMATIC CIRCUITS 9 Hrs

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves, Design of Pneumatic Circuit using Cascade Method. Fluidics – Introduction to fluidic devices, simple circuits, PLC-construction, types, operation, programming. Applications of PLC in fluid power control. Fluid power circuits failures and troubleshooting.

Theory :45Hr Total:45 Hrs

REFERENCES:

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2006.
2. Majumdar S.R., “Oil Hydraulics”, Tata McGraw-Hill, 2001.
3. Majumdar S.R., “Pneumatic Systems: Principles and maintenance”, Tata McGraw Hill, 2001.
4. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
5. Harry L. Stevart D.B, “Practical guide to fluid power”, Taraoeala sons and Port Ltd. Broadey, 1976.
6. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
7. Shanmuga Sundaram K., “Hydraulic and Pneumatic Controls”, S.Chand & Company Ltd, 2006.
8. Festo Didatic, TP 100, 101, 201, 202
9. Srinivasan R, “Hydraulic and Pneumatic controls”, Vijay Nicole, 2006.

U15MEPE20 SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the knowledge of business environment
CO 2: Understand Indian money market, stock market and exchange rate management
CO 3: Discuss economic planning and policies in India
CO 4: Discuss Sustainable development & green marketing
CO 5: Discuss evolution of sustainable development
CO 6: Practice environment audit for sustainable development

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							S		M	M	M			
CO2							S		M	M	M			
CO3							S		M	M	M			
CO4			M				S		M	M	M			
CO5			M				S		M	M	M			
CO6			M				S	M	M	M	M			

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

BUSINESS ENVIRONMENT: **9 Hrs**

Meaning of business, nature of modern business, Environment of business, Economic system, Macro economic scenario, neoliberal profile of the economy (LPG) Indian Money Market, Capital Market in India, Stock market and its regulation, Currency convertibility, Exchange rate management

BUSINESS AND GOVERNMENT IN INDIAN PERSPECTIVE 9 Hrs

Economic roles of the state and government, Economic planning in India, Export import policy and trade liberalization, Industrial policy resolution in India, Indian economic policies, Exit policy, disinvestment policy, taxation policy.

BASICS OF SUSTAINABLE DEVELOPMENT 9 Hrs

Sustainable Development: Definition, Elements, Indicators, Principles, Guidelines for sustainable development, Concern for environment: Eco-friendly manufacturing, Packaging, Green marketing, Green funding, Institutional support for establishing and maintaining Environment Friendly Business.

EVOLUTION OF SUSTAINABLE DEVELOPMENT 9 Hrs

Sustainable development-History, ideology, concept and approaches, Sustainable development and Human Development, Concept of Environmental Sustainability, Review of key international and local drivers of the sustainability agenda, Sustainable finance, Ethics and sustainable development.

ENVIRONMENT AND SUSTAINABILITY 9 Hrs

Environment Impact Assessment, Environmental Audit, Environment Management System, Environmental Legislations, ISO 14000, Governmental Institutions for Environmental Management.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Bala Krishnamurthy, “Environmental Management: Text and Cases”, PHI, 2000.
2. Anindita Basak, “Environmental Studies”, Pearson Education,2009.
3. Kaushik, Anubha, “Perspectives in Environmental Studies”, New Age International, 2016.
4. Betz, Fredrick, “Managing Technological Innovation”,Prentice Hall, Englewood cliffs, New Jersey., 2011.
5. Rohatgi, P.K, Rohatgi K and Bowonder. B,“Technological Forcasting” , Tata Mc Graw Hill, 2002

U15MEPE21 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the basics of rapid manufacturing techniques in manufacturing
CO 2: Apply the liquid and solid based rapid prototyping system in suitable applications
CO 3: Applypowder based rapid prototyping system in suitable applications
CO 4: Apply the different materials for rapid prototyping system
CO 5: Apply the concepts of reverse engineering in rapid prototyping
CO 6: Apply the new technologies in rapid prototyping for various applications

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								S	S				S
CO2	S								S	S				S
CO3	S								S	S				S
CO4	S								S	S				S
CO5	S								S	S				S
CO6									S	S				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **9Hrs**

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle –Fundamental – File format – Other translators – medical applications of RP – On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEM **9Hrs**

Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

POWDER BASED RAPID PROTOTYPING SYSTEMS 9Hrs

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

MATERIALS FOR RAPID PROTOTYPING SYSTEMS 9Hrs

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials – case study.

REVERSE ENGINEERING AND NEW TECHNOLOGIES 9Hrs

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Rafiq I. Noorani, “Rapid Prototyping: Principles and Applications”, Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, “Rapid Prototyping: Principles and Applications”, World Scientific, 2003.
3. N.Hopkinson, r.j.m, hauge, p m, dickens, “Rapid Manufacturing: An Industrial revolution for the digital age”, Wiley, 2006
4. IAN GIBSON, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering,Software conversion and Rapid Prototying”, Wiley, 2006
5. Paul F.Jacobs, Rapid Prototyping and Manufacturing, “Fundamentals of Stereolithography”, McGraw Hill, 2002.
6. D.t.Pham and S.S.Dimov, “Rapid Manufacturing”, Springer Verlog, 2001.

U15MEPE22 TOTAL PRODUCTIVE MAINTENANCE

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Understand the roots and the evolution of TPM.
CO 2: Discuss breakdowns and minor stoppages in manufacturing.
CO 3: Identify the importance of Breakdowns influence in equipment effectiveness calculations
CO 4: Analyze the 3 steps and 12 stages involved in TPM implementation.
CO 5: Identify the importance and steps involved in autonomous maintenance.
CO 6: Apply the knowledge of the implementation of TPM in industries.

Prerequisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M	M		M			M		S
CO2	M					M	M		M			M		S
CO3	M					M	M		M			M		S
CO4	M					M	M		M	M		M		S
CO5	M					M	M		M			M		S
CO6	M					M	M		M	M		M		S

Course Assessment methodsSS

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

TPM-OVERVIEW **8 Hrs**

History of equipment management- evolution from preventive maintenance to Total Productive Maintenance-Four developmental stages of TPM- Definition of TPM- 5 Pillars of TPM-Principles of prevention-Goals of TPM.

BREAKDOWNS AND EQUIPMENT EFFECTIVENESS **10Hrs**

Breakdowns and minor stoppages- Preventive Medicine and Preventive Maintenance-Lifespan characteristics and breakdown measures- Countermeasures for achieving zero breakdowns.
TPM and overall equipment effectiveness –Six major Obstacles to equipment effectiveness-Measuring equipment effectiveness-Availability, performance rate, quality rate.

TPM IMPLEMENTATION **9 hrs**

Requirements for fundamental improvement – 3 Stages of TPM implementation-Preparation stage, Implementation stage,Stabilization stage.

AUTONOMOUS MAINTENANCE **9 hrs**

Definition-Autonomous maintenance skills- Seven stage Implementation of autonomous maintenance-Characteristics of autonomous maintenance programs.

TPM COMPANYWIDE COOPERATION **9 Hrs**

Preparing for TPM-Assuring organizational support for TPM-Planning for TPM implementation-Quick response systems-Activities aimed at early discovery of abnormalities-Maintenance prevention design-Early equipment management.

Theory: 45 Hrs **Total : 45 Hrs**

REFERENCES :

1. Seiichi Nakajima, "Introduction to TPM", Productivity Press, Chennai, 1992.
2. Fumiu Goto, "Equipment planning for TPM Maintenance Prevention Design", Productivity Press,1992.
3. Kunio Shirose, "Total Productive Maintenance for Workshop Leaders", Productivity Press, 1992.
4. Kunio Shirose, "TPM for Operators", Productivity Press, 1996.
5. T. Suzuki, "New Directions for TPM", Productivity Press, 1993.
6. Kelly .A, "Maintenance planning and control", Butterworths, London, 1991.

U15MEPE23 ERGONOMICS

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply the basic principles of ergonomics in humanization
CO 2: Apply the principles of work capacity and fatigue
CO 3: Examine the design of displays and controls
CO 4: Apply the principles of virtual environment in controls design
CO 5: Apply the principles of measures of human error and safety in work environment
CO 6: Design of system and job with social aspects

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					S			S	S				S
CO2	S					M			S	S				S
CO3	S	S	M						S	S				S
CO4	S					M			S	S				S
CO5	S					S			S	S				S
CO6			S				S		S	S				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION 9 Hrs

Focus of ergonomics-areas of application in work system-History of ergonomics-Humanization of work -modern ergonomics-future directions for ergonomics-designing for population of users-sources of human variability-Anthropometry in ergonomics-Types of anthropometric data.

WORK CAPACITY AND FATIGUE 9 Hrs

Stress and fatigue- Muscle function –Types and fatigue-fatigue and discomfort-fatigue after prolonged exertion-fatigue and pain-Electromyography-Cardiovascular system-Respiratory system- work capacity-Factors affecting work capacity

DISPLAY CONTROLS AND VIRTUAL ENVIRONMENT 9 Hrs

Principles for Design of visual display- Auditory displays –synthetic speech-Auditory warnings and cues- Design of controls- vehicle controls-Integrating displays and controls-case study of designing brake lights in cars-Virtual environment.

HUMAN ERROR AND SAFETY 9Hrs

Factors influencing human error-Mental work load in human-machine interaction-physiological and psychological measures of mental work load-error categorization-error production-error detection-Heuristics and biases in human decision making- Accidents and safety-Scope of accident investigation.

SOCIAL ASPECTS OF SYSTEM DESIGN 9Hrs

Systems design in ergonomics –Formulation,analysis,design,realization,implementation and validation-Organizational aspects of safety-principles of socio technical job design-Psychosocial factors-Motivation-Job enlargement and Job enrichment-Job satisfaction-Cross cultural considerations

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Bridger, RS, “Introduction to ergonomics”,Taylor and Francis, 2003.
2. Khan MI, “Industrial Ergonomics” PHI Learning, 2010.
3. Megaw ED,“Contenmprory ergonomics” ,Taylor & Fracis, 2009.
4. Martand T. Telsang, “Industrial Engineering And Production Management”, S.Chand & Company Ltd, 2006.

U15MEPE24 PLANT LAYOUT AND MATERIAL HANDLING

L	T	P	C
3	0	0	3

Course Objective:

After successful completion of the course, the students should be able to

CO 1: Apply the principles of plant location in an industry
CO 2: Apply the principles of capacity in selection of equipment and man power requirements
CO 3: Apply the tools and techniques for plant layout
CO 4: Apply the principles of planning and maintenance in industrial buildings and utilities
CO 5: Apply the factors of containerization and palletization in material handling
CO 6: Design and analysis of material handling

Prerequisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S								S	S				S
CO2	S								S	S				S
CO3	S								S	S				S
CO4	S								S	S				S
CO5	S								S	S				S
CO6	S		S		S				S	S				S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

PLANT LOCATION AND PHYSICAL FACILITIES 9 hrs

Factors to be considered – Influence of location on plant layout, selection of plant site, consideration in facilities planning and layout – Equipment required for plant operation, Capacity, Serviceability and flexibility and analysis in selection of equipments, space and man power requirements.

PLANT LAYOUT 9 hrs

Need for layout, types of layout, factors influencing product, process, fixed and combination layout, tool and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure – visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

INDUSTRIAL BUILDINGS AND UTILITIES 9 hrs

Centralized electrical, pneumatic, water line systems. Types of buildings, lighting, heating, airconditioning and ventilation utilities – planning and maintenance, waste handling, statutory requirements, packing and storage of materials: Importance of packaging, layout for packaging – packaging machinery – wrapping and packing of materials, cushion materials.

MATERIAL HANDLING 9 hrs

Importance and Scopes – Principles of material handling – engineering and economic factors - planning, relationship to plant layout – types and selection of material handling systems, factors influencing their choice – concept of containerization and palletization.

ANALYSIS OF MATERIAL HANDLING 9 hrs

Factors involved – motion analysis, flow analysis, graphical analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys – Designing of material handling systems – System equation - Planning chart, Unit load design – principle - efficiency of containers, pallet sizes.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Fred E Meyers, “Plant Layout and Material Handling”, Prentice Hall, 1999.
2. James A. Tompkins , John A. White, Yavuz A. Bozer and J. M. A. Tanchoco “Facilities Planning”, John Wiley & Sons, 2003.
3. Govindan, K. R., “Plant Layout and Material Handling”, Anuradha, Kumbakonam, 2001.
4. Khanna, O. P., “Industrial Engineering and Management”, Dhanpatrai and Sons, 2003.
5. Apple, James M. “Plant Layout and Material Handling”, 3rd. ed. John Wiley and Sons, New York, 1977.

U15MEPE25 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply supply chain strategies in supply chain planning.
CO 2: Organize supply chain operations and outline supply chain macro processes.
CO 3: Apply supplier assessment factors for effective sourcing.
CO 4: Build distribution networks by identifying its influencing factors.
CO 5: Apply managerial levers to achieve coordination in practice.
CO 6: Identify supply chain drivers and summarize steps to achieve strategic fit.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M							M	M	M				M
CO2	M								M	M				M
CO3	M							M	M	M				M
CO4	M								M	M				M
CO5	M							M	M	M				M
CO6	M							M	M	M				M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

SUPPLY CHAIN BASICS 9 Hrs

Definition- flow in supply chain- objectives of SCM-Decision phases of a supply chain- Supply chain strategy, supply chain planning, Supply chain operation- Process view of a supply chain- Supply chain Macro process-Case studies of successful supply chains.

SOURCING DECISIONS IN SUPPLY CHAIN 9 Hrs

Role of sourcing- benefits of effective sourcing decisions- Supplier scoring and assessment factors- Supplier selection-Auctions and negotiations-Contracts and supply chain performance-Design collaboration- Procurement process- Product categorization- Sourcing planning and analysis.

DISTRIBUTION & NETWORK DESIGN IN SUPPLY CHAIN 9 Hrs

Role of distribution in a supply chain- Factors Influencing distribution network design- Design options for a distribution network- ebusiness- Network design decisions-Factors influencing network design decisions- Framework for global site location-Convetional versus tailored networks.

SUPPLY CHAIN COORDINATION 9 Hrs

Supply chain coordination and Bullwhip effect- obstacles to supply chain coordination-Managerial levers to achieve coordination- Building strategic partnerships and trust in supply chains-Effect of Interdependence on Supply Chain Relationships-Achieving coordination in practice.

SUPPLY CHAIN PERFORMANCE 9 Hrs

Meaning- Drivers of supply chain performance- Facility, Inventory, Transportation, Information, Sourcing, Pricing-Competitive and supply chain strategies-Value chain- Obstacles for a strategic fit- Step to achieve a strategic fit-Issues affecting strategic fit-Scope of strategic fit in a supply chain.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Sunil chopra Peter meindl, D.V.Kalra,“ Supply chain management”,Pearson Education,Printice Hall of India, 2010.
2. Rahul.V. Altekar, “Supply Chain Management, Concept and cases”, PHI, 2009.

U15MEPE26 MARKETING MANAGEMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Apply concepts of marketing in business strategic planning process.
CO 2: Identify characteristics affecting customer behavior and list the stages in buyer decision.
CO 3: Apply product line and product mix decisions and interpret product development process.
CO 4: Apply segmentation techniques in business markets for competitive advantage.
CO 5: Apply segmentation techniques in business markets for competitive advantage.
CO 6: Apply marketing research instruments for effective customer relationship management.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M			M	M				
CO2						M			M	M		M		
CO3						M			M	S				M
CO4						M			M	M				M
CO5						M			M	M		M		M
CO6					M	M			M	S		M		M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

MARKETING PROCESS **9 Hrs**

Definition, Marketing system,4P's and 4C's of marketing, needs, wants and demands,selling versus marketing, concepts of marketing, marketing triangle, Business Strategic planning process-Strategy formulation-Factors influencing marketing strategy-Marketing process-Marketing environment.

BUYER BEHAVIOUR **9 Hrs**

Characteristics affecting customer behavior- cultural, social, personal, psychological factors-Types of buying decision behavior- Buyer decision process-stages in buyer decision process for new products-Influence of individuals and product characteristics on the rate of adoption.

PRODUCT PRICING **9 Hrs**

Definition of product-Types of product-tangible product, consumer product,organizational product-Product life cycle-Product development process-Product line and product mix decisions-Product strategies for international markets- Pricing- objectives of pricing- Factors affecting pricing decisions-Price elasticity-Pricing methods-Price adjustment strategies.

MARKET SEGMENTATION **9 Hrs**

Definition-Segmenting consumer markets-Segmenting business markets-Segmenting international markets-Requirements for effective segmentation- Introduction to multiple segmentation- Evaluating marketing segments-Market targeting-Product differentiation and Product positioning for competitive advantage.

MARKETING RESEARCH **9 Hrs**

Introduction to marketing information systems-Internal data,marketing intelligence, marketing research-Steps in marketing research- Research instruments-Analyzing marketing information-Customer Relationship Management, Data warehousing-Information distribution.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Rajan Saxena, “Marketing Management”, Tata Mc-graw Hill,2009.
2. Ramasamy and Nama kumari, “Marketing Environment: Planning, implementation and control the Indian context” Macmillan,2009.
3. Philip Kotler and Gary Armstrong “Principles of Marketing”, Prentice Hall of India, 2008.
4. Philip Kotler, Kevin Lane Keller, “Marketing Management”, Pearson Prentice Hall, 2009.

U15MEPE27 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Identify the role of Entrepreneurship and study factors affecting entrepreneurial growth.
CO 2: Apply motivational techniques for effective stress management in entrepreneurship development.
CO 3: Identify ownership structures for better project formulation and business growth.
CO 4: Apply appropriate corrective measures after categorizing causes of industrial sickness.
CO 5: Apply knowledge on sources of finance for managing working capital.
CO 6: Applybreak even analysis and network analysis in costing management.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M			M	M			M	M			S
CO2						M				M	M			S
CO3							S			S	M			M
CO4						M				W				
CO5											S			M
CO6			W			W					S			S

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT 8 Hrs

Entrepreneur – Evolution – Characteristics of entrepreneur – Functions of entrepreneur – Differences between entrepreneur and manager – Differences between entrepreneur and intrapreneur - Types of entrepreneur –Contribution of Entrepreneurship to Economic Growth of Country –Economic and Non economic factors affecting entrepreneurial growth.

MOTIVATION **8 Hrs**

Definition – Nature of Motivation – Internal and External factors affecting Motivation - Training for Achievement - Kakinada experiment,Thematic appreciation test, Self rating, Business game – Stress Management – Symptoms and causes of stress – Psychosomatic, psychological, Behavioral problems – Coping with stress.

GROWTH STRATEGIES IN BUSINESS **8 Hrs**

Outline of role of enterprises – Ownership structure – Sole proprietorship, Partnership – Project formulation – Significance, Contents of a project - Objectives of business growth – Stages of growth – Internal growth strategies – Expansion, Diversification - External growth strategies – Franchising – Joint Ventures – Acquisition – Mergers and Subcontracting.

INDUSTRIAL SICKNESS **7 Hrs**

Process of Industrial sickness-Signals and symptoms – Causes and consequences – corrective measures – Government policies – IPR 1948, IPR 1956, IPR 1977, IPR1980, IPR 1990.

FINANCING AND ACCOUNTING **7 Hrs**

Need for financing- Differences between Fixed capital and working capital – Sources of finance – Term loans – Financial institutions – Management of working capital- Gross working capital, Net working capital – Types of working capital – Factors determining working capital.

COSTING **7 Hrs**

Definition – Methods of costing – Classification of costs – Elements of costs –Break even point analysis - Network analysis - PERT/CPM – Taxation – Income Tax – Sales Tax – Excise duties.

Theory : 45 Hrs **Total:45Hrs**

REFERENCES:

1. Dr. R. Radhakrishnan and Dr. S. Balasubramanian, “Intellectual Property Rights”, Excel Books,2008.
2. Vasanth Desai, “Dynamics of Entrepreneurial Development and Management” Himalaya Publishing House,2011.
3. N.P.Srinivasan & G.P. Gupta,“Entrepreneurial Development”, Sultanchand & Sons, 2013.
4. P.Saravanavelu, “Entrepreneurship Development”, Eskapee publications, 2008.
5. S.S.Khanka, “Entrepreneurial Development”, S.Chand & Company Ltd., 2013.

U15MEPE28 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the student would be able to

CO 1: Understand the governing equations of fluid dynamics and boundary conditions

CO 2: Apply the knowledge of finite element discretization methods for solving explicit and implicit schemes for two dimensional conduction problems.

CO 3: Understand various grid generation methods.

CO 4: Apply finite volume techniques for different schemes for solving one dimensional heat conduction equation.

CO 5: Understand SIMPLE algorithm.

CO 6: Understand the impact and applications of CFD in Engineering.

Pre-requisite: Fluid Mechanics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M							M	M		M	M	
CO2	S	M							M	M			M	
CO3	M	M							M	M			M	
CO4	S	M							M	M		M	M	
CO5	M	M							M	M		M	M	
CO6	W				W								W	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

INTRODUCTION AND GOVERNING EQUATIONS 10 Hrs

Introduction - Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions - Governing equations for boundary layers - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.

DISCRETIZATION BASIC ASPECTS OF DISCRETIZATION 10 Hrs

Discretization techniques – Finite difference - Finite volume and Finite Element Method– Comparison of discretization by the three methods - Introduction to Finite differences - Transient one-dimensional and two-dimensional conduction – Explicit - Implicit - Crank-Nicolson– Stability criterion. Difference equations - Numerical errors - Grid independence test.

INTRODUCTION TO GRID GENERATION 8 Hrs

Choice of grid, grid oriented velocity components, cartesian velocity components, staggered and collocated arrangements, adaptive grids.

CONVECTION – DIFFUSION 8 Hrs

Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, hybrid and power law schemes. Transient one dimensional heat conduction equation.

CALCULATION OF FLOW FIELD 9 Hrs

Representation of the pressure - Gradient term and continuity equation – Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure Correction equation - Numerical procedure for SIMPLE algorithm.

Theory : 45 Hrs Total : 45 Hrs

REFERENCES:

1. K.A. Hoffman, (2000), Computational Fluid Dynamics for Engineering, Vol I - III Engineering Education System, Austin, Texas.
2. J.D. Anderson, Jr., (2000), Computational Fluid Dynamics – The basics with applications, McGraw-Hill, Incs.
3. K. Muralidhar, T. Sundarajan, (2001), Computatioanl Fluid Flow and Heat Transfer,Narosa Publishing House, New Delhi.
4. S.V. Patankar, (1999), Numerical Heat Transfer and Fluid Flow, Hemisphere, New York.
5. V.V. Ranade, (2002), Computational Flow Modeling for Chemical Reactor Engineering,Academic Press

U15ME*PE*29 **MECHATRONICS**

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Explainmechatronics design process.
CO 2: Choose sensors based on their working principle.
CO 3: Discussthe working of various actuators.
CO 4: Discuss the architecture of microprocessors and microcontroller.
CO 5: Explain the architecture of PLC and contrast it from PC and relay systems.
CO 6: Discuss the various case studies.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M											
CO2			M											
CO3	M													
CO4	M				M									
CO5			M											
CO6					S									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION TO MECHATRONICS **11 Hrs**

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics.
Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

ACTUATORS **5 Hrs**

Electro – pneumatics and Electro – hydraulics - Solenoids – Direct Current motors – Servomotors – Stepper motors –BLDC Selection and application.

MICROPROCESSSOR BASED CONTROLLERS 13 Hrs

Architecture of microprocessor and microcontroller– Pin Configuration – Addressing Modes – Instruction set, Timing diagram of 8085.

PROGRAMMING LOGIC CONTROLLERS 13 Hrs

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC Problem – Application of PLCs for control.

CASE STUDIES 3 Hrs

Pick and place robot – Automatic Car Park Systems – Automatic Camera – Adaptive cruise control - Engine Management Systems.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Bolton, W. "Mechatronics", Pearson Education,2011.
2. *'*Mechatronics*",*HMT Ltd.,Tata McGraw Hill Publication Co. Ltd., New Delhi,2000.
3. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2011.
4. Ramachandran, K.P., Vijayaraghavan, G.K.and Bala Sundaram, M.S. "Mechatronics: Integrated Mechanical Electronic System",Wiley India Pvt Ltd,2008.
5. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall,2004.
6. Dan Necsulesu, "Mechatronics", Pearson Education,Asia, 2002.
7. Lawrence J. Kamm, "Understanding Electro-Mechanical Engineering", An Introduction to Mechatronics, Prentice Hall of India Pvt Ltd,2000.
8. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003.
9. B.P. Singh, "Advanced Microprocessor and Microcontrollers", New Age InternationalPublisher,2008.

U15GS*T*002 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply & analyze quality concepts and philosophies of TQM

CO2: Apply concepts of continuous improvement

CO3: Apply TQM concepts to enhance customer satisfaction and deal with customer related aspects

CO4: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality

CO5: Apply and analyze the TQM tools as a means to improve quality

CO6: Understand quality systems, procedures for its implementation, documentation and auditing

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		M		M							M			
CO2		M		M							M			
CO3		M		M							M			
CO4					S						M			
CO5		M			S						M			
CO6					W						M			

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment	Course end survey

4. Group Presentation 5. End semester exam	

INTRODUCTION **9 Hrs**

Definition of Quality, Dimensions of Quality, Quality Costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing

TQM PRINCIPLES **9 Hrs**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS

STATISTICAL PROCESS CONTROL **9 Hrs**

The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma

TQM TOOLS **9 Hrs**

Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA

QUALITY SYSTEMS **9 Hrs**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

Theory :45 Hrs **Total: 45 Hrs**

References:

1. Dale H.Besterfield, "Total Quality Management", Pearson Education
2. James R.Evans& William M.Lindsay, "The Management and Control of Quality", South-Western (Thomson Learning), 2008.
3. Feigenbaum.A.V."Total Quality Management", McGraw Hill
4. Oakland.J.S. "Total Quality Management", Butterworth – Hcinemann Ltd., Oxford
5. Bhaskar S. "Total Quality Management", (2007-revised edition) Anuradha Agencies, Chennai
6. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 2007
7. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers.

U15GS*T*003 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO1: Apply the concepts of management and administration and analyze the evolution of management thoughts.
CO2: Apply the concepts of planning, forecasting and decision making
CO3: Analyze organizational structures and apply staffing concepts
CO4: Analyze the motivational and leadership theories
CO5: Apply & analyzethe communication and controlling processes.
CO6: Analyze the various international approaches to management

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1											M			
CO2											M			
CO3											M			
CO4									M		M			
CO5										M	M			
CO6											M			

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

MANAGEMENT CONCEPTS 9 Hrs

Management – Definition – Importance – Functions – Skills required for managers - Roles and functions of managers – Science and Art of Management –Management and Administration. Evolution of Classical, Behavioral and Contemporary management thoughts.

PLANNING 9 Hrs

Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives.
Forecasting – Purpose – Steps and techniques. Decision-making – Steps in decision making.

ORGANISING 9 Hrs

Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority –Benefits and Limitations. Centralization Vs De-Centralization and Delegation of Authority.Staffing – Manpower Planning – Recruitment – Selection – Placement – Induction.

DIRECTING & CONTROLLING 9 Hrs

Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation.
Leadership – Styles and theories of Leadership.
Communication – Process – Types – Barriers – Improving effectiveness in Communication.
Controlling – Nature – Significance – Tools and Techniques.

CONTEMPORARY ISSUES IN MANAGEMENT 9 Hrs

Corporate Governance Social responsibilities – Ethics in business – Recent issues. American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management.

Theory : 45 Hrs Total:45 Hrs

REFERENCES:

1. Tripathy PC And Reddy PN, “Principles of Management”, Tata McGraw-Hill, 4th Edition, 2008.
2. Dinkar Pagare, “Principles of Management”, Sultan Chand & Sons, 2000.
3. Kanagasapapathi. P “Indian Models of Economy, Business and Management”, Prentice Hall of India, New Delhi, ISBN: 978-81-203-3423-6, 2008.
4. Vijayaraghavan, G.K.and Sivakumar, M. “Principles of Management”, Lakshmi Publications, 5th Edition, 2009.
5. Bhaskar S. “Principles Of Management”, (2011) Anuradha Agencies, Chennai
6. Harold Koontz & Heinz Weihrich, “Essentials of Management – An International perspective”, 8th edition. Tata McGraw-Hill, 2009.
7. Charles W.L. Hill and Steven L McShane – Principles of Management, Tata Mc GrawHill, 2009.

U15GS*T*007 **PROFESSIONAL ETHICS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of the course, the students should be able to

CO1: Analyze the various concepts and theories of engineering ethics
CO2: Apply concepts of ethics and analyze its impact on society
CO3: Apply and analyze the concept of safety and risk in the light of engineering ethics
CO4: Analyze and evaluate the rights & responsibilities of engineers
CO5: Analyze the ethical issues engineers are to consider while operating globally
CO6: Applying and analyzing the responsibilities of engineers in management and leadership roles

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1						M		S						
CO2						M		S				M		
CO3						M		S						
CO4						M		S						
CO5						M		S						

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

ENGINEERING ETHICS AND THEORIES **9 Hrs**

Definition, Moral issues, Types of inquiry, Morality and issues of morality, Kohlberg and Gilligan's theories, consensus and controversy, Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self respect, duty ethics, ethical rights, self interest, egos, moral obligations.

SOCIAL ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hrs**

Engineering as social experimentation, codes of ethics, Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment.

SAFETY **9 Hrs**

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Bhopal gas tragedy.

RESPONSIBILITIES AND RIGHTS OF ENGINEERS **9 Hrs**

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination.

GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS **9 Hrs**

Multinational Corporations – Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – Engineers as trend setters for global values.

Theory :45 Hrs **Total: 45 Hrs**

References:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering". (2005) McGraw-Hill, New York.
2. John R. Boatright, "Ethics and the Conduct of Business", (2003) Pearson Education, New Delhi.
3. Bhaskar S. "Professional Ethics and Human Values", (2005) Anuradha Agencies, Chennai.
4. Charles D. Fleddermann, "Engineering Ethics", 2004 (Indian Reprint) Pearson Education / Prentice Hall, New Jersey.
5. Charles E. Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and cases", 2000 (Indian Reprint now available) Wadsworth Thompson Learning, United States.

OPEN ELECTIVES

U15MEOE01 COMPUTER AIDED DESIGN

L	T	P	C
3	0	0	3

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Summarize the basic concepts of CAD systems.
CO 2: Explaindifferent geometric modeling techniques.
CO 3: Make use of parametric design conceptsto represent an object.
CO 4: Estimate the mass properties of 3D objects and prepare bill of materials.
CO 5: Develop part programs for various operations in CNC machines.
CO 6: Apply post processing commands for different controllers

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W								M			M		M
CO2	S				M					M			S	
CO3	S								M				M	
CO4	M				S								S	
CO5					S					M		M		M
CO6					S				M			M		M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

OVERVIEW OF CAD SYSTEMS 9Hrs
Conventional and computer aided design processes-advantages and disadvantages.Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations.Networking of CAD systems.

GEOMETRIC MODELING 9Hrs
Wireframe, surface, NURBS and solid modeling-applications and advantages.Creating primitive solids, sweeping solids, Boolean operations.Extracting entities from a solid. Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry (CSG) and Analytical Solid Modeling (ASM)

PARAMETRIC DESIGN AND OBJECT REPRESENTATION 9Hrs

Types of co-ordinate systems.Parametric design - definition and advantages.Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids – manipulations, Automated 2D drafting - basics, mechanical assembly - bill of materials generation. Mass property calculations.

PART PROGRAMMING: 9Hrs

Manual part programming (Using G and M Codes) in CNC lathe and CNC Milling, Part programming for Linear and Circular interpolation, Part programming using standard canned cycles for Turning, Drilling and Milling.

POST PROCESSING: 9Hrs

Component Modeling and interfacing with CAM software. CL data generation, NC Code generation for CNC controller like FANUC, HAAS, SINUMERIC etc., Post processing commands for different CAD/CAM software like Pro-E, SOLID WORKS, EDGE CAM etc.,

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Vera B Anand, "Computer Graphics and Geometric Modeling for Engineers", John Wiley & Sons, New York, 2000.
2. Radhakrishnan P and Subramanyan S, “CAD/CAM/CIM”, New Age International Pvt. Ltd., 2004.
3. Radhakrishnan P and Kothandaraman C P, "Computer Graphics and Design”, Dhanpat Rai & Sons, New Delhi, 2002.
4. Ibrahim Zeid,"CAD/CAM Theory and Practice", McGraw Hill Inc., New York, 2003.
5. Barry Hawhes, "The CAD/CAM Process”, Pitman Publishing, London, 1998.
6. William M Newman and Robert Sproul, "Principles of Interactive Computer Graphics", McGraw Hill Inc., New York, 1994.
7. Sadhu Singh, "Computer-Aided Design and Manufacturing", Khanna Publishers, New Delhi, 1998.
8. Mikell.P.Groover, “Computer Aided Design and Manufacturing”, Dorling Kindersely India Pvt. Ltd.,2008.

U15MEOE02 RENEWABLE ENERGY SOURCES

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Illustrate the various energy sources and Natural cycles.
CO 2: Calculate the performance of flat plate collectors.
CO 3: Discuss the design aspects of wind mills, OTEC, tidal and geothermal power plants.
CO 4: Explain the various factors affecting the design of bio digester for various waste.
CO 5: Describe the concept of MHD and thermoelectric generators.
CO 6: Illustrate the working principle of various types of fuel cells.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					W	M		M	M		W	M	
CO2	S	W					M		M	M			M	
CO3	M						M		M	M			M	
CO4	S						S		M	M			S	
CO5	M								M	M			M	
CO6	M						W		M	M			M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

ENERGY AND ENVIRONMENT **5Hrs**

Primary energy sources - world energy resources - energy cycle of the earth and Global warming – Renewable energy resources and their importance - Potential impacts of harnessing the different renewable energy resources- Economics of renewable energy systems.

SOLAR ENERGY **15 Hrs**

Principles of solar energy collection includes extra-terrestrial and terrestrial radiation, sun earth relationship, solar constant, solar time-.solar radiation geometry ,solar day length, solar radiation map, solar radiation on tilted surface measurements - types of collectors - characteristics andevaluation- Solar distillation-

design principles of Liquid flat plate collectors, performance and testing of collectors - Solar water and air heaters - solar cooling - solar drying - solar ponds - solar tower concept - solar

furnace.- Applications of solar energy liquid flat plate collectors-performance analysis of lfp collector with calculation of Ƞinst

WIND, TIDAL AND GEO THERMAL ENERGY 10Hrs

Blade element and linear momentum theory of wind mills - types of windmills - design aspects of horizontal axis windmills power extraction from turbines axial thrust, blade design – applications - Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants - Geothermal power plants. Principle of ocean thermal energy conversion (OTEC)-site consideration for wind mills- Limitations.

BIO ENERGY 7Hrs

Energy from bio mass and bio gas plant – types and design of digester for biogas plants – applications - Energy from wastes - utilization of industrial, municipal and agricultural wastes- Bio-diesel production and economics.

DIRECT ENERGY CONVERSION SYSTEM 8 Hrs

Magneto hydrodynamic systems (MHD)and types-working principles - thermoelectric generators – thermionic generators - Fuel cells and its classification; Transport mechanism in fuel cells and concept of energy conversion. Solid oxide fuel cells (SOFC); PEM fuel cells; Direct methanol fuel cells (DMFC), Molten carbonate fuel cell (MCFC)- solar cells - types, Emf generated, power output, losses and efficiency applications. Hydrogen conversion and storage systems.

Theory :45 Hrs Total:45Hrs

REFERENCES:

1. Rai G.D, “Non-conventional Energy sources” 4th edition (24th Reprint), Khanna Publishers, New Delhi, 2009.
2. Kothari “Renewable Energy Sources and Emerging Technologies”, Eastern Economy Edition, 2009.
3. Sukhatme, S.P., “Solar Energy, Principles of Thermal Collection and Storage”, TataMCGraw Hill, 2008.
4. S.Rao and Parul ehar, “Energy Technology: Non conventional, Renewable and Conventional”,Khanna Publishers, 2009.
5. Garg. H. P and Prakash. J., “Solar Energy - Fundamentals and applications”,Tata Mc Graw Hill, 2000.
6. G.D. Rai, “Non Conventional Energy Sources”,Khanna Publishers, New Delhi, 1999.
7. Twidell, J.W. and Weir, A., “Renewable Energy Sources”,E&FN Spon Ltd., 1986
8. B.H.Khan, “Non conventional energy resources”; Tata Mcgraw hill, 2006.
9. John Andrews and nick jelly, “Energy science principles, technologies and impacts”, oxford university press, 2007.
10. Bent Sorensen, “Renewable energy physics, engineering, environmental impacts, economic & planning”, academic press, 2011.
11. G.N.Tiwari. “Solar Energy- Fundamentals, Design, Modelling and Applications”, Narusa Publishing House, New Delhi, 2002.

U15MEOE03 INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Identify the evaluation of industrial safety and health standards
CO 2: Apply the philosophies behind industrial accidents
CO 3: Apply the hierarchical levels in a safety organization
CO 4: Apply the concept of industrial process safety
CO 5: Apply the safety procedures for human
CO 6: Apply the types of industrial hazards and preventive measures

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M								
CO2	M					S			M	M				M
CO3	M					S		M	M	M				
CO4	M					S	M		M	M				M
CO5						S			M	M		M		
CO6	M					S	M		M	M		M		

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

INTRODUCTION **7 Hrs**

Definition-Development before industrial revolution-Milestones in industrial safety movement-Development of accident prevention programs-3 E's of safety- Development of Safety organizations-Safety and health movement- Managing emergency in industries.

ACCIDENT PREVENTION **7 Hrs**

Safety and productivity-Fallacies about safety-Industrial psychology in accident prevention-Basic philosophy of accident prevention-Unsafe condition,Unsafe act, Injury, Fault of persons-Cost of accidents- Safety education.

SAFETY ORGANIZATION **7 Hrs**

Purpose of a safety organization-Safety policy- Safety committee- types- Role of safety coordinator- Responsibilities,Interferences and Sufferings of safety supervisor-Safety publicity-Accident reporting-Accident investigation-Accident statistics-Safety audits.

INDUSTRIAL PROCESS SAFETY **8 Hrs**

Overview-Safety performance by industry sector-Incident pyramid-Process hazard and risk-Failure of defences- Process safety management-Scope, Functions, Features and Characteristics-Role of organizational levels in Process safety Management-Assessing organizations safety effectiveness.

HUMAN SIDE OF SAFETY **8 Hrs**

Management of change-Process and equipment integrity-Human behavior aspects and modes-The Swiss cheese model of industrial accidents-Active and Latent failures-examples - Safety lessons-Human Factors influencing the likelihood of failure-Organizational culture, Demographic effects.

INDUSTRIAL HYEGIENE AND HAZARDS **8 Hrs**

OSHA and industrial hyegiene-work site analysis-recognizing and controlling hazards-Occupational diseases prevention-Employee welfare-Statutory welfare schemes, Non statutory schemes-Health hazards-Control strategies- Fire hazards and prevention, Electrical hazard prevention and safety.

Theory :45 Hrs **Total:45Hrs**

REFERENCES:

1. Krishnan N.V., “Safety in Industry", Jaico Publisher House, 2005.
2. Singh, U.K. and Dewan, J.M., "Safety, Security and risk management", APH Publishing Company, New Delhi, 2005.
3. C. Ray Asfahl, David W. Rieske “ Industrial Safety and health management”, Prentice Hall,2009.
4. R.K. Mishra,“Safety Management”, AITBS publishers, 2012.
5. Krishnan N.V., “Safety in Industry", Jaico Publisher House, 2005.
6. Singh, U.K. and Dewan, J.M., "Safety, Security and risk management", APH Publishing Company, New Delhi, 2005.
7. C. Ray Asfahl, David W. Rieske “ Industrial Safety and health management”, Prentice Hall,2009.
8. R.K. Mishra,“Safety Management”, AITBS publishers, 2012.

ONE CREDIT COURSES

U15ME*I*001 GEOMETRICAL DIMENSIONING AND TOLERANCING

L	T	P	C
0	0	2	1

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Understand and explain the concepts of advanced geometrical dimensioning and tolerancing

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					S					S		

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content

Introduction Dimension types and applications, Definitions, The role of dimensions, Floating Fastener Condition Position MMC, Tooling / Production, Inspection, CMM (coordinate measuring machine), Functional gage, Manual inspection , Zero Tolerancing Position zero tolerance, Fixed Fastener Condition Non-functional datum feature, Functional secondary size datum feature, RFS, MMC Shift, Tertiary size datum feature , Composite positional tolerancing, Two single segment feature control

Total: 15 Hrs

U15ME*I*002 IMPLEMENTATION OF STATISTICAL PROCESS AND CONTROL

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Apply the concept of statistical process control

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				S				M			

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content

1. Introduction to SPC
2. Basic statistical concepts
3. Types of Control Chart
4. Calculating Control Limits
5. Variables Control Charts
6. Uses of Control Charts
7. Process Capability
8. Process Control v Process Capability
9. Attribute Control Charts
10. Example of SPC software (Minitab)
11. Process Capability and Six Sigma
12. Company Implementation

Total: 15 Hrs

U15ME*I*003 LEAN FOR WORLD CLASS MANUFACTURING

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Apply the concept of lean for world class management

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					S				M	S		

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content
Basics of employees working in teams, Lean Thinking (Toyota Production System), Six Sigma, Theory of Constraints, Total Quality Management, Quality Function Deployment (QFD), Seven Basic Quality Tools, Statistical Process Control (SPC), and other methods. Upon completion, students should recognize appropriate selection, application, and deployment of these tools for excellence in their own work environment.

Total: 15 Hrs

U15ME*I*004 GOOD SHOP FLOOR PRACTICES FOR MANUFACTURINGEXCELLENCE

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Understand the concepts of floor practices

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				M	S					M		S

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content

1. Good shop floor
2. 5S work place management
3. Waste elimination
4. Problem Solving Tools
5. Measurement System Analysis (MSA)
6. Process Capability /Machine Capability studies
7. Process Audits
8. Engineering metrology
9. Training of new employees on shop floor
10. Kaizen
11. My Model Machine
12. Poke yoke techniques
13. Set up approval techniques
14. Preventive maintenance

Total: 15 Hrs

U15ME*I*005 TEAM DYNAMICS

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Apply the concept of team dynamics

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								M	S	M		M

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content

In this course the main text and lectures will cover theories and findings on topics that students will also explore through group exercises in class. Two tests will assess learning of the basic concepts and findings. Students will also demonstrate their ability to apply what they are learning by writing two essays analyzing case studies. One recounts the story of a group expedition to Antarctic (intragroup dynamics); the other is a first-person account of ethnic conflict in Bosnia (intergroup dynamics). Finally, class groups will each focus in depth on a particular topic and read primary articles reporting empirical studies. Groups will give a short presentation to the class on this topic and turn in a review paper. An optional final exam will give students who are unhappy with their grades on the tests a chance to improve their scores.

Total: 15 Hrs

U15ME*I*006 LEAN MANAGEMENT TOOLS

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Understand the concepts of lean management tools

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					S					S		S

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content

In this course students will bring information on specific company projects to be worked on during this training for real application of these concepts, tools and techniques. First, the basics of Lean Manufacturing are discussed to gain a common¬ understanding of the standard practices, tools and techniques that are utilized in multiple industries. Next, participants will focus on gaining an understanding the standard practices,¬ tools and techniques that are applied. The Toyota Production System (TPS) is examined and understood as the way to effectively implement Lean Manufacturing in the automotive industry. Lastly, participants will apply these tools on specific company projects utilizing¬ Lean Manufacturing methodologies and techniques

Total: 15 Hrs

U15ME*I*007 VALUE STREAM MAPPING

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Apply the concept of value stream mapping for improving process performance

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M			S					S		S

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content

1. An overview of value stream mapping
2. Identification of bottlenecks
3. Calculation of Overall Operating Efficiency (OEE)
4. Understanding of the impact of Single Minute Exchange of Die (SMED)
5. Applications of the methods
6. The classic pull principle: KANBAN
7. Practical implementation of a business game in a model production system
8. Continuous Improvement Production

Total: 15 Hrs

U15ME*I*008 VALUE ANALYSIS AND VALUE ENGINEERING

L	T	P	C
0	0	2	1

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Apply the concept of value stream mapping for improving process performance

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	S		S							S

Course Assessment methods:

Direct	Indirect
1. End semester exam	Course end survey

Course Content
1. Introduction: concept of value engineering, advantages and applications, problem recognition, role of creativity.
2. Analysis of Functions: Functions, use, esteem and exchange values, basic V/S secondary functions, using and evaluating functions.
3. Value engineering techniques: Selecting products and operations for VE action, determining and evaluating functions, assigning rupee equivalents, developing alternative means to required functions, decision making for optimum alternatives.

Total: 15 Hrs