KUMARAGURUCOLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)
COIMBATORE – 641049

CURRICULUM AND SYLLABUS

IIIrd- VIIIth Semesters

BE MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE – 641 049

B.E MECHANICAL ENGINEERING

CURRICULUM

SEMESTER III

Code No.	Course Title	L	T	P	C
Theory					
U14MA*T*304	Partial differential equations and Fourier Analysis	3	1	0	4
U14ME*T*301	Fluid Mechanics and Machinery	3	1	0	4
U14ME*T*302	Engineering Materials and Metallurgy	3	0	0	3
U14ME*T*303	Strength of Materials	3	1	0	4
U14ME*T*304	Machine Drawing	1	0	3	3
U14ME*T*305	Manufacturing Technology – I	3	0	0	3
Practical					
U14ME*P*301	Strength of Materials Laboratory & Metallurgy Laboratory	0	0	2	1
U14ME*P*302	Manufacturing Technology – I Laboratory	0	0	2	1
U14CE*P*312	Fluid Mechanics and Machines Laboratory	0	0	2	1
U14GH*P*301	Social Values	1	0	1	1

Total Credits: 25

SEMESTER IV

Code No.	Course Title	L	T	P	C
Theory					
U14MA*T*401	Numerical Methods	3	1	0	4
U14ME*T*401	Engineering Thermodynamics	3	1	0	4
U14ME*T*402	Engineering Metrology and Quality Control	3	0	0	3
U14ME*T*403	Manufacturing Technology – II	3	0	0	3
U14ME*T*404	Kinematics of Machinery	3	1	0	4
U14GS*T*001	Environmental Science and Engineering	3	0	0	3
Practical					
U14ME*P*401	Manufacturing Technology – II Laboratory	0	0	2	1
U14ME*P*402	Metrology and Instrumentation laboratory	0	0	2	1
U14EN*P*401	Communication Skill Laboratory	0	0	2	1
U14GH*P*401	National and Global Values	1	0	1	1

Total Credits: 25

SEMESTER V

Code No.	Course Title	L	T	P	C
Theory					
U14ME*T*501	Dynamics of Machinery	3	1	0	4
U14ME*T*502	Design of Machine Elements	3	1	0	4
U14ME*T*503	Thermal Engineering	3	1	0	4
U14ME*T*504	Computer Aided Design and Manufacturing	3	0	0	3
U14ME*T*505	Instrumentation and Control Engineering	3	0	0	3
U14MC*T*507	Mechatronics	3	0	0	3
Practical					
U14ME*P*501	Mechanism and Dynamics Laboratory	0	0	2	1
U14ME*P*502	Computer Aided Design Laboratory	0	0	2	1
U14ME*P*503	Thermal Engineering Laboratory - I	0	0	2	1
U14ME*P*504	Mini project	0	0	3	1

Total Credits: 25

SEMESTER VI

Code No.	Course Title	L	T	P	C
Theory					
U14ME*T*601	Design of Transmission Systems	3	1	0	4
U14ME*T*602	Heat and Mass Transfer	3	1	0	4
U14ME*T*603	Finite Element Analysis	3	1	0	4
U14*GST*003	Principles of Management	3	0	0	3
E1	Elective I	3	0	0	3
E2	Elective II	3	0	0	3
Practical					
U14ME*P*601	Thermal Engineering Laboratory – II	0	0	2	1
U14ME*P*602	Design and Analysis Project	0	0	3	1
U14ME*P*603	Industry Based One Credit Course/ Skill Development Programme	0	0	2	1
U14MC*P*604	Mechatronics Laboratory	0	0	2	1

Total Credits: 25

SEMESTER VII

Code No.	Course Title	L	T	P	C
Theory					
U14GS*T*002	Total Quality Management	3	0	0	3
U14GS*T*004	Operations Research	3	0	0	3
U14GS*T*005	Engineering Economics and Financial Management	3	0	0	3
U14GS*T*007	Professional Ethics	3	0	0	3
E3	Elective III	3	0	0	3
E4	Elective IV	3	0	0	3
Practical					
U14ME*P*701	Computer Aided Simulation and Analysis Laboratory	0	0	2	1
U14ME*P*702	Project Work-Phase I	0	0	6	2
U14ME*P*703	Computer Aided Manufacturing Laboratory	0	0	2	1
U14ME*P*704	Industrial Training/Technical Paper Presentation	0	0	2	1

Total Credits:23

SEMESTER VIII

Code No.	Course Title	L	T	P	C
Theory					
E5	Elective V	3	0	0	3
E6	Elective VI	3	0	0	3
E7	Elective VII	3	0	0	3
Practical					
U14ME*P*801	Project work- Phase II	0	0	18	6

Total Credits: 15

I and II semester : 24 + 24 = 48
III and IV semester : 25 + 25 = 50
V and VI semester : 25 + 25 = 50
VII and VIII semester : 23 + 15 = 38
Total credits : 186

ELECTIVES FOR SIXTH SEMESTER

Code No.	Course Title	L	T	P	C
Elective I					
U14ME*T*E60	Advanced Welding Processes	3	0	0	3
U14ME*T*E61	Lean Manufacturing	3	0	0	3
U14ME*T*E62	Marketing Management	3	0	0	3
U14ME*T*E63	Fluid Power Systems	3	0	0	3
U14ME*T*E64	Refrigeration and Air Conditioning	3	0	0	3
Elective II					
U14ME*T*E65	Vibration and Noise Control	3	0	0	3
U14ME*T*E66	Unconventional Machining Processes	3	0	0	3
U14ME*T*E67	Gas dynamics and Jet propulsion	3	0	0	3
U14ME*T*E68	Tool Engineering Design	3	0	0	3
U14ME*T*E69	Composite Materials	3	0	0	3

ELECTIVES FOR SEVENTH SEMESTER

Code No.	Course Title	L	T	P	C
Elective III					
U14ME*T*E70	Production Planning and Control	3	0	0	3
U14ME*T*E71	Computer Integrated Manufacturing	3	0	0	3
U14ME*T*E72	Industrial Safety Management	3	0	0	3
U14ME*T*E73	Ergonomics	3	0	0	3
U14ME*T*E74	Advanced Mechanics of Solids	3	0	0	3
U14ME*T*E75	Design of Jigs, Fixtures and Press Tools	3	0	0	3
U14ME*T*E76	Design and Optimization	3	0	0	3
U14ME*T*E77	Introduction to Human Body Mechanics	3	0	0	3
Elective IV					
U14ME*T*E78	Modeling and Simulation of Engineering Systems	3	0	0	3
U14ME*T*E79	Design for Manufacture	3	0	0	3
U14ME*T*E80	Rapid Prototyping	3	0	0	3
U14ME*T*E81	Nuclear Engineering	3	0	0	3
U14ME*T*E82	Theory of Combustion and Emission	3	0	0	3
U14ME*T*E83	Automobile Engineering	3	0	0	3
U14ME*T*E84	Fundamentals of Nano Technology	3	0	0	3
U14EC*T*E12	Electro Magnetic Field	3	0	0	3
U14MA*T*E65	Signals and Systems	3	0	0	3

ELECTIVES FOR EIGHTH SEMESTER

Code No.	Course Title	L	T	P	C
Elective V					
U14ME*T*E85	Material Handling Systems & Equipment	3	0	0	3
U14ME*T*E86	Advanced Foundry Technology	3	0	0	3
U14ME*T*E87	Supply Chain Management	3	0	0	3
U14ME*T*E88	Entrepreneurship Development	3	0	0	3
U14ME*T*E89	Project Engineering and Management	3	0	0	3
Elective VI					
U14ME*T*E90	Tribology	3	0	0	3
U14ME*T*E91	Product Life cycle Management	3	0	0	3
U14GST006	Product Design and Development	3	0	0	3
U14ME*T*E92	Solar Energy Engineering	3	0	0	3
U14ME*T*E93	Renewable Energy Sources	3	0	0	3
U14ME*T*E94	Security and cyber crime	3	0	0	3
Elective VII					
U14ME*T*E95	Micro Electro Mechanical Sensors	3	0	0	3
U14ME*T*E96	Power Plant Engineering	3	0	0	3
U14ME*T*E97	Sustainable Development	3	0	0	3
U14ME*T*E98	Energy Conservation and Management	3	0	0	3
U14ME*T*E99	Soft Computing Techniques	3	0	0	3
U14ME*T*E100	Robotics	3	0	0	3
U14ME*T*E101	Maintenance Engineering	3	0	0	3
U14MA*T*E03	Modeling and analysis of Engineering Systems	3	1	0	4

ONE CREDIT COURSES

Course Code	Course Title
U14MEI001	Advanced Geometrical Dimensioning and Tolerancing
U14MEI002	Implementation of statistical process and control
U14MEI003	Lean for world class manufacturing
U14MEI004	Good shop floor practices for manufacturing excellence
U14MEI005	Team Dynamics
U14MEI006	Lean management tools
U14MEI007	Value stream mapping for improving process performance
U14MEI008	Value Engineering- Concepts and Applications

Name of the industries offer the course:

1 TUV Rheinland
41, Shristi Mahal,
II Level, 8th Street, Tatabad
Coimbatore Ho,
Coimbatore – 641001.

2 COINDIA CAD Solutions
COINDIA Complex (Near SiTARC),
1 St Floor, 340/342, Avarampalayam Road,
K.R.Puram (po),
Coimbatore - 641 006.

3 UMS Technologies Ltd

1062,Gopal Bagh, Avinashi Road,
Coimbatore - 641018

4 The Coimbatore Productivity Council
"Vyshnav Building"(4th Floor),
Opp.K.G.Big Cinemas,
95-A, Race Course,
Coimbatore-641018.

SEMESTER III

L	T	P	C
3	1	0	4

U14MA*T*304 PARTIAL DIFFERENTIAL EQUATIONS AND FOURIER ANALYSIS

Course Outcomes (COs):

CO1: To form partial differential equations and solve certain types of partial differential equations.

CO2: To know how to find 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: To know how to solve one dimensional wave equation, one dimensional heat equation and two dimensional heat equation in steady state using Fourier Series.

CO4: To find the Fourier transform, sine and cosine transform of certain functions and use Parseval's identity to evaluate integrals.

Pre-requisite:

1. U14MA*T*201- Engineering Mathematics – 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
CO1	S											
CO2	S											
CO3	S	S										
CO4	S	S										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 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:60 Hrs

References:

1. Grewal B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Veerarajan T., "Engineering Mathematics" (for semester IV), , 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 (Revised) 2009.

L	T	P	C
3	1	0	4

U14ME*T*301 FLUID MECHANICS AND MACHINERY

Course outcomes

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

CO 1: Discuss properties of fluids and classification of flows
CO 2: Formulate and solve equations of momentum and energy
CO 3: Solve problems in flow through pipes and dimensional analysis
CO 4: Explain the concept of turbines with performance
CO 5: Explain the working of pumps and study the 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											
CO2		S										
CO3		S										
CO4			W									
CO5		W										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 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:60 Hrs**

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.

U14ME*T*302 ENGINEERING MATERIALS & 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: Explain various reactions, microstructure and compositions in the phase diagrams.

CO 2: Select appropriate heat treatment process for specific applications.

CO 3: Identify the composition, properties, applications of various ferrous, non ferrous metals and alloy

CO 4: Discuss the properties and applications of non metallic materials.

CO 5: Explain the various testing procedure to evaluate material properties.

Pre-requisite:

1. U14PH*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
CO1		M										
CO2		S										
CO3		S										
CO4	M											
CO5		S										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

REFERENCES:

1. Kenneth, G., Budinski and Michael K.Budinski, “Engineering Materials”, Prentice- Hall of India Private Limited, 4th Indian print, 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.

U14ME*T*303 STRENGTH OF MATERIALS

L	T	P	C
3	1	0	4

Course Outcomes

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

CO 1: Describe the fundamentals of stress and strain concepts.
CO 2: Draw the shear force and bending moment diagrams in beams
CO 3: Determine the deflection in beams and buckling of columns
CO 4: Explain the effect of torsion of shafts and springs.
CO 5: Analyze the complex stress systems.

Pre-requisite:

1. U14ME*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
CO1	S											
CO2		S	M									
CO3		M										
CO4	S											
CO5		S										

Course Assessment methods:

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

STRESSES AND STRAINS 11+4Hrs

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+2Hrs**

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:60 Hrs**

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. R.K. Bansal 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 publishing co., New Delhi-2007.

L	T	P	C
1	0	3	3

U14ME*T*304 MACHINE DRAWING

Course outcomes

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

CO 1: Recall basic concepts of machine drawing and define fits and tolerance.
CO 2: Explain various types of fits and tolerances.
CO 3: Develop sectional views of fasteners, joints and couplings.
CO 4: Develop assembly drawings of bearings and valves
CO 5: Draw assembly of machine parts.

Pre-requisite:

1. U14ME*T*101- Engineering Graphics

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											
CO2	M											
CO3	S											
CO4	S											
CO5	S											

Course Assessment methods:

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

BASIC CONCEPTS OF MACHINE DRAWING 6Hrs

BIS codes for Engineering Drawing – Abbreviations – Conventional representation of standard components – Systems of dimensioning and dimensioning of common components – surface finish, symbols and representing surface finish on drawing – sectioning conventions – Representation of welded joints, riveted joints and screw threads

FITS AND TOLERANCES 6Hrs

Types of fits – types of tolerance – representation of tolerance on drawing – calculation of minimum and maximum clearances and allowances – Geometrical tolerance – form and position tolerances – symbols –indicating geometrical tolerances on drawings – Introduction to selective assembly and interchangeable manufacture.

FASTENERS, JOINTS AND COUPLINGS 12Hrs

Making free hand sketches of the following assemblies: Fasteners – square threaded nut and bolt – Hexagonal headed nut and bolt – cotter joint with sleeve – knuckle joint – Gib and cotter joint – couplings – protected and unprotected type flanged coupling.

PART AND ASSEMBLY DRAWING OF BEARING AND VALVES 18Hrs

Plummer block – Foot step ball bearing – Foot step journal bearing – stop valve – Rams bottom safety valve.

ASSEMBLY OF MACHINE PARTS 18Hrs

Screw jack – Tailstock – Tool head of shaper – Machine vice – connecting rod. Study of blue print drawings

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

. **REFERENCES:**

1. Gopalakrishna, K.R., "Machine Drawing", Subhas publishing House, Bangalore, 2002
2. Sidheswar, N., Kannaiah, P., and Sastri, V.V.S., "Machine Drawing", TMH New Delhi, 2006.
3. John, K.C., and Verghese, P.L., "Machine Drawing", Jovast Publishers, Trissur, 2004.
4. "Faculty of Mechanical Engineering", "PSG Design Data Book", DPV Printers, 2006.
5. Ajeet singh, "Machine Drawing", TMH, New Delhi, 2008.
6. Narayanan, K.L., Kanniah, P., and Venkata Reddy, K., "Machine Drawing", New Age International Publications, 2004.

L	T	P	C
3	0	0	3

U14ME*T*305 MANUFACTURING TECHNOLOGY – I

Course outcomes

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

CO 1: Outline the various casting processes

CO 2: Explain the working principle of various welding fabrication processes

CO 3: Understand basic operations in bulk deformation process

CO 4: Enumerate the principle of sheet metal and various forming processes.

CO 5: Identify various operations, accessories and work holding devices in turning process in lathe.

Pre-requisite:

1. 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											
CO2	M											
CO3		M										
CO4		M										
CO5		M										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

REFERENCES:

1. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt.Ltd., Mumbai, 2001.
2. Serope Kalpajian and Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 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 Publishing Limited, II Edition, 2002.
5. P.C. Sharma, Production Technology, S. Chand and Company, New Delhi, IV Edition, 2007.
6. Begman, Manufacturing Process – John Wilely & Sons, IX Edition, 2004.

L	T	P	C
0	0	2	1

U14ME*P*301 STRENGTH OF MATERIALS LABORATORY & METALLURGY LABORATORY

Course outcomes

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

CO 1: Demonstrate various tests on mechanical properties of materials
CO 2: Perform deflection test and compression test
CO 3: Compare microstructure of ferrous and nonferrous metals
CO 4: Execute various heat treatment processes and identify the microstructures
CO 5: Measure the wear resistance of aluminium samples

Pre-requisite:

1. 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			W									
CO2			W									
CO3			M									
CO4			M									
CO5			M									

Course Assessment methods:

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

a) STRENGTH OF MATERIALS LABORATORY:

LIST OF EXPERIMENTS

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) METALLURGY LABORATORY:

LIST OF EXPERIMENTS

1. Study of microstructure on ferrous and non ferrous materials
2. Identification and Micro structure study on
3. Ferrous Materials- EN8, Mildsteel, (Non ferrous, Aluminium, castiron)

1. Heat Treatment - Comparison of hardness and microsturcture of
   i. As received specimens
   ii. Heat treated Specimens (Annealed, Normalized, Quenched and tempered specimens
2. Conducting sliding wear test on non ferrous materials- Aluminium

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

L	T	P	C
0	0	2	1

U14ME*P*302 MANUFACTURING TECHNOLOGY – I LABORATORY

Course outcomes

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

CO 1: Demonstrate various turning operations.
CO 2: Perform thread cutting and boring operations
CO 3: Prepare sand moulds for various patterns.
CO 4: Convert round rod into square and hexagonal shape.
CO 5: Demonstrate various welding operations

Pre-requisite:

1. U14MEP101- 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
CO1			W									
CO2			W									
CO3			M									
CO4			W									
CO5			W									

Course Assessment methods:

Direct	Indirect
1. Lab Exercices 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:45 Hrs**

U14CE*P*312 FLUID MECHANICS AND MACHINES LABORATORY

L	T	P	C
0	0	2	1

Course outcomes

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

CO 1: Measurement of flow through the orifice meter and venturimeter.
CO 2: Sketch the characteristic curves of centrifugal pumps.
CO 3: Show the performance characteristics of Pelton wheel and Francis turbine.
CO 4: Demonstrate the model flow study using wind tunnel.
CO 5: Determine the friction factor for a given set of pipes

Pre-requisite:

1. 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									
CO2			M									
CO3			W									
CO4			W									
CO5			M									

Course Assessment methods:

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

LIST OF EXPERIMENTS:

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:45 Hrs**

L	T	P	C
1	0	1	1

U14GH*P*301 HUMAN EXCELLENCE-SOCIAL VALUES

(Common to all branches of Engineering and Technology)

Course outcomes

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

1. Adopt and practice social values as his regular duties.
2. Take over the social responsibilities.
3. Give solutions and to manage the challenging social issues.
4. Voluntarily participate and organize social welfare programmes.
5. Explore his ideology of techno social issues and provide the best solution.

Pre-requisite:

1. U14GHP201- Family and Professional Values

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				
CO2							M	S				
CO3								S				
CO4								S				
CO5							S	S				

Course Assessment methods:

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

ORGIN OF SOCIETY **5 Hours**

Evolution of universe: Creation theory, Big bang theory, Evolution theory, Permanence theory - Mithya, Maya – Evolution of living being - Evolution of Man – Formation of society and social values.

Practical: Group Discussion on Evolution of Man and formation of society, Panel discussion on Social values - Pancha Bhoodha Navagraha Meditation.

SELF AND SOCIETY **2 Hours**

Duty to self, family, society and world –Realization of Duties and Responsibilitiesof individuals in the society (Five fold cultures) – impact of social media on present day youth and correction measures.

Practical: Case study – interaction with different professionals.

EDUCATION& SOCIETY **3 Hours**

Education: Ancient and Modern Models.

Practical: Making Short film on impact of education in social transformation.

DISPARITY AMONG HUMAN BEINGS **3 Hours**

Wealth's for humans, Factors leading to disparity in human beings and Remedies.

Practical: Debate on disparity and social values.

CONTRIBUTION OF SELF TO SOCIAL WELFARE **3 Hours**

Participation in Social welfare – Related programmes– Recognized association – Activities for social awareness – Programme by Government and NGOs – Benefits of social service – Balancing the family and social life.

Practical: In campus, off campus projects.

GENERAL PRACTICAL **14 Hours**

Ashtanga Yoga: Pathanjali maharishi & Yoga – Involvement – Rules of Asanas - Suryanamaskara (12 Steps)- Meditation.

Standing : Pada Hastasana, Ardha Cakrasana, Trikonasana, Virukchsana (Eka Padaasana)

Sitting : Padmasana, Vakrasana, Ustrasana, Paschimatanasana.

Prone : Uthanapathasana, Sarvangasana, Halasana, Cakrasana,

Supine : Salabhasana, Bhujangasana, Dhanurasana, Navukasana.

L: 16 Hr, P: 14, **Total: 30 Hours**

References:

1. Steven , Weinberg, "**The First Three Minutes"** : A Modern View of the Origin of the Universe (English), Perseus books group,1977.
2. Vethathiri's Maharishi's, **"Vethathirian Principles of Life"** The World Community Service Centre, Vethathiri Publications, 2003.
3. Vethathiri's Maharishi's, **"Karma Yoga: The Holistic Unity"** The World Community Service Centre, Vethathiri Publications, 1994.
4. Vethathiri's Maharishi's, **"Prosperity of India"** The World Community Service Centre, Vethathiri Publications, 1983.
5. Swami Vivekananda, "**The Cultural Heritage of India"** 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
6. Vivekananda Kendra Prakashan Trust, **"YOGA"**, Vivekanandha Kendra Prakashan Trust,Chennai, 1977.

SEMESTER IV

U14MA*T*401 NUMERICAL METHODS

L	T	P	C
3	1	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 and summary information through numerical integration

CO 4: Predict the system dynamic behaviour through solution of ODEs modeling the system

CO 5: Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

CO 6: Have the necessary proficiency of using MATLAB for obtaining the above solutions.

Pre-requisite:

1. 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											
CO2	S	S										
CO3	S	S										
CO4		S										
CO5		S										
CO6					S							

Course Assessment methods:

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

INTRODUCTION 3Hrs

Simple mathematical modeling and engineering problem solving – Algorithm Design – Flow charting and pseudocode - Accuracy and precision – round off errors

NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS 7+3 Hrs

Solution of nonlinear equations - False position method – Fixed point iteration – Newton Raphson method for a single equation and a set of non- linear equations Solution of linear system of equations by Gaussian elimination, Gauss Jordan method - Gauss Seidel method.

CURVE FITTING AND INTERPOLATION 7+3Hrs

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

NUMERICAL DIFFERENTIATION AND INTEGRATION 7+3Hrs

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

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION 10+3Hrs

Initial value problems - Single step methods: Taylor's series method – Truncation error – Euler and Improved Euler methods – Fourth order Runge – Kutta method – Multistep methods: Milne's predictor - corrector method.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (PDEs) 11+3Hrs

PDEs and Engineering Practice – Laplace Equation derivation for steady heat conduction – Numerical solution of the above problem by finite difference schemes – Parabolic Equations from Fourier`s Law of Transient Heat Conduction and their solution through implicit schemes – Method of Lines – Wave propagation through hyperbolic equations and solution by explicit method. Use of MATLAB Programs to workout solutions for all the problems of interest in the above topics.

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

REFERENCES:

1. Steven C.Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", SixthEdition, WCB/McGraw-Hill, 2004.
2. John H. Mathews and Kurtis D. Fink, "Numerical Methods using Matlab", Fourth Edition, Prentice Hall of India, 2004.
3. Gerald C. F. and Wheatley P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
4. Sastry S.S, "Introductory Methods of Numerical Analysis", Third Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2003.
5. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2007.

L	T	P	C
3	1	0	4

U14ME*T*401 ENGINEERING THERMODYNAMICS

(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: Understand the basic concepts and laws of thermodynamics.
CO 2: Apply concept of enthalpy and entropy in thermal systems.
CO 3: Explain the working principle of steam cycles.
CO 4: Apply the concepts of thermodynamics to gas mixtures.
CO 5: Solve problems in psychrometry and its processes.

Pre-requisite:

1. 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											
CO2		M										
CO3	W											
CO4	M											
CO5	M											

Course Assessment methods:

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

BASIC CONCEPTS AND FIRST LAW **11 + 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 + 3Hrs**

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 **9 + 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.

IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS **6+3Hrs**

Gas mixtures- properties ideal and real gases, equation state, Avagadro's Law, 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 **7+3Hrs**

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

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

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", 3rd Edition, 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.

U14ME*T*402 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: Explain the fundamentals of linear and angular measurements.
CO 2: Discuss various form measurement techniques.
CO 3: Explain the working of advanced instruments used in metrology.
CO 4: Construct various control charts for the variables and attributes.
CO 5: Explain various sampling methods, concepts and OC curves.

Pre-requisite:

1. 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											
CO2	S											
CO3		M										
CO4		M										
CO5	S											

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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 run out, 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 9 Hrs

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 9 Hrs

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:45 Hrs

REFERENCES:

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 19th edition, 2005.
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 2004.
3. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005
4. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications, 2000
5. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
6. Donald Deckman, "Industrial Instrumentation", Wiley Eastern, 2003.

L	T	P	C
3	0	0	3

U14ME*T*403 MANUFACTURING TECHNOLOGY – II

Course outcomes

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

CO 1: Outline theory of metal cutting
CO 2: Discuss the working principles of machine tools.
CO 3: Identify manufacturing components,
CO 4: Explain various surface finishing processes and gear manufacturing.
CO 5: Interpret the economics of machining.

Pre-requisite:

1. U14ME*T*305- 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
CO1			M									
CO2	M											
CO3	M											
CO4	M											
CO5	S											

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs

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, 2003.
3. Hajra Choudhry, S.K., and Bose, S.K., "Workshop Technology Vol II", 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. Amstead B.H., "Manufacturing Processes", Phillip Ostwald, L.Begemon, John Wiley and Sons, 2002.
6. Rajput, R.K., "Manufacturing Technology", Laxmi Publications (P) Ltd, New Delhi, 2007.
7. Boothroyd.,"Fundamentals Of Metal Machining And Machine Tools", CRC Press, 1988.

U14ME*T*404 KINEMATICS OF MACHINERY

L	T	P	C
3	1	0	4

Course Outcomes

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

CO 1: Recall basics of different types of mechanisms
CO 2: Calculate velocity and acceleration in planar mechanisms.
CO 3: Construct cam profile for specific follower motion.
CO 4: Solve problems in gears and gear trains.
CO 5: Apply the frictional forces in transmission of power and control of mechanisms.

Pre-requisite:

1. 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											
CO2		S										
CO3		S										
CO4		M										
CO5	S											

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 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 **9+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 **9+3Hrs**

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

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

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, 2006.
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", Wiley-Eastern Ltd., New Delhi, 2004.
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, 2009.

L	T	P	C
3	0	0	3

U14GS*T*001 ENVIRONMENTAL SCIENCE AND ENGINEERING

(Common to all branches of Engineering and Technology)

Course Outcomes

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

CO 1: Play a important role in transferring a healthy environment for future generations

CO 2: Analyze the impact of engineering solutions in a global and societal context

CO 3: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems

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

CO 5: Highlight the importance of ecosystem and biodiversity

CO 6: Paraphrase the importance of conservation of resources

Pre-requisite:

1. U14CH*T*202- Applied Chemistry

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					
CO2							S					
CO3						S						
CO4						M						
CO5						M						
CO6						M						

Course Assessment methods:

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

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **10Hrs**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, 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, floods, drought, conflicts over water, dams benefits and problems – 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, water logging, salinity, 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 – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

ECOSYSTEMS AND BIODIVERSITY **14 Hrs**

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem, Food chains, food webs 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 and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **8 Hrs**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hrs**

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and waste products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

HUMAN POPULATION AND THE ENVIRONMENT **6 Hrs**

Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

FIELD WORK

Visit to local area to document environmental assets- river / grassland / hill / mountain, visit to local polluted site- urban / rural / industrial / agricultural, study of common plants, insects, birds, study of simple ecosystems-pond, river, hill slopes etc.,

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

REFERENCES:

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co., 2013
2. Masters G.M., and Ela W.P., Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition.
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 Pubications. 2003

5. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media. 1996
6. Cunningham, W.P., Cooper, T.H.., & Gorhani E., Environmental Encyclopedia, Jaico Publ.,House, Mumbai, 2001
7. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, 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

U14ME*P*401 MANUFACTURING TECHNOLOGY-II 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: Operate milling machine and perform various milling operations
CO 2: produce components using shaper
CO 3: Perform keyway cutting operations using slotter.
CO 4: Perform drilling, boring, reaming and tapping, cylindrical and surface grinding operations
CO 5: Produce bevel gears

Pre-requisite:

1. U14MET305-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
CO1			W									
CO2			W									
CO3			W									
CO4			W									
CO5			W									

Course Assessment methods:

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

LIST OF EXPERIMENTS:

1. Spur Gear cutting using Milling and Gear Hobing machine
2. Hexagonal block using shaping machine
3. Key way cutting using milling machine
4. Contour profile milling
5. Dove tail machining using shaper machine
6. Key way and V-block cutting using shaping machine
7. Step block machining using shaping machine
8. Internal keyway machining using vertical slotting machine
9. Drilling, reaming and tapping for a given dimension of hole
10. Cylindrical and surface grinding of a shaft
11. Facing, plain, step and taper turning
12. Single start V thread cutting and knurling
13. Boring and internal thread cutting

Experiments beyound the syllabus to be conducted

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

U14ME*P*402 **METROLOGY AND INSTRUMENTATION 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 various gauges for measurement.
CO 2: Demonstrate linear and angular measurement using precision instruments.
CO 3: Apply the load cell to measure the force and torque
CO 4: Use thermocouple and vibrometer for taking measurement.
CO 5: Measure pressure and surface roughness

Pre-requisite:

1. 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											
CO2	M											
CO3	M											
CO4	M											
CO5	M											

Course Assessment methods:

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

LIST OF EXPERIMENTS:

1. Measurement of dimensions using vernier height gauge
2. Calibration of dial gauge
3. Checking dimensions of part using slip gauges
4. Measuring part dimensions using Electrical, Optical and Mechanical comparators
5. Measurements of gear tooth dimensions using gear tooth vernier
6. Measurements of composite gear tooth error using gear roll tester
7. Measurement of Taper Angle using sine bar
8. Measurement of screw thread parameters using Tool Makers Microscope and Profile Projector.
9. Measurement of displacement using LVDT.
10. Measurement of Force and Torque using load cell
11. Measurement of temperature using Thermocouple
12. Measurement of Vibration / Shock using vibration pick up
13. Measurement of pressure
14. Measurement of surface roughness

Experiments beyound the syllabus to be conducted

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

L	T	P	C
0	0	2	1

U14EN*P*401 COMMUNICATION SKILL LABORATORY

(Common to all branches of Engineering and Technology)

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: Present the individual, academic curricular and career profiles

CO 2: Demonstrate the industry-ready communication competency in GDs & interviews

CO 3: Project desirable soft skills to interface the corporate

Pre-requisite:

1. 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		
CO2										S		
CO3										S		

Course Assessment methods:

Direct	Indirect
1. Lab Exercices 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:45 Hrs**

REFERENCES:

1. Bhatnagar R.P. & Rahul Bhargava, "English for Competitive Examinations", Macmillian Publishers, India, 1989, ISBN: 9780333925591
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, ISBN : 8121905516

L	T	P	C
1	0	1	1

U14GH*P*401 HUMAN EXCELLENCE-GLOBAL VALUES

(Common to all branches of Engineering and Technology)

Course Outcomes(COs)

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

CO1: Act as a good and responsible citizen.
CO2: Conserve and protect eco cycle.
CO3: Voluntarily work with global welfare organization and provide solution for global peace.
CO4: Invent his Technical design by considering humanity and nature.

Pre-requisite:

1. U14GHP301-Human Excellence- Social Values

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				
CO2							M	S				
CO3							M	S				
CO4							M	S				

Course Assessment methods:

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

ROLE OF A RESPONSIBLE CITIZEN **4 Hours**

Citizen - its significance–National and Global perspectives.
Practical: Group discussion on National and Global values.

GREATNESS OF INDIAN CULTURE **2 Hours**

Emerging India – past and present, about Culture, Morality and spirituality– Beauty of Unity in diversity - Impact of western culture in India and Indian culture over other countries.
Practical: Demonstration and impact measurements of simple and good actions.

GLOBAL WELFARE ORGANISATIONS **2 Hours**

Education – Health – Nature – Peace
Practical: Organizing an event linking with one of the Organizations In campus /off campus.

PRESERVING NATURE **2Hours**

Appreciating the flora and fauna on Earth - Importance ofEcological balance – Conservation.
Practical: Trekking, field visit.

GLOBAL PEACE **4 Hours**

One World and One Humanity - Global Peace.

Global personalities: Thiruvalluvar, Vallalar, Vivekanadar, Mahatma Gandhi,Vethathiri Maharishi – Plans for world peace.
Practical: Group discussion on individual plans for world peace.

GENERAL PRACTICAL **16 Hours**

Simplified physical Exercise – Kayakalpa practice (Follow up practice) – Meditatyion - Theory & Practice
Pranayama : Bhastrika, Kapala Bhati, Nadi suddhi, Sikari, Sitali.
Mudhra : Chin Mudhra, Vayu Mudhra, Shunya Mudhra, Prithvi Mudhra, Surya Mudhra, Varuna Mudhra, Prana Mudhra, Apana Mudhra, Apana Vayu Mudhra, Linga Mudhra, Adhi Mudhra, Aswini Mudhra.

L: 14 Hr, P: 16, **Total: 30Hours**

REFERENCES:

1. Drunvalo Melchizedek, "The Ancient Secret of the Flower of Life", Vol. 1, Light Technology Publishing; First Edition edition (April 1, 1999)
2. Dr.M. B. Gurusamy, "Globalisation – Gandhian Approach" Kumarappa Research Institution, 2001.
3. Vethathiri's Maharishi's, **"Karma Yoga: The Holistic Unity"** The World Community Service Centre, Vethathiri Publications, 1994.
4. Vethathiri's Maharishi's, **"World peace"** The World Community Service Centre, Vethathiri Publications,1957.
5. Vethathiri's Maharishi's, **"Atomic Poison"** The World Community Service Centre, Vethathiri Publications, 1983.
6. Vethathiri's Maharishi's, **"The World Order Of Holistic Unity"** The World Community Service Centre, Vethathiri Publications, 2003.
7. Swami Vivekananda, "**What Religion Is"** 41th edition, The Ramakirshna Mission Institute of Culture, 2009.

SEMESTER V

L	T	P	C
3	1	0	4

U14ME*T*501 DYNAMICS OF MACHINERY

Course outcomes

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

CO 1: Calculate the inertia forces in reciprocating and rotating masses and turning moments in flywheels.

CO 2: Balance reciprocating and rotating masses.

CO 3: Analyze free vibration systems.

CO 4: Determine the frequency of damped and forced vibration systems.

CO 5: Appreciate the gyroscopic effect in mechanical applications and maintain equilibrium speed using governors.

Pre-requisite:

1. U14ME*T*404- 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
CO1	S											
CO2	S											
CO3		S										
CO4		S										
CO5		S										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 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 **8 + 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:60 Hrs**

REFERENCES:

1. Rattan S.S., “Theory of Machines”, 3rd edition, TMH, New Delhi, 2009.
2. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2006.
3. Ghosh A. and Mallick A.K., “Theory of Mechanisms and Machines”, Affiliated East-West Press Pvt. Ltd., New Delhi, 3rd edition, 2004.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 4th edition, 2010.
5. Rao J.S. and Dukkipati R.V., “Mechanism and Machine Theory”, Wiley-Eastern Limited, New Delhi, 2004.
6. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva low-Priced Student Edition, 2006.
7. Sadhu Singh “Theory of Machines” Pearson Education, 2002.

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

L	T	P	C
3	1	0	4

U14ME*T*502 DESIGN OF MACHINE ELEMENTS

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

Course outcomes

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

CO 1: Explain steady and variable stresses and apply the theories of failure in design of machine elements.

CO 2: Design a shaft subject to combined static and variable loads.

CO 3: Select appropriate rolling contact bearing, gasket and seal from the standard catalog based on loads.

CO 4: Analyze the temporary and permanent joints and design joints based on applications.

CO 5: Design flywheels, fasteners, helical spring, compression and tension springs for the specific applications.

Pre-requisite:

1. U14MET303- 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
CO1			S									
CO2			S									
CO3					M							
CO4			S									
CO5			S									

Course Assessment methods:

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

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

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 + 3 Hrs**

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:60 Hrs**

REFERENCES:

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw-Hill , 2003.
2. Bhandari V.B, "Design of Machine Elements", Second Edition, 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.

L	T	P	C
3	1	0	4

U14ME*T*503 THERMAL ENGINEERING

(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 of IC engines and combustion process.
CO 2: Discuss the working principle of air standard cycles and performance of engines
CO 3: Estimate the dimensions of steam nozzles and steam turbines for power generation.
CO 4: Find the power requirement of reciprocating air compressors.
CO 5: Calculate the cooling load for air conditioning and COP of refrigeration systems.

Pre-requisite:

1. U14MET401- 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
CO1			W									
CO2			S									
CO3		M										
CO4			W									
CO5			S									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 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. Air-fuel ratio calculation, Lubrication system and cooling system, CRDI, MPFI.

GAS POWER CYCLES & ENGINE PERFORMANCE **10+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, critical pressure ratio - Impulse and reaction principles, compounding, velocity diagrams for simple turbines, speed regulations – governors.

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**

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:60 Hrs**

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, Fifth edition, 2002.
3. Arora, C.P., “Refrigeration and Air conditioning”, Tata Mc-Graw-Hill Publishers 2007.
4. Ganesan.V., “Internal Combustion Engines”, Third edition, Tata McGraw-Hill 2007.

L	T	P	C
3	0	0	3

U14ME*T*504 COMPUTER AIDED DESIGN AND MANUFACTURING

Course outcomes

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

CO 1: Explain the basic concept of a CAD system and

CO 2: Discuss different types of geometrical modeling.

CO 3: Demostrate the concept of parametric design for mechanical assembly.

CO 4: Discuss the various part programming for different operations in CNC machines.

CO 5: Understand and explain post processing commands

Pre-requisite:

1. 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											
CO2					S							
CO3			S									
CO4		S										
CO5					S							

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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: 9 Hrs

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:45 Hrs**

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.

L	T	P	C
3	0	0	3

U14ME*T*505 INSTRUMENTATION AND CONTROL ENGINEERING

Course outcomes

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

CO 1: Discuss the general concepts of measurements systems
CO 2: Calculate measurement of displacement, force, torque and speed
CO 3: Discuss the measurement of temperature, pressure, flow and vibration
CO 4: Explain control systems and transfer functions
CO 5: Discuss polar and bode plots

Pre-requisite:

1. U14MET402- Engineering Metrology and Quality Control

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											
CO2		S										
CO3	M											
CO4		S										
CO5		S										

Course Assessment methods:

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

GENERAL CONCEPTS OF MEASUREMENT SYSTEM 7 Hrs

Introduction – functional elements of measurement system – classification – static characteristics of instruments – errors in measurements – calibration. Transduction principles: resistive, capacitive, inductive, piezo-electric, photo-voltaic, thermo-electric, magnetic, ultrasonic and pneumatic.

MEASUREMENT OF DISPLACEMENT, FORCE, TORQUE AND SPEED 9 Hrs

Measurement of displacement: Potentiometer, LVDT, capacitive and digital transducers. Measurement of Force: Strain gauge, load cells - Measurement of torque - Measurement of Speed: magnetic and optical methods.

MEASUREMENT OF TEMPERATURE, PRESSURE, FLOW AND VIBRATION 9 Hrs

Measurement of temperature: Bi-metallic, thermocouple, RTD, thermistor, pyrometer- Measurement of pressure: deadweight, manometer, elastic elements, McLeod and Pirani gauges - Measurement of flow: hot wire anemometer, magnetic flow meter, ultrasonic meter - Measurement of vibration using accelerometers.

BASICS OF LINEAR CONTROL SYSTEMS **9 Hrs**

Introduction: open and closed loop systems and their elements – Transfer function of elements- Modeling of physical systems: Mechanical systems: Translational, rotational, hydraulic and heat transfer- Analogy with electrical systems- Block diagram reduction algebra, signal flow graphs.

TIME AND FREQUENCY DOMAIN ANALYSIS **11 Hrs**

Time response of second order systems - Frequency domain specifications- Correlation between time and frequency response of 2^{nd} order systems- stability analysis using Polar and Bode plots.

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

REFERENCES:

1. Ernest O.Doeblin, "Measurement systems applications and design", McGraw Hill International editions, 2001.
2. Katsuhiko Ogata **,** **"**Modern Control Engineering", 5th Edition, Prentice Hall of India Pvt. Ltd, 2010.
3. J.P. Holman, "Experimental Methods for Engineers", Tata McGraw-Hill, 2004.
4. Williams Bolton, "Instrumentation and control, Elsevier Ltd, 2004.
5. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes Publishers, 2000.

L	T	P	C
3	0	0	3

U14MC*T*507 MECHATRONICS

Course outcomes

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

CO 1: Explain mechatronics design process and adaptive control systems
CO 2: Explain overview of signal conditioning.
CO 3: Discuss the working of various actuators.
CO 4: Discuss the architecture of microprocessors.
CO 5: Discuss the various case studies.

Pre-requisite:

1. 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											
CO2	M											
CO3	M											
CO4	M											
CO5					S							

Course Assessment methods:

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

INTRODUCTION TO MECHATRONICS **7 Hrs**

Introduction to Mechatronics – Conventional and Mechatronics approach in designing products – Mechatronics design process - Mechatronics in Manufacturing – Adoptive and distributed control systems – Modeling and simulation of mechatronics systems.

SIGNAL CONDITIONING **4 Hrs**

Over view of signal conditioning: Amplifiers, Construction of Instrumentation amplifier- Filters- Analog to Digital converters- Digital to Analog converters.

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 – Peripheral Interfacing- Basic instruction set – simple programs- Programming to interface temperature, level, pressure and flow sensors.

PROGRAMMING LOGIC CONTROLLERS **13 Hrs**

Architecture of Programmable Logic Controllers – Input/Output modules – programming methods – arithmetic instructions- logic instruction set- data manipulation- program subroutines -Timers and counters – Master control – Branching – Analog input/output – Selection of PLC and troubleshooting.

CASE STUDIES **3 Hrs**

Pick and place robot – Automatic Car Park Systems – Automatic Camera – Automatic Washing Machine - Engine Management Systems.

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

REFERENCES:

1. Bolton, W. "Mechatronics", Pearson Education, 4th Edition, 2008.
2. 'Mechatronics', HMT Ltd., Tata McGraw Hill Publication Co. Ltd., New Delhi, 5th Edition, 2009.
3. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2005.
4. Ramachandran, K.P., Vijayaraghavan, G.K.and Bala Sundaram, M.S. "Mechatronics: Integrated Mechanical Electronic System" Wiley India Pvt Ltd.
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 (Indian Reprint).
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 International Publisher,2008.

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0	0	2	1

U14ME*P*501 MECHANISMS AND DYNAMICS LABORATORY

Course outcomes

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

CO 1: Construct characteristic curve for governor and profile of cam.
CO 2: Manipulate the gyroscopic couple and moment of inertia for a given application.
CO 3: Perform static and dynamic balancing of rotating and reciprocating masses.
CO 4: Measure natural frequency of forced and free vibrations.
CO 5: Explain the working of simple bar and link mechanisms.

Pre-requisite:

1. U14MET404- 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
CO1			M									
CO2			M									
CO3			M									
CO4			M									
CO5			W									

Course Assessment methods:

Direct	Indirect
1. Lab Exercices 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:45 Hrs**

L	T	P	C
0	0	2	1

U14ME*P*502 COMPUTER AIDED DESIGN LABORATORY

Course outcomes
After successful completion of the course, the student would be able to
CO 1: Reproduce the various commands using modeling software
CO 2: Describe the assembly module
CO 3: Convert 3D to 2D and 2D to 3 D drawings
CO 4: Create three dimensional models
CO 5: Assemble various machine components like flange coupling and screw jack etc.,

Pre-requisite:
1. 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							
CO2	M											
CO3					S							
CO4					S							
CO5					S							

Course Assessment methods:

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

LIST OF EXPERIMENTS:
1. 3D Surface and solid modeling – protrusion, cut, sweep, draft, loft, blend, rib Editing – Move, Patttern, Mirror, Round, Chamfer
2. Assembly – creating assembly from parts – assembly constraints,
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning
4. Instrumentation to Surface Modeling
5. 3D Modeling of machine elements like Flanged coupling, screw jack, etc.
6. Assembly of 3D model component like Flanged coupling, screw jack, etc.
7. Exploded view of component

Experiments beyond the syllabus to be conducted

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

LIST OF EQUIPMENTS:
Computer System with 17” VGA Color Monitor and Pentium IV,i5 Processor - 30 Nos.
40 GB HDD
512 MB / 1 GB RAM
Color Desk Jet Printer - 1 No.
Software: modeling software (Pro-E,CATIA etc) 30 licenses
In this lab the assessment and evaluation of the student’s outcome is based on the following criterion.

U14ME*P*503 THERMAL ENGINEERING LABORATORY –I

L	T	P	C
0	0	2	1

Course outcomes

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

CO 1: Perform internal combustion engine (Petrol/Diesel) test to measure power, efficiency, fuel consumption and emissions.

CO 2: Measure fuel properties such as viscosity, flash point and fire point.

CO 3: Conduct performance test on reciprocating air compressor.

CO 4: Study the working principle of boiler

CO 5: Explain the concept of CRDI & MPFI engines

Pre-requisite:

1. U14MET401- 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
CO1				W								
CO2				W								
CO3				W								
CO4	M											
CO5	M											

Course Assessment methods:

Direct	Indirect
1. Lab Exercices 2. Model Exam 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. Study on boiler efficiency calculation using indirect method.
10. Performance test on reciprocating air compressor.
11. Study the working principle of Non IBR boiler.
12. Study on CRDI and MPFI engines.

Experiments beyond the syllabus to be conducted

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

SEMESTER VI

L	T	P	C
3	1	0	4

U14ME*T*601 DESIGN OF TRANSMISSION SYSTEMS

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

Course outcomes

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

CO 1: Select suitable belt, chain drives for given applications.
CO 2: Design spur and helical gears.
CO 3: Design bevel and worm gears for power transmission.
CO 4: Decide the layout and design the gear box.
CO 5: Design a cam and clutches for desired applications.

Pre-requisite:

1. U14MET502- 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
CO1			S									
CO2			S									
CO3			S									
CO4			S									
CO5			S									

Course Assessment methods:

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

DESIGN OF FLEXIBL ELEMENTS **9+3 Hrs**

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 + 3 Hrs**

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 and helical gears.

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

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+3 Hrs**

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

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

REFERENCES:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill , 2008.
2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
3. Maitra G.M., Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw-Hill, 2001.
4. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 2004.
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., 2001.
7. Ugural A. C, "Mechanical Design, An Integrated Approach", McGraw-Hill, 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.

L	T	P	C
3	1	0	4

U14ME*T*602 HEAT AND MASS TRANSFER

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

Course outcomes

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

CO 1: Appraise the conduction, convection and radiation mode of heat transfer through various applications.

CO 2: Evaluate heat transfer for forced and free convection applications

CO 3: Calculate the parameters of heat exchangers, condensers and evaporator using LMTD and NTU Methods for various applications.

CO 4: Explain the radiation heat transfer problems.

CO 5: Apply principles of heat and mass transfer to basic thermal engineering systems.

Pre-requisite:

1. U14ME*T*503- Thermal Engineering

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											
CO2			S									
CO3			S									
CO4	M											
CO5			S									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 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 + 4 Hrs**

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 + 3 Hrs**

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 + 1 Hrs**

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:60 Hrs**

REFERENCES:

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, August 2007, Reprint 2008, 3rd edition.
2. Yunus Cengal "Heat and Mass Transfer" Tata McGraw Hill, 3rd edition, 2008.
3. Holman J.P 'Heat Transfer' - Tata Mc Graw Hill, Ninth edition, 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, 2nd edition
7. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, March 2006.

L	T	P	C
3	1	0	4

U14ME*T*603 FINITE ELEMENT ANALYSIS

Course outcomes

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

CO 1: Understand the principles involved in discretization and finite element approach.

CO 2: write finite element equation for simple elements.

CO 3: Apply finite element concepts for solving thermal and solid mechanics problems

CO 4: Solve problems in finite element method adopted for cylinders and other axisymmetric objects.

CO 5: Apply finite element concepts for solving curved boundary problems using ISO parametric elements.

Pre-requisite:

1. U14MA*T*304- Partial Differential Equations and Fourier Analysis

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											
CO2		S										
CO3		S										
CO4		S										
CO5		S										

Course Assessment methods:

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

INTRODUCTION **9 + 3 Hrs**

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 shape functions – Applications to plane trusses- One dimensional steady state conduction heat transfer problems.

TWO DIMENSIONAL CONTINUUM **9 + 3 Hrs**

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 dimensional heat transfer problems

AXISYMMETRIC CONTINUUM **9 + 3 Hrs**

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 CONTINUUM 9 + 3 Hrs

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:60 Hrs**

REFERENCES:

1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education, 3rd Edition, 2002.
2. David V Hutton "Fundamentals of Finite Element Analysis" McGraw-Hill Int. Edition, 2004.
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 International Student Edition, 2005.
5. O.C.Zienkiewicz and R.L.Taylor, "The Finite Element Methods, Vol.1", Butterworth Heineman, 5th Edition, 2000.
6. Logan D.L, 'A first course in the Finite Element Method" Third edition, Thomson Learning, 2002.

L	T	P	C
3	0	0	3

U14GS*T*003 PRINCIPLES OF MANAGEMENT

Course outcomes

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

CO 1: Understand the concepts of management, administration and the evolution of management thoughts.

CO 2: Understand and apply the planning concepts.

CO 3: Analyze the different organizational structures and understand the staffing process.

CO 4: Analyze the various motivational and leadership theories and understand the communication and controlling processes.

CO 5: Understand the various international approaches to management

Pre-requisite:

1. 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	
CO2											S	
CO3											S	
CO4									S	S		
CO5											S	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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. Harold Koontz & Heinz Weihrich, "Essentials of Management – An International perspective", 8th edition. Tata McGraw-Hill, 2009.
6. Charles W.L. Hill and Steven L McShane – Principles of Management, Tata Mc Graw-Hill, 2009.

U14ME*P*601 THERMAL ENGINEERING LABORATORY - II

L	T	P	C
0	0	2	1

Course outcomes

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

CO 1: Perform steady state conduction, free and forced convection experiments.
CO 2: Conduct radiation heat transfer experiment.
CO 3: Study the performance of various types of heat exchangers
CO 4: Study the performance of refrigerator.
CO 5: Study the performance of air conditioner.

Pre-requisite:

1. U14MEP503- Thermal Engineering 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
CO1			W									
CO2			W									
CO3	W											
CO4	W											
CO5	W											

Course Assessment methods:

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

LIST OF EXPERIMENTS:

HEAT TRANSFER 35Hrs

1. Thermal conductivity measurement by guarded plate method.
2. Thermal conductivity of insulation using lagged pipe apparatus.
3. Determination of convective heat transfer coefficient by free convection apparatus.
4. Determination of convective heat transfer coefficient by forced convection apparatus.
5. Heat transfer from pin-fin (natural & forced convection modes).
6. Determination of Stefan-Boltzmann constant.
7. Determination of emissivity of a grey surface.
8. Effectiveness of Parallel/counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING 10Hrs

1. Determination of COP of a refrigeration system.
2. Experiments on air-conditioning system.

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:45 Hrs**

L	T	P	C
0	0	3	1

U14ME*P*602 DESIGN AND ANALYSIS PROJECT

Course outcomes

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

CO 1: Analyze and identify the problems in the mechanical systems.
CO 2: Select and apply proper modern tools.
CO 3: Find solution for problems.
CO 4: Make use of the benefits of team work.
CO 5: Develop drawing, bill of materials and analysis procedures.

Pre-requisite:

1. 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										
CO2					S							
CO3					S							
CO4									S	S		
CO5		M										

Course Assessment methods:

Direct	Indirect
1. Project review 2. Model project viva voce 3. End semester viva voce 4. Project report	Course end survey

The students in convenient groups of not more than five members have to choose one simple item for design. If required, the project team can also have an industrial guide.

The problem chosen may be for a component or a process of mechanical systems.

A proper solution to be proposed by means of model, design and analysis.

The project report should contain detailed drawing, analytical calculations, bill of materials and applications of modern tools where ever applicable.

L	T	P	C
0	0	2	1

U14MC*P*604 MECHATRONICS LABORATORY

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.

Pre-requisite:

1. U14MC*T*506-Mechatronics

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							
CO2					S							
CO3			S									
CO4			W									
CO5			W									

Course Assessment methods:

Direct	Indirect
1. Lab Exercices 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:45 Hrs**

SEMESTER VII

L	T	P	C
3	0	0	3

U14GS*T*002 TOTAL QUALITY MANAGEMENT

Course outcomes

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

CO 1: Understand quality concepts and philosophies of TQM

CO 2: Apply TQM principles and concepts of continuous improvement

CO 3: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality

CO 4: Understand the TQM tools as a means to improve quality

CO 5: Remember and understand the quality systems and procedures adopted

Pre-requisite:

1. U14GST005- Principles of Management

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						
CO2												M
CO3					S							
CO4					S							
CO5		M										

Course Assessment methods:

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

INTRODUCTION **9 Hrs**

Definition of Quality, Dimensions of Quality, Quality costs, Basic concepts of Total Quality Management, Role of Senior Management, Quality Council, Quality Statements, Barriers to TQM Implementation, Principles of TQM, Contributions of Deming, Juran and Crosby

TQM PRINCIPLES **9 Hrs**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement,5S, Kaizen, Supplier Partnership, Performance Measures – Basic Concepts, Strategy.

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, Process capability, Concept of six sigma.

TQM TOOLS **9 Hrs**

Benchmarking, Quality Function Deployment (QFD), 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. Besterfiled, "Total Quality Management", Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.
2. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 2007.
3. James R.Evans & William M.Lidsay, "The Management and Control of Quality", South-Western (Thomson Learning), 2008.
4. Feigenbaum.A.V. "Total Quality Management", McGraw Hill, 2001.
5. Oakland.J.S. "Total Quality Management", Butterworth – Hcinemann Ltd., Oxford. 2004.
6. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 2000.

L	T	P	C
3	0	0	3

U14GS*T*004 OPERATIONS RESEARCH

Course outcomes

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

CO 1: Apply linear programming model and assignment model to domain specific situations

CO 2: Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results

CO 3: Apply the concepts of PERT and CPM for decision making and optimally managing projects

CO 4: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

CO 5: Analyze the inventory and queuing theories and apply them in domain specific situations.

Pre-requisite:

1. 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											
CO2		S										
CO3											S	
CO4											S	
CO5											S	

Course Assessment methods:

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

LINEAR MODEL **9 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 MODELS **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, Sixth Edition, 2003
2. Hira and Gupta "Introduction to Operations Research", S.Chand and Co.2002
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, Second Edition, 2004

U14GS*T*005 ENGINEERING ECONOMICS AND FINANCIAL 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: Evaluate the economic theories, cost concepts and pricing policies

CO 2: Understand the market structures and integration concepts

CO 3: Understand the measures of national income, the functions of banks and concepts of globalization

CO 4: Apply the concepts of financial management for project appraisal

CO 5: Understand accounting systems and analyze financial statements using ratio analysis

Pre-requisite:

1. 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	
CO2											M	
CO3						M						
CO4											S	
CO5											S	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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. Financial Management & Policy -*J*ames C. Van Horne
6. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain
7. Management Accounting Principles & Practice -P. Saravanavel.

U14GST007 PROFESSIONAL ETHICS

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 ethical theories and concepts
CO 2: Discuss an engineer's work in the context of its impact on society
CO 3: Explain and analyze the concepts of safety and risk
CO 4: Review the professional responsibilities and rights of Engineers
CO 5: Explain the concepts of ethics in the global context.

Pre-requisite:

1. U14GHP401-Human Excellence Global Values

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				
CO2						M	M					
CO3						S						
CO4						S	M					
CO5								S				

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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.

U14ME*P*701 COMPUTER AIDED SIMULATION AND ANALYSIS 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: Demonstrate stress analysis of various mechanical components using analysis software.
CO 2: Perform modal analysis for 2D component.
CO 3: Analyze thermal stresses in a component.
CO 4: Simulate mechanical systems using CAD software.
CO 5: Simulate flow using CFD software

Pre-requisite:

1. U14MEP502-Computer Aided Design 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
CO1					M							
CO2					M							
CO3					S							
CO4					M							
CO5					M							

Course Assessment methods:

Direct	Indirect
1. Lab Exercices 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

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

LIST OF EQUIPMENTS:

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

L	T	P	C
0	0	6	2

U14ME*P*702 PROJECT WORK-PHASE I

Course outcomes

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

CO 1: Identify a problem in mechanical engineering field through literature survey.
CO 2: Construct a design to overcome its problems
CO 3: Make use of analysis, to confirm the identity
CO 4: Predict motion/heat transfer using simulation tools.
CO 5: Select the optimum design

Pre-requisite:

1. U14ME*P*602- Design and Analysis Project

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
CO2			S			M	M					
CO3				S	S			M				
CO4					S							
CO5			S	S								

Course Assessment methods:

Direct	Indirect
1. Project review 2. Model project viva voce 3. End semester viva voce 4. Project report	Course end survey

- The objective of the Project Work –Phase I is to enable the students to identify a problem in mechanical engineering field using literature survey / industry survey. The project work can be a innovative, improvement of existing system in the mechanical engineering/interdisciplinary area and may include design, experimentation, fabrication and 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 the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in 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.

U14ME*P*703 COMPUTER AIDED MANUFACTURING 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: Write manual part programming for a component in CNC Lathe

CO 2: Write part programmes manually for a component in CNC Milling machine.

CO 3: Write part programming for a component and also standard canned cycle for different turning and milling operations.

CO 4: Develop CAD models, CL data and NC Code using CAD/CAM Software.

CO 5: To demonstrate the operations of a robot.

Pre-requisite:

1. U14MET504- Computer Aided Design and Manufacturing

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							
CO2					M							
CO3					M							
CO4					S							
CO5					S							

Course Assessment methods:

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

LIST OF EXPERIMENTS:

1. Manual part programming (Using G and M Codes) in CNC lathe
   Part programming for Linear and Circular interpolation, Chamfering and Grooving
   Part programming using standard canned cycles for Turning, Facing, Taper turning and Thread cutting.
2. Manual part programming (using G and M codes) in CNC milling
   2.1 Part programming for Linear and Circular interpolation and Contour motions.
   2.2 Part programming involving canned cycles for Drilling, Peck drilling, andBoring.
3. Exposure to Component Modeling and CL data generation using CAD/CAM Softwarelike Unigraphics, Pro/E, Edge CAM, Master CAM, etc.,
   NC code generation using CAD/CAM software-Post processing for standard CNC control like FANUC, HAAS, SINUMERIC etc.,
4. Study on machining centre (VMC/HMC)
5. Study on 3D Printing
6. Demonstration on operation of Robot.

Experiments beyond the syllabus to be conducted

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

HARDWARE:

1. Computer Server 1
2. Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server – 30 Nos
3. A3 size plotter 1
4. Laser Printer 1
5. Trainer CNC Lathe 1
6. Trainer CNC milling 1

SOFTWARE:

7. CAD/CAM software 15 licenses
8. CAM Software (CNC Programming and tool path simulation for FANUC / Sinumeric and Heiden controller) - 15 licenses
9. Licensed operating system Adequate

SEMESTER VIII

L	T	P	C
0	0	18	6

U14ME*P*801 PROJECT WORK-PHASE II

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: Identify the process the fabrication / manufacturing.
CO 4: Experiment of the model developed.
CO 5: Summarize the results and submit a report.

Pre-requisite:

1. U14MEP702- Project Work-Phase 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
CO1		S										
CO2		S										
CO3		S										
CO4				M					M			
CO5				S						S	M	

Course Assessment methods:

Direct	Indirect
1. Project review 2. Model project viva voce 3. End semester viva voce 4. Project report	Course end survey

- Create a model/fabricate a model/conduct experiment/simulate system 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.

U14ME*T*E60 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: Recognize different solid state and beam welding processes.
CO 2: Illustrate the working of electro slag welding and plasma arc welding.
CO 3: Solve problems in testing and design of weldments.
CO 4: Explain the special features of plasma arc welding processes
CO 5: Understand and explain the procedure for design and testing of weldment

Pre-requisite:

1. U14MET305- 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
CO1		S										
CO2		S										
CO3			S									
CO4		M										
CO5			S									

Course Assessment methods:

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

SOLID STATE WELDING PROCESSES **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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:45 Hrs**

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.

L	T	P	C
3	0	0	3

U14ME*T*E61 LEAN MANUFACTURING

Course outcomes

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

CO 1: Explain various concepts of lean manufacturing
CO 2: Discuss lean manufacturing tools and methodologies
CO 3: Describe group technology and Just in time manufacturing process
CO 4: Draw value stream mapping for given manufacturing setup.
CO 5: implementation tools in lean manufacturing

Pre-requisite:

1. 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										
CO2		M										
CO3		M			M							
CO4		S										
CO5		W										

Course Assessment methods:

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

INTRODUCTION AND LEAN MANUFACTURING CONCEPTS 11Hrs

Objectives of lean manufacturing-key principles and implications of lean manufacturing-Traditional Vs lean manufacturing – Lean benefits. Value creation and waste elimination- Major kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement / Kaizen- Worker involvement.

LEAN MANUFACTURING TOOLS & METHODOLOGIES 10Hrs

Standard work -communication of standard work to employees -standard work and flexibility – visual controls-quality at the source- 5S principles -preventive maintenance-total quality management-total productive maintenance -changeover/setup time -batch size reduction.

GROUP TECHNOLOGY AND JUST IN TIME MANUFACTURING 9 Hrs

Part family- Production flow analysis – Composite part concept – Machine cell design -Case studies. Introduction to JIT- elements of JIT - Kanban system.

VALUE STREAM MAPPING **8 Hrs**

The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -poke yoka- Kanban – overall equipment effectiveness.

IMPLEMENTING LEAN AND RECONCILING LEAN WITH OTHER SYSTEMS 7 Hrs

Road map-senior management Involvement-best practices. Toyota production system-lean six sigma-lean and ERP-lean with ISO9001: 2000

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

REFERENCES:

1. Michael L George, David T Rowlands, Bill Kastle, “What is Lean Six Sigma”, McGraw-Hill, New York, 2004.
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, 2002.
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 Chase F. Robert Jacobs and Nicholas J Aquilano, “Operations Management for Competitive Advantage”, McGraw Hill/Irwin; Tenth Edition, 2003.
7. Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 2004.
8. Alan Robinson “Continuous Improvement in Operations”, Productivity Press, Portland, Oregon, 2003.

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U14ME*T*E62 MARKETING MANAGEMENT

Course outcomes

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

CO 1: Understand and explain marketing philosophies.
CO 2: Classify markets and list factors influencing buyer behavior
CO 3: Analyze methods of pricing and describe marketing research process.
CO 4: Understand the importance of portfolio analysis in market planning.
CO 5: Discuss role of media in marketing management

Pre-requisite:

1. U14GST003-Principles of Management

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											
CO2		M										
CO3		S										
CO4		S										
CO5		S			M					M		

Course Assessment methods:

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

MARKETING PROCESS **10 Hrs**

Definition, Marketing process, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, marketing organizations, industrial versus consumer marketing, product hierarchy.

BUYER BEHAVIOUR AND MARKET SEGMENTATION **8 Hrs**

Cultural, demographic factors, motives, types, buying decisions, customer value and loyalty, segmentation factors - demographic -Psycho graphic and geographic segmentation.

PRODUCT PRICING AND MARKETING RESEARCH **9 Hrs**

Definition, Objectives, pricing, decision frame work, pricing methods, price sensitivity. Introduction, uses, process of marketing research, marketing information systems – Data mining & ware housing.

MARKETING PLANNING **9 Hrs**

Market opportunity, Components of marketing plan, product market selection, the marketing planning process, portfolio analysis, BCG, GEC grids, strategic planning process.

ADVERTISING, SALES PROMOTION AND DISTRIBUTION **9 Hrs**

Introduction to advertising, Factors in audience pervasions, decisions, role of media. Significance of sales promotion, planning sales promotion programmes, types. Marketing channels, channel design, wholesaling, retailing, modern trends in retailing.

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

REFERENCES:

1. Rajan Saxena, "Marketing Management", Tata Mc-graw Hill, 3rd edition, 2006.
2. Ramasamy and Nama kumari, "Marketing Environment: Planning, implementation and control the Indian context" Macmillan 4 edition, 2009.
3. Philip Kotler and Gary Armstrong "Principles of Marketing" – 12th Edition, Prentice Hall of India, 2008.
4. Green Paul, Donald Tull and Albaum, "Research for marketing decisions", 5th Edition Prentice Hall of India, 2008

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U14ME*T*E63 FLUID POWER SYSTEMS

Course outcomes

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

CO 1: Understand and explain the fundamentals of fluid power systems
CO 2: Explain the working of hydraulic control devices
CO 3: Construct hydraulic circuits for industrial applications
CO 4: Explain the working of pneumatic components
CO 5: Construct pneumatic circuits

Pre-requisite:

1. U14MET301-Fluid Mechanics and 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
CO1	S											
CO2		S										
CO3			S									
CO4		M										
CO5			S									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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 valve , check valve – pressure control valve – Simple pressure relief valve, pressure reducing valve, pressure sequencing 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 :45 Hrs 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, 2003.
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, 2004.
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.

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U14ME*T*E64 REFRIGERATION AND AIR CONDITIONING

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

Course outcomes

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

CO 1: Analyze vapour compression and absorption refrigeration system.
CO 2: Select the components and refrigerants for specific applications.
CO 3: Understand and explain the various terminologies involved in psychrometric process.
CO 4: Estimate cooling load calculations for various air-conditioning systems.
CO 5: Demonstrate the various types of air conditioning systems

Pre-requisite:

1. U14MET602-Heat and Mass Transfer

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										
CO2	S											
CO3	M											
CO4			S									
CO5			W									

Course Assessment methods:

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

REFRIGERATION CYCLE **9 Hrs**

Thermodynamic principles of refrigeration - Concept of Aircraft refrigeration system (Elementary Treatment only) - Vapour compression refrigeration cycle - use of P-H charts - Vapor absorption refrigeration system - Ammonia water and Lithium Bromide water systems - Steam jet refrigeration system, COP comparison.

REFRIGERANTS AND SYSTEM COMPONENTS **9 Hrs**

Compressors and its types (elementary treatment.) - Condensers – Thermostatic expansion devices - evaporators - cooling towers. Refrigerants - properties - selection of refrigerants, Alternative Refrigerants, charging of refrigeration units - Applications to refrigeration systems - ice plant - food storage plants - milk -chilling plants – refrigerated cargo ships.

PSYCHROMETRY **9 Hrs**

Psychometric processes - Grand and Room Sensible Heat Factors - bypass factor - requirements of comfort air conditioning and types - comfort charts - factors governing optimum effective temperature - Use of psychometric charts.

COOLING LOAD CALCULATIONS **9 Hrs**

Types of load - design of space cooling load - heat transfer through building. Solar radiation - infiltration - internal heat sources (sensible and latent) - outside air and fresh air load - estimation of total load - Domestic, commercial and industrial system.

AIRCONDITIONING **9 Hrs**

Air conditioning equipments – air cleaning and air filters - humidifiers - dehumidifiers - air washers - condenser – cooling tower and spray ponds - elementary treatment of duct design-Air distribution systems, Window, Split type and central air conditioning systems, applications: automobiles, industry, stores, and public buildings

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

REFERENCES:

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

U14ME*T*E65 VIBRATIONS AND NOISE CONTROL

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Course outcomes

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

CO 1: Apply their knowledge, skills to develop mathematical models for single DOF system with or without damping.

CO 2: Model the free of forced vibration absorbs,

CO 3: Solve problems in multi degrees of freedom systems.

CO 4: Measure the vibration using instruments for analysis.

CO 5: Discuss about noise and its control.

Pre-requisite:

1. U14ME*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
CO1		S										
CO2		S										
CO3		S										
CO4		M										
CO5	M											

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

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”, Dorling kindesley (india) Pvt.Ltd. Licensess
3. of pearson education in south asia, delhi-110092
4. Rao, S.S.,” Mechanical Vibrations,” Printice hall, 2011.
5. Den Hartog, J.P, “Mechanical Vibrations,” Read books, 2008.
6. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa, New Delhi, 2000.
7. William.w.Seto, “Theory and problems of Mechanical Vibrations,”Schaum Outline Series, Mc Graw Hill Inc., Newyork,1990

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U14ME*T*E66 UNCONVENTIONAL MACHINING PROCESS

Course outcomes

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

CO 1: Select appropriate advanced materials processes for a given product or component recognising material, size, precision, and surface quality requirements.

CO 2: Discuss the working principles and equipments of ultrasonic machining and abrasive jet machining

CO 3: Outline the fundamentals of EDM and wire cut EDM processes

CO 4: Understand and explain the working of ECM Processes and solve simple problems.

CO 5: Discuss about radiant energy processes.

Pre-requisite:

1. U14MET305- 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
CO1		M										
CO2		M										
CO3		M										
CO4		M										
CO5		M										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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 PROCESSES 9 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:45 Hrs**

REFERENCES:

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2002, ISBN 81-7764-294-4.
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 (8^{th} Edition), 2001: ISBN – 81-203-1243-0.
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

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U14ME*T*E67 GAS DYNAMICS AND JET PROPULSION

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

Course outcomes

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

CO 1: Know the differences between compressible and incompressible flows.
CO 2: Study the behavior of flow through variable area
CO 3: Solve problems in Rayleigh and Fanno flow.
CO 4: Understand and explain the concept of normal and oblique shock
CO 5: Understand the knowledge about the rocket propulsion and various propellants.

Pre-requisite:

1. U14MET401-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
CO1	W											
CO2	M											
CO3		M										
CO4		M										
CO5		M										

Course Assessment methods:

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

COMPRESSIBLE FLOW – FUNDAMENTALS **8+2 Hrs**

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.

FLOW THROUGH VARIABLE AREA DUCTS **9 + 3 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.

FLOW THROUGH CONSTANT AREA DUCTS **9 + 3 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.

NORMAL SHOCK **10+4 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.

PROPULSION **9 + 3 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.

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

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.

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U14ME*T*E68 TOOL ENGINEERING DESIGN

Course outcomes

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

CO 1: Select suitable cutting tool for machining process.
CO 2: Design tools and holding for CNC applications.
CO 3: Explain the construction of jigs and fixtures.
CO 4: select suitable presses and tools.
CO 5: Apply suitable molding for the design of die components.

Pre-requisite:

1. U14MET504- Computer Aided Design and Manufacturing

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										
CO2			S									
CO3		M										
CO4		M	M									
CO5			S									

Course Assessment methods:

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

CUTTING TOOLS **9 Hrs**

Materials-properties, classification, selection, insert and coated tools, tool wear, tool life. Recent developments and applications.

SINGLE POINT TOOLS **9 Hrs**

Nomenclature, types and styles, design and manufacture of HSS and carbide insert type tools for turning, boring, shaping, planning and slotting operations. Design of form tools. Tools and holders for CNC applications, tools for dry machining.

MULTIPOINT CUTTERS:

Nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, taps, dies, thread chasers, milling cutters, broaches, hobs and gear shaper cutters. Grinding-wheel specification and selection.

JIGS **9 Hrs**

Degrees of freedom, principles of location and clamping, principles of jig design, fool proofing, elements of jigs, classification of jigs, design of jigs for drilling and reaming.

FIXTURES:

Principles of fixture design, locators and different types of clamps, elements of fixtures, provision for tool setting, design of fixtures for milling, turning, boring and grinding operations. Fixtures for turning centers and machining centers. Modular fixturing-concepts and applications.

PRESS TOOLS **9 Hrs**

Design and manufacture of die sets for sheet metal components-simple, compound and progressive dies for punching and blanking operations. Dies for drawing and bending operations. Selection of presses and tools.

DESIGN OF INJECTION MOULDING AND DIE CASTING DIES **9 Hrs**

Product and mould, thermal considerations, design of two plate mould, runner and gate design, mould cooling and ejection, analysis of mould flow.

SPECIAL TOOLS:

Design of limit gauges. Tool maintenance and planning.

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

REFERENCES

1. Arshinov V and Alekseev G, "Metal cutting Theory and Cutting Tool Design", MIR Publishers, Moscow, 2004.
2. Donaldson C and LeCain C H, "Tool Design", Tata McGraw Hill Publishing Company Ltd.,New Delhi, 2004-2008.
3. Bhattacharyya A, “Metal Cutting Theory and Practice”, New Central Books Agency (P) Ltd, Calcutta, 2000-2008.
4. Cracknell P C and Dyson R W, “Handbook of Thermoplastics Injection Mould Design”, Chapman and Hall, 2002.
5. Mikell P Groover, “Fundamentals of Modern Manufacturing”, John Wiley and Sons, Singapore, 2004-2008.
6. SME, "Manufacturing Engineers Hand Book", 2001.
7. Kempster, "Introduction to Jig and Tool Design", VIVA Books, New Delhi, 2000.
8. Rodin P, "Design and Production of Metal cutting Tools", MIR Publishers, Moscow, 1968.

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U14ME*T*E69 COMPOSITE MATERIALS

Course outcomes

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

CO 1: Explain the various types of composites and its fabrication techniques.
CO 2: Discuss the applications of metal matrix composites.
CO 3: Explain the production and applications of ceramic matrix composites.
CO 4: Know different types of fibres and fibre composites
CO 5: Discuss about advanced composite fabrication techniques

Pre-requisite:

1. U14MET302- Engineering Materials and Metallurgy

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											
CO2	S											
CO3	S											
CO4	M											
CO5	S											

Course Assessment methods:

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

INTRODUCTION TO COMPOSITES **9 Hrs**

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.

METAL MATRIX COMPOSITES **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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).

ADVANCES IN COMPOSITES **9 Hrs**

Carbon /Carbon composites – Advantages of carbon matrix – Limitations of carbon matrix Carbon fibre – Chemical Vapour Deposition (CVD) of carbon on carbon fibre perform. Sol - gel technique.

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

REFERENCES:

1. Mathews F.L. and Rawlings R.D., "Composite materials: Engineering and Science", Chapman and Hall, London, England, 1st edition, 2006.
2. Chawla K.K., "Composite materials" Springer –Verlag, (1987), 3rd edition, 2008.
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.

U14ME*T*E70 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: Outline the fundamentals of production planning and production control.

CO 2: Apply work measurement techniques and methods study procedures for productivity improvement.

CO 3: Extend product information and infer steps in product planning.

CO4: Solve Problems related to production scheduling.

CO5: To discuss the effect of demand on inventories and outline recent trends in production process control

Pre-requisite:

1. U14GST004- Operations Research

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										
CO2		S										
CO3		S										
CO4		M	M									
CO5		M	M									

Course Assessment methods:

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

INTRODUCTION **9 Hrs**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration-Standardization, Simplification & specialization-Break even analysis-Problems-Economics of a new design.

WORK STUDY **9Hrs**

Method study, basic procedure-Selection-Recording of process-Techniques - Critical analysis, Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study- Procedures-equipments-Allowances - Production study - Work sampling - standard data - Predetermined motion time standards.

PRODUCT PLANNING AND PROCESS PLANNING 9Hrs

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity- balancing.

PRODUCTION SCHEDULING 9Hrs

Production Control Systems-Loading-Scheduling-Master production Scheduling-Scheduling rules-Gantt charts-Basic scheduling problems-Job shop scheduling-Batch production scheduling-Line of balance - Dispatching and expediting– functions and types- Manufacturing lead time.

INVENTORY CONTROL AND RECENT TRENDS IN PPC 9Hrs

Inventory control - Purpose of holding stock - Effect of demand on inventories- Ordering procedures. Two bin system - Ordering cycle system - Determination of Economic order quantity and economic lot size –Selective inventory control policies- ABC analysis

Introduction to computer integrated production planning systems-elements of Just In Time systems-Fundamentals of MRP I- MRP II and ERP.

Theory :45 Hrs Total:45 Hrs

REFERENCES:

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand and Company, Second Edition, 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 Book Corpn.2001
4. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Ed. John Wiley and Sons, 2000.
5. K.C.Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, (1990) reprint 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, 2002.

U14ME*T*E71 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: Identify the manufacturing activities interrelated with computers for plant operations

CO 2: Understand the concept of Group Technology and the various approaches of Computer Aided Process Planning.

CO 3: Explain the phases of shop floor control activities

CO 4: Apply the system modeling tools in CIM and the fundamental concepts of data communications.

CO 5: Explain the applications of database and system protocol.

Pre-requisite:

1. U14MET504- Computer Aided Design and Manufacturing

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							
CO2					S							
CO3		M			M							
CO4					S							
CO5					S							

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

REFERENCES:

1. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education, 3rd Edition, July 2007.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition 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.

U14ME*T*E72 INDUSTRIAL SAFETY 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: Describe the functions and activities of safety engineering department

CO 2: Apply ergonomics for safety working environment and to apply operational safety for various manufacturing operations

CO 3: Express the level of safety in industries

CO 4: Describe the method of preventing accidents to humans and to provide first aid and accident reports

CO 5: Test out safety standards and requirements mentioned in factory act for accident prevention

Pre-requisite:

1. 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										
CO2		M										
CO3		M										
CO4		M										
CO5		M										

Course Assessment methods:

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

SAFETY MANAGEMENT **9 Hrs**

Evaluation of modern safety concepts - Safety management functions - safety department – safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

ERGONOMICS AND OPERATIONAL SAFETY **9 Hrs**

Introduction to Ergonomics – areas of applications – Anthropometry and it uses in ergonomics – principles of applied Anthropometry in ergonomics. Hot metal and Cold metal Operation - Boiler, pressure vessels –heat treatment shop - gas furnace operation - electroplating- Safety in welding and cutting. Safety in Machine shop - metal cutting - shot blasting, grinding, painting - power press and other machines.

SAFETY MEASURES **9 Hrs**

Layout design and material handling various classes of Fires – ABCDE, fire extinguishers - Use of electricity - Management of toxic gases and chemicals - Industrial fires and prevention - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries. Control of major industrial hazards.

ACCIDENT PREVENTION **9 Hrs**

Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes, training methods - Specific hazard control strategies - HAZOP - Training and development of employees - First Aid- Accident reporting, investigation.

SAFETY, HEALTH, WELFARE & LAWS **9 Hrs**

Safety and health standards - Industrial hygiene - occupational diseases prevention - Welfare facilities - History of legislations related to Safety- Indian boiler act - The environmental protection act - Electricity act - Explosive act – Factories act 1948 – statutory authorities.

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

REFERENCES:

1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travellers bookseller, New Delhi- 5th edition 2001.
2. Krishnan N.V., “Safety in Industry", Jaico Publisher House, 2005.
3. Occupational Safety Manual BHEL, 1988.
4. Industrial safety and the law by P.M.C. Nair Publisher's, Trivandrum, 2004.
5. Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 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, 5th edition 2009.
8. R.K. Mishra, “Safety Management”, AITBS publishers, 2012.

U14ME*T*E73 **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: Understand method study and their applications
CO 2: Identify the different work measurement techniques
CO 3: Classify the incentive schemes
CO 4: Discuss about the man and machine system
CO 5: List various types of displays

Pre-requisite:

1. 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										
CO2		M										
CO3		M										
CO4		M										
CO5		M										

Course Assessment methods:

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

METHOD STUDY **9 Hrs**

purpose of work study, its objectives, procedure & applications; method study definition & basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, simo,cyclo-graphs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.

WORK MEASUREMENT **9 Hrs**

Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; time study: basic procedure, equipments needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be timed; rating and methods of rating, allowances, calculation of standard time. Work sampling: Basic procedure, design of work sampling study conducting work sampling study and establishment of standard-time.

JOB EVALUATION AND INCENTIVE SCHEMES **9 Hrs**

Starlight line, Tailor, Merrick and Gantt incentive plans Standard data system; elemental & non-elemental predetermined motion system, work factors system; Methods Time Measurement (MTM), MOST.

HUMAN FACTOR ENGINEERING **9 Hrs**

Definition and history of development of human factors engineering, types &characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing: Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.

DISPLAY SYSTEMS AND ANTHROPOMETRIC DATA **9 Hrs**

Display- types of visual display, visual indicators and warning signals; factorial and graphic display; general principles of auditory and tactral display, characteristics and selection.

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

REFERENCES:

1. ILO; work-study; International Labour Organization
2. Khan MI; Industrial Ergonomics; PHI Learning
3. Barrnes RM; Motion and Time Study; Wiley pub
4. Megaw ED; Contenmprory ergonomics; Taylor & fracis
5. Sandera M and Mc Cormick E; Human Factors in Engg and design; MGHill
6. Currie RM; Work study; BIM publications

U14ME*T*E74 ADVANCED MECHANICS OF SOLIDS

L	T	P	C
3	0	0	3

Course outcomes

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

CO 1: Solve problems in stresses and strains and draw shear force and bending moment diagrams.

CO 2: Solve and draw the shear force and bending moments.

CO 3: Discuss the theory of flexural stresses and simple bending.

CO 4: Analyze pin joint frames and shear stress distribution across various beam section.

CO 5: Solve problems in deflection of beams and cylindrical shell using macaulay methods, mohr's theorem.

Pre-requisite:

1. U14MET303- 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
CO1	S											
CO2	S											
CO3		M										
CO4		S										
CO5		S										

Course Assessment methods:

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

SIMPLE STRESSES & STRAINS **9 Hrs**

Simple Stresses & Strains-Elasticity and plasticity Types of stresses & strains, Hooke's law stress strain diagram for mild steel, working stress, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain, Elastic moduli & the relationship between them, Bars of varying section, composite bars, Temperature stresses. Strain energy , Resilience , Gradual, sudden, impact and shock loadings.

SHEAR FORCE AND BENDING MOMENT **9 Hrs**

Shear Force and Bending Moment- Definition of beam , Types of beams , Concept of shear force and bending moment , S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., uniformly varying loads and combination of these loads ,Point of contra flexure , Relation between S.F., B.M and rate of loading at a section of a beam.

THEORY OF SIMPLE BENDING **9 Hrs**

Flexural Stresses-Theory of simple bending ,Assumptions , Derivation of bending equation: M/I = f/y = E/R Neutral axis , Determination bending stresses , section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections, Design of simple beam sections.

ANALYSIS OF PIN-JOINTED PLANE FRAMES **9 Hrs**

Shear Stresses- Derivation of formula ,Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

Analysis of Pin-Jointed Plane Frames- Determination of Forces in members of plane, pin jointed, perfect trusses by (i) method of joints and (ii) method of sections. Analysis of various types of cantilever& simply ,supported trusses-by method of joints, method of sections & tension coefficient methods.

DEFLECTION OF BEAMS AND CYLINDRICAL SHELL **9 Hrs**

Deflection of Beams- Bending into a circular arc ,slope, deflection and radius of curvature, Differential equation for he elastic line of a beam , Double integration and Macaulay methods, Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems , Moment area method , application to simple cases including overhanging beams.

Cylinders-Thin seamless cylindrical shells , Derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetric strains , changes in dia, and volume of thin cylinders, Riveted boiler shells, thin spherical shells. Thick cylinders, Lame's equation , cylinders subjected to inside & outside pressures , compound cylinders.

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

REFERENCES:

1. Bruhns, O. T Advanced mechanics of solids: Springer.
2. Cook, R. D., & Young, W. C. Advanced mechanics of materials: Macmillan,2001.
3. Ugural, A. C., & Fenster, S. K. Advanced strength and applied elasticity: PTR Prentice Hall.
4. Hartog, J. P. D. Advanced strength of materials: Dover Publications.
5. Boresi, A. P., Schmidt, R. J., & Sidebottom, O. M. Advanced Mechanics of Materials: John Wiley,2003
6. Solecki, R., & Conant, R. J. Advanced mechanics of materials: Oxford University Press.
7. L. S. Srinath. Advanced mechanics of solids-Tata McGraw-Hill education 2009

L	T	P	C
3	0	0	3

U14ME*T*E75 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

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

Course outcomes

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

CO 1: List the types of jigs and fixtures and explain its functions.
CO 2: Design and develop various types of jigs for given components.
CO 3: Design and develop various types of fixture for given components.
CO 4: Illustrate the working of press tools and solve problems in strip layout.
CO 5: Design and develop various types of press tool dies.

Pre-requisite:

1. 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											
CO2			S									
CO3			S									
CO4		M										
CO5			S									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

REFERENCES:

1. Edward G Hoffman, “Jigs & Fixture Design”, Thomson – Delmar Learning, Singapore 2010.
2. Donaldson. C, “Tool Design”, Tata McGraw-Hill, 2008.
3. Kempster, “Jigs & Fixtures Design”, The English Language Book Society”, 1978.
4. Joshi, P.H., “Jigs & Fixtures”, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2010.
5. Hiram E Grant, “Jigs and Fixture” Tata McGraw-Hill, New Delhi, 2003.
6. “Fundamentals of Tool Design”, CEEE Edition, ASTME, 1983.
7. PSG Design Data –Faculty of mechanical engineering, PSG College of Technology, Coimbatore.

U14ME*T*E76 DESIGN AND OPTIMIZATION

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 appropriate optimization algorithms for a problem.

CO 2: Interpret advanced optimization methods and tools.

CO 3: Summarize the basic principles of common optimization algorithms.

CO 4: Evaluate optimization techniques for optimum selection of materials & processes in mechanical design.

CO 5: Build applications by employing industrial design principles & optimization tools.

Pre-requisite:

1. U14GST004- Operations Research

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										
CO2				S	M							
CO3		M										
CO4				S	S							
CO5				S	S							

Course Assessment methods:

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

INTRODUCTION **9 Hrs**

Introduction to Optimum design. Introduction to detail design optimization by simulation, prototyping and optimum. Selection of configuration, materials and processes.

OPTIMIZATION APPROACH **9 Hrs**

Optimization approach-Classical mathematical methods of optimization. Mechanical System Design problem-economic political environment, issues of human safety & welfare, and professional ethics.

OPTIMIZATION METHODS **9 Hrs**

Optimum mechanical design concepts. Overview and application of optimization methods to machine elements and mechanical system design. Prototyping, simulation, and use of standards for detail design optimization.

OPTIMIZATION TECHNIQUES **9 Hrs**

Optimization techniques- Optimum selection of material & processes in mechanical design using material selection charts and optimisation methods.

APPLICATIONS **9Hrs**

Applications- Optimizing product design functionality, aesthetics and economics by employing industrial design principles and by suitable selection of material & processing including use of polymers, composites and other non metallic materials.

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

REFERENCES:

1. Robert F. RHYDER, Manufacturing Process Design and Optimization, New York: Marcel Dekker, 2000
2. S.S.Rao, Optimization: Theory & Application Wiley Eastern, 2002
3. K. Deb, Optimization for engineering design, Prentice Hall India, 2003
4. J.S.Arora, Introduction to optimum design, McGraw Hill, 2000

U14ME*T*E77 INTRODUCTION TO HUMAN BODY MECHANICS

L	T	P	C
3	0	0	3

Course outcomes

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

CO 1: Define the basics biomechanics of the musculoskeletal system.
CO 2: Label the bio mechanics of tissues-bones-cartilages (composition & structure).
CO 3: Analyze the biomechanics of joints.
CO 4: Categorize motion & gait analysis.
CO 5: Explain the properties & applications of bio-materials.

Pre-requisite:

1. 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										
CO2		S										
CO3		S										
CO4		M										
CO5		M										

Course Assessment methods:

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

BIOMECHANICS **9 Hrs**

Introduction to Biomechanics- Basic terminology and concept of human musculoskeletal system, anatomy and overall function.

BIOMECHANICS OF TISSUES **9 Hrs**

Biomechanics of Tissues- Structures of musculoskeletal system – composition, structure and biomechanical behaviour: bone, articular cartilage, muscle, tendon and ligament.

BIOMECHANICS OF JOINTS **9 Hrs**

Biomechanics of joints-Structure, range of motions, musculoskeletal model of forces: (i) hip; (ii) knee; (iii) shoulder; (iv) elbow; spine. Lubrication of joints.

MOTION AND GAIT ANALYSIS **9 Hrs**

Motion and gait analysis- Method, gait cycle, segmental kinetics, engineering approaches to posture analysis.

JOINT REPLACEMENT AND FRACTURE-FIXATION **9 Hrs**

Joint replacement and fracture-Fixation – stress analysis and basic design approach, failure mechanisms, wear in joint arthroplasty and bone remodeling. Biomaterials- Properties and application.

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

REFERENCES:

1. Leveau, B. F. Biomechanics of Human Motion: Basics And Beyond For The Health Professions: Slack Incorporated,2001.
2. Tözeren, A. Human Body Dynamics: Classical Mechanics And Human Movement: Springer.
3. Yamaguchi, G. T. Dynamic Modeling Of Musculoskeletal Motion: A Vectorized Approach For Biomechanical Analysis In Three Dimensions: Springer.
4. Zatsiorsky, V. M. Kinematics of Human Motion: Human Kinetics.2003
5. Nordin, M., & Frankel, V. H. Basic Biomechanics of The Musculoskeletal System: Lippincott Williams & Wilkins,2003.
6. Winter, D. A. Biomechanics And Motor Control Of Human Movement: Wiley,2004.
7. Perry, J. Gait Analysis: Normal And Pathological Function: Slack, 2006.

U14ME*T*E78 MODELLING AND SIMULATION OF ENGINEERING 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: Outline the fundamentals of system simulation
CO 2: Identify the different types of techniques to generate Random numbers
CO 3: Outline random number and variate generation.
CO 4: Understand validation of simulated models.
CO 5: Familiar with various simulation packages.

Pre-requisite:

1. 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										
CO2		M										
CO3		M										
CO4			M	M								
CO5					S							

Course Assessment methods:

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

SYSTEM AND SYSTEM ENVIRONMENT **9 Hrs**

Component of a System – Continuous and discrete systems – Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two server queue – inventory system.

RANDOM NUMBER GENERATION **9 Hrs**

Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap test – poker test.

RANDOM – VARIATE GENERATION **9 Hrs**

Inverse transform technique for Exponential, Uniform, triangular, weibull, empirical, uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution; Direct Transformation for normal distribution.

ANALYSIS AND EVALUATION OF MODEL **9 Hrs**

Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification and validation of simulation models.

SIMULATION SOFTWARE PACKAGES **9 Hrs**

Comparison and selection of General Purpose Simulation System (GPSS), SIMSCRIPT, SLAM, Arena simulation language, Modeling basic operations using Arena – An Electronic Assembly and testing system, Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, Arena Integration and customization.

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

REFERENCES:

1. Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", 3rd Edition, Pearson Education, Inc 2004
2. David Kelton.W. and Randall P. Sowdowski, "Simulation with Arena", 2nd Edition , McGraw Hill, 2002.
3. Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
4. Narsingh Deo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.

U14ME*T*E79 DESIGN FOR MANUFACTURE

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.

Pre-requisite:

1. U14MET305-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
CO1			M									
CO2			M									
CO3			S	M								
CO4			S	M								
CO5			S	M								

Course Assessment methods:

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

INTRODUCTION **9 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 and application of form design.

CASTING DESIGN AND WELDMENT DESIGN **9 Hrs**

Factors affecting casting design- Strength aspects – Sand casting and die casting design-Factors affecting weldment design-Gas and arc welding design.

FORMED METAL COMPONENTS AND NON METALLIC PARTS DESIGN **9 Hrs**

Design considerations for the manufacture of extruded, cold headed metal parts – Tube and section bends – Powder metal parts -Thermo setting plastic parts-Reinforced – Plastic/Composite parts.

MACHINED COMPONENTS DESIGN **9 Hrs**

Design considerations for the manufacture of Turned parts-drilled parts-milled parts, planned, shaped and slotted parts-Ground parts-parts produced by EDM.

DESIGN FOR ASSEMBLY **9 Hrs**

Types of assembly – DFA –Index – evaluation of assembly – assembly cost reduction – case of assembly – impact on quality – related software usage – case studies.

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

REFERENCES:

1. James G. Bralla – "Handbook of product design for manufacture", McGraw Hill Book Co.,1986.
2. Henry Peck – "Designing for manufacture", Sir Isaac Pitman & Sons Ltd., 1973.
3. Matousek – "Engineering Design", Blackie & sons, 1974 **ISBN-13:** 9780216912731

L	T	P	C
3	0	0	3

U14ME*T*E80 RAPID PROTOTYPING

Course outcomes

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

CO 1: Illustrate the fundamentals of RPT and its materials
CO 2: Demonstrate the various RPT systems
CO 3: Explain the working of powder based RP system
CO 4: Discuss the applications of materials for RP system
CO 5: Explain the reverse engineering and new technologies pertaining to RPT.

Pre-requisite:

1. U14MET403- 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
CO1	M											
CO2	M											
CO3	M											
CO4	M											
CO5	M											

Course Assessment methods:

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

INTRODUCTION **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 9 Hrs

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 9 Hrs

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:45 Hrs**

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, second edition, 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.

U14ME*T*E81 **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: Understand fundamental knowledge about nuclear reactions, fuels and reactors.

CO 2: Discuss the nuclear reaction reactor materials

CO 3: Illustrate the reprocessing methods of nuclear fuel, heat transfer techniques in a nuclear reactor and the safety disposal of nuclear wastes.

CO 4: Describe the concepts and applications of nuclear energy.

CO 5: Understand and explain the safety disposal of nuclear wastes.

Pre-requisite:

1. 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											
CO2		M										
CO3		M				S						
CO4		M				S						
CO5						S						

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

REFERENCES:

1. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley, 2002.
2. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York, 2002.
3. Wakil M.M.El., "Power Plant Technology" – McGraw-Hill International, 2006.

U14ME*T*E82 THEORY OF COMBUSTION AND EMISSION

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 phenomenon of combustion in IC engines
CO 2: Analyze the combustion phenomena in SI engines
CO 3: Analyze the combustion phenomena in CI engines
CO 4: Appraise combustion characteristics of gas turbines.
CO 5: Understand the emission standards for SI and CI engines.

Pre-requisite:

1. U14MET503- Thermal Engineering

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											
CO2		M										
CO3		M										
CO4		S										
CO5	S											

Course Assessment methods:

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

THEORIES OF COMBUSTION **9 Hrs**

Combustion Principles- Combustion - Combustion equations, heat of combustion - Theoretical flame temperature, Chemical equilibrium and dissociation - Theories of Combustion - Pre-flame reactions, Reaction rates-Laminar and Turbulent, Flame Propagation in Engines.

COMBUSTION IN SI ENGINE **9 Hrs**

Combustion in SI Engine- Initiation of combustion, stages of .combustion, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, features and design consideration of combustion chambers.- Flame structure and speed, Cycle by cycle variations, Lean burn combustion, stratified charge combustion systems. Heat release correlations. After treatment devices for SI engines.

COMBUSTION IN CI ENGINE **9 Hrs**

Combustion in CI Engine- Stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, features and design considerations of combustion chambers- delay period correlations, heat release correlations, and influence of the injection system on combustion. Direct and indirect injection systems. After treatment devices for diesel engines.

COMBUSTION IN GAS TURBINES **9 Hrs**

Combustion in Gas Turbines- Flame stability, re-circulation zone and requirements – Combustion chamber configuration, materials.

EMISSIONS AND POLLUTANTS IN ENGINES **9 Hrs**

Emissions- Main pollutants in engines, Kinetics of NO formation, NOx formation in SI and CI engines. Unburned-hydrocarbons, sources, formation in SI and CI engines, Soot formation and oxidation, Particulates in diesel engines, Emission control measures for SI and CI engines, Effect of emissions on Environment and human beings.

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

REFERENCES:

1. Ganesan, V . “Internal Combustion Engines”, Tata McGraw Hill Book Co, 2003.
2. John B. Heywood, “Internal Combustion Engine Fundamentals”, Tata McGraw Hill New Delhi, 2002.
3. Mathur, M. L, and Sharma. R. P., “A Course in Internal Combustion Engines”, Dhanpat Rai- Publications New Delhi, 2000.
4. Obert, E. F., “Internal Combustion Engine and Air Pollution”, International Text Book Publishers, 2001.
5. Cohen, H, Rogers, G. E. C, and Saravanamuttoo, H. I. H., “Gas Turbine Theory”, Longman, 2004.

U14ME*T*E83 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: Classify the engine components and accessories.
CO 2: Explain fuel supply and electrical systems
CO 3: Explain the working principle of various transmission and control systems.
CO 4: Understand the concepts of steering, brakes and suspension systems
CO 5: Discuss the alternative energy sources, hybrid and off road vehicles.

Pre-requisite:

1. 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											
CO2	M											
CO3	M											
CO4	M											
CO5						M						

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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**

Electronic control of carburetion - Electronic fuel injection system – Mono-point and Multi - Point Injection Systems – Construction, Operation and Maintenance of Lead Acid Battery – Electrical systems – Battery generator –Advanced starting system technology – 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 – Suspension systems – Braking Systems – Types and Construction – Antilock Braking System – Electronic brake force distribution (EBP) and traction control- Suspension system – active suspension –LED lighting (Advanced lighting technology) Ignition – Electronic & Programmed- Direct ignition

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 :45 Hrs **Total:45 Hrs**

REFERENCES:

1. Ed May, “Automotive Mechanics”, Tata McGraw-Hill-2003
2. Kirpal Singh “Automobile Engineering Vol. 1& 2”, Standard Publishers, New Delhi, 2009.
3. William H.Crouse and Donald L.Angline “Automotive Mechanics”, 9th Edition. Tata McGraw-Hill, 2007.
4. Srinivasan, “Automotive Mechanics” 2nd edition, Tata McGraw-Hill, 2003.
5. Joseph Heitner, “Automotive Mechanics”, 2nd edition, East-West Press, 2005.
6. Halderman, “Automotive Engines “Theory and Servicing” 5th Edition, Pearson, 2004.
7. Tom denton, “Automobile Electrical and Electronic System”, 4th edition, Routedge publisher, 2012.

U14ME*T*E84 FUNDAMENTALS OF NANO TECHNOLOGY

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 nanostructures and explain its properties.
CO 2: Explain the various production methods of nano particles.
CO 3: Explain the working of different microscopic technique
CO 4: Understand the fabrication of nano structure
CO 5: Discuss the nano devices and their applications.

Pre-requisite:

1. 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											
CO2	M											
CO3	M											
CO4	M											
CO5	M											

Course Assessment methods:

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

INTRODUCTION AND CLASSIFICATION 9 Hrs

Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems.

NANOMATERIALS AND CHARACTERIZATION 9 Hrs

Fabrication methods – Top down processes – Milling, lithographics, machining process – Bottom-up process – Vapour phase deposition methods, plasma-assisted deposition process, MBE and MOVPE, liquid phase methods, colloidal and solgel methods – Methods for templating the growth of nanomaterials – Ordering of nanosystems, self-assembly and self-organisation – Preparation, safety and storage issues.

GENERIC METHODOLOGIES FOR NANOTECHNOLOGY 9 Hrs

Characterization: General classification of characterization methods – Analytical and imaging techniques – Microscopy techniques - Electron microscopy, scanning electron microscopy, transmission electron microscopy, STM, field ion microscopy, scanning tunnelling microscopy, atomic force microscopy – Diffraction techniques – Spectroscopy techniques – Raman

spectroscopy – Surface analysis and depth profiling – Mechanical properties, electron transport properties, magnetic and thermal properties.

INORGANIC SEMICONDUCTOR NANOSTRUCTURES 9 Hrs

Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, lithography and etching, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques.

NANODEVICES AND THEIR VARIOUS APPLICATIONS 9 Hrs

Nanomagnetic materials – Particulate nanomagnets and geometrical nanomagnets – Magneto resistance – Probing nanomagnetic materials – Nanomagnetism in technology – Carbon nanotubes – fabrication- applications – Organic FET, organic LED‟s – Organic photovoltaics – Injection lasers, quantum cascade lasers, optical memories, electronic applications, colulomb blockade devices.

Theory :45 Hrs Total:45 Hrs

REFERENCES:

1. Charles P Poole, Frank J Owens, “Introduction to Nanotechnology”, John Wiley and Sons, 2007.
2. Kelsall Robert W, Ian Hamley, Mark Geoghegan, “Nanoscale Science and Technology”, Wiley Eastern, 2005.
3. Gregory Timp, “Nanotechnology”, Springer-Verlag, 2005.
4. Michael Kohler, Wolfgang, Fritzsche, “Nanotechnology: Introduction to Nanostructuring Techniques”, 2004.
5. Bharat Bhushan, “Springer Handbook of Nanotechnology”, 2004.

L	T	P	C
3	0	0	3

U14EC*T*E12 ELECTRO MAGNETIC FIELD

Course outcomes

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

CO 1: Understand the basic concepts of static electric and magnetic field.

CO 2: Analyze electric and magnetic fields in materials

CO 3: Analyze time varying electric and magnetic fields.

Pre-requisite:

1. 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											
CO2		S										
CO3		S										
CO4												
CO5												

Course Assessment methods:

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

STATIC ELECTRIC FIELD **9 Hrs**

Introduction to electromagnetic fields and its applicability in various engineering fields. Different Co-ordinate Systems – Curl, Divergence and Gradient – Stokes theorem and Divergence theorem - Coulomb's Law– Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges, continuous charge distribution, charges distributed uniformly on an infinite and finite line, Infinite uniformly charged sheet.

Electric Scalar Potential – Relationship between potential and electric field - Potential due to infinite uniformly charged line, electrical dipole - Electric Flux Density – Gauss Law.

STATIC MAGNETIC FIELD **9 Hrs**

Biot-Savart Law– Magnetic Field intensity due to a finite and infinite wire carrying a current, – Magnetic field intensity on the axis of a circular loop carrying a current – Ampere's circuital law.

Magnetic flux density – The Lorentz force equation – Force on a wire carrying a current placed in a magnetic field – Torque on a loop carrying a current – Magnetic moment – Magnetic Vector Potential.

ELECTRIC AND MAGNETIC FIELDS IN MATERIALS **9 Hrs**

Poisson's and Laplace's equation – Electric Polarization - Capacitance – Capacitance of parallel plate capacitor , coaxial cable, two wire line – Capacitance of parallel plate capacitor with two dielectrics – Electrostatic energy and energy density – Boundary conditions for

electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current.
Inductance – Inductance of loops and solenoids – Mutual inductance –Energy density in magnetic fields – magnetization and permeability - magnetic boundary conditions.

TIME VARYING ELECTRIC AND MAGNETIC FIELDS 9 Hrs

Faraday's law – Transformer and Motional electromotive forces - Displacement current – Maxwell's equations in integral form and differential form –Maxwell's equation in phasor form - Poynting Vector and the flow of power – Poynting theorem. Electromagnetic wave equations –Waves in free space and in homogenous material- Skin effect

APPLICATIONS OF ELECTROMAGNETICS 9 Hrs

Power generation using Magneto Hydro Dynamics, Case study on risk managements of electromagnetic fields due to mobile phones and power lines, Case study on nuclear fusion reactors. Simulation of electromagnetic force analysis for models using FEM, MOM solvers.

Theory :45 Hrs Total:45 Hrs

REFERENCES:

1. William H.Hayt, J A Buck, "Engineering Electromagnetics" 7th Edition, Tata McGraw-Hill 2006.
2. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems," Prentice Hall of India 2nd Edition 2003.
3. Sadiku M.N.O. "Elements of Engineering Electromagnetics" Oxford University Press, Third Edition.
4. Clayton.R.Paul, Keith W.Whites, Syed.A.Nasar"Introduction to Electro Magnetic Fields", Third Edition, WCB/McGraw-Hill, Edition 2007.
5. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics" John Wiley & Sons (Third edition 2003).
6. Narayana Rao, N: "Elements of Engineering Electromagnetics" Fifth Edition, Prentice Hall of India, New Delhi, 2003.
7. David K.Cheng "Field and Wave Electromagnetics" Second Edition, Pearson Edition.

U14MA*T*E65 SIGNALS AND SYSTEMS

L	T	P	C
3	1	0	4

Course outcomes

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

CO 1: Apply laws of Physics to model simple real life systems to predict its dynamic behavior

CO 2: Use Fourier analysis to identify the frequency characteristics of signals of interest

CO 3: Use time domain and frequency domain methods to understand the inherent behavior of LTI systems

CO 4: Take up advanced courses on system dynamics, digital signal processing and design of feedback control systems

Pre-requisite:

1. U14MAT304- Partial differential Equations and Fourier Analysis

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											
CO2		S										
CO3		S										
CO4			S									
CO5												

Course Assessment methods:

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

REPRESENTATION OF SIGNALS AND SYSTEMS 3 Hrs

Introduction to systems, signals and their interaction. Continuous time and discrete time signals, periodic and aperiodic signals, energy and power signals. Representation of simple systems with examples. Linear and nonlinear systems, Systems with and without memory, Time varying and time- invariant systems

DYNAMIC SYSTEM MODELING & SIMULATION 12 Hrs

Lumped element modeling - Laws of Physics applied to Simple Mechanical Systems and RLC Electrical circuits System State - State variables and forms of state equations. Matrix representation of state equations for linear dynamic systems – Free response and forced response Time response from general system models through numerical integration. Use of Continuous System Simulation Tools (MATLAB)

PERIODIC SIGNALS AND FOURIER SERIES 7 Hrs

Obtaining trigonometric Fourier series – Exponential Fourier Series –Fourier Spectra – Parseval's Theorem- Linearity and time-shifting properties of Fourier Series

FOURIER TRANSFORMS FOR APERIODIC SIGNALS 10 Hrs

Fourier Transform(FT) pair and equations relating them – Magnitude and phase spectra from Fourier Transforms – Linearity, time scaling , time shifting, time differentiation and integration properties of FTs - Parseval's Energy Theorem – Existence condition for FT

ANALYSIS OF LINEAR TIME INVARIANT (LTI) SYSTEMS USING TRANSFORMS 13 Hrs

Impulse Response of LTI system- Convolution integral – FT for convolved time signals - Transfer function of LTI system using Fourier Transform – System gain and phase responses in sinusoidal steady state – Bode plots – Applications in Communication and Control – Analog filters

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

REFERENCES:

1. Mrinal Mandal and Amrit Asif, `Continuous and Discrete Time Signals and Systems', Cambridge University Press, 2007
2. Cha, P.D., Rosenberg J.J. & Dym, C.L. `Fundamentals of Modeling and Analyzing Engineering Systems', Cambridge University Press, 2000
3. Yang W.Y. et. al., `Signals and Systems with MATLAB', Springer, 2009
4. Oppenheim A.V. & Willsky A.S., `Signals & Systems', PHI Learning Pvt.Ltd., 2011
5. Krishnaveni V. & Rajeshwari, A. `Signals & Systems',Wiley – India, 2012.

U14ME*T*E85 MATERIAL HANDLING SYSTEMS AND 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: Outline the importance of material handling.

CO 2: Identify load & categorize material handling based on application through general analysis procedure

CO 3: Apply the design procedures of material handling equipments & components

CO 4: Model load lifting & load movement attachments with proper design consideration & plan for appropriate material storage.

CO 5: Demonstrate the automation of material handling.

Pre-requisite:

1. U14MET502- 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
CO1		M										
CO2		S										
CO3			S									
CO4			S									
CO5			S		M							

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Tutorial 6. 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:45 Hrs**

REFERENCES:

1. Rudenko, N. „Material Handling Equipments, Peace Publishers, Moscow.
2. James M. Apple, „Material Handling System Design, John-Willlwy 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, Volumes I and II, MIR

Kulwiac R. A., Material Handling Hand Book, JohnWilly Publication, New York

L	T	P	C
3	0	0	3

U14ME*T*E86 ADVANCED FOUNDRY TECHNOLOGY

Course outcomes

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

CO 1: Design different casting system and use different Foundry practices to make practical component.

CO 2: Explain the procedure for casting of various metals

CO 3: Design gating systems for casting

CO 4: Understand and discuss the recent trends in casting and foundry layout

CO 5: Perform different testing to study the defect in the casting and apply engineering skills to minimize the defects.

Pre-requisite:

1. U14MET305- 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
CO1			S									
CO2		S										
CO3		M	S									
CO4		M										
CO5			M	M								

Course Assessment methods:

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

CASTING PROCESS **10 Hrs**

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box moulding processes.

CASTING METALLURGY **8 Hrs**

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys ,Babbit alloy and Cu alloy.

DESIGN OF GATING SYSTEMS **10 Hrs**

Gating systems and their characteristics; the effects of gates on aspiration; turbulence and dross trap; recent trends. Chvorinov's Rule Riser design; risering curves; NRL method of riser design; feeding distance; risering of complex casting.

RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT **8 Hrs**

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

TESTING OF CASTINGS **9 Hrs**

Causes and remedies for casting defects –Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonic cell – studies in testing of joints & castings. Methods of elimination and control of dissolved gases in castings. use of statistical quality control in foundry.

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

REFERENCES

1. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
2. Principle of metal casting – Heime, Looper and Rosenthal – Tata McGraw Hill – 2001
3. Taylor H.F., Fleming.M.C.,, "Foundry Engineering" M.C. & Wiley Eastern Ltd., 2006
4. ASM Handbook, Vol 15, Casting, 2004

U14ME*T*E87 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: Understand basics of a supply chain
CO 2: Analyze sourcing decision in a supply chain
CO 3: Discuss factors influencing distribution network design.
CO 4: Extend managerial levers to achieve supply chain coordination
CO 5: Understand the role of supply chain drivers in achieving a strategic fit

Pre-requisite:

1. U14GST003- Principles of Management

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						
CO2						S						
CO3			S									
CO4		S										
CO5		S	M									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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.

SOURCING DECISIONS IN SUPPLY CHAIN **9 Hrs**

Role of sourcing- benefits of effective sourcing- Supplier assessment factors- Contracts and supply chain performance- Design collaboration- Procurement process through product categorization

DISTRIBUTION & NETWORK DESIGN IN SUPPLY CHAIN **9 Hrs**

Role- Influencing factors- Design options for a distribution network- ebusiness- Network design decision influencing factors- Framework for global site location

SUPPLY CHAIN COORDINATION **9 Hrs**

Need- Bullwhip effect- obstacles to supply chain coordination- Managerial lever to achieve coordination- Creating effective contracts and conflict resolution Mechanisms- Achieving coordination in practice

SUPPLY CHAIN PERFORMANCE **9 Hrs**

Meaning- Supply chain drivers- Facility, Inventory, Transportation, Information, Sourcing, Pricing- Obstacles for a strategic fit- Step to achieve a strategic fit

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

REFERENCES:

1. Sunil chopra Peter meindl, D.V.Kalra, Supply chain management, Fourth edition, Pearson Education,Printice Hall of India, 2010.
2. Rahul.V. Altekar, Supply Chain Management, Concept and cases, PHI, 2009.

U14ME*T*E88 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: Estimate the level of knowledge required to be an entrepreneur and to understand the role of Entrepreneurship to the country economic growth

CO 2: Know the role of creativity in entrepreneurial development and to develop business models

CO 3: Predict financial needs and source of financing based on market research

CO 4: Describe the role of government in Entrepreneurial development

CO 5: Summarize knowledge on managing on Industry for growth and expansion

Pre-requisite:

1. U14GST005-Engineering Economics and Financial Management

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					
CO2							S	M				
CO3				S								
CO4						M	M					
CO5											S	

Course Assessment methods:

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

ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT 9 Hrs

Entrepreneur – Definition – Need for Entrepreneurship – Concepts – Characteristics – Competencies – Why Entrepreneurs – Contribution of Entrepreneurship to Economic Growth of Country – types of Entrepreneurs – Intrapreneurs – Differences – Entrepreneur – Intrapreneur – Manager – Factors Contributing and affecting Entrepreneurs growth - Qualities

ENTREPRENEURIAL PROMOTION 9 Hrs

The Role of Creativity – The Innovation Process – Sources of New Ideas - Methods of Generating Ideas Creative Problem Solving – Entrepreneurial Process – The Importance of a Business Model – Components of Effective Business Models – Developing and Writing a Business Model

PROJECT MANAGEMENT 9 Hrs

Forms of Business Organization – Micro Small Medium Enterprises – Sole Proprietorship – Partnership – Joint stock Companies – Cooperatives – Determining the Financial Needs – Sources of Financing – Equity and Debt funding – Evaluating Financial Performances – The Marketing Function – Industry Analysis – Competitor Analysis – Market Research for New Venture – Marketing Strategy

GOVERNMENT ROLE IN ENTREPRENEURIAL DEVELOPMENT 9 Hrs

Government Schemes – Micro – Small – Medium –Women – Enterprises – District Industry Centre – Special Economic Zones – Tax Benefits – Export and Import – Financial – Non Financial Incentives from State and Central Governments – Sector Reservation for Micro, Small and Medium Industries - Essential Contacts for Entrepreneurs

INDUSTRY MANAGEMENT 9 Hrs

Challenges of Growth – Strategies for Firm Growth – Internal and External Growth Planning – Professional Ethics – Human Values – Creativity for Growth – Social Responsibility – Modernization Methods – Labour Welfare – Tax Knowledge – Expansion – Investment Reserve Strategy – Contribution to Society.

Theory :45 Hrs Total:45 Hrs

REFERENCES:

1. Entrepreneurial Development by S S Khanka, S. Chand & Co: 2012.
2. Intellectual Property Rights Text and Case, by Dr. R. Radhakrishnan and Dr. S. Balasubramanian, Excel Books – 2008.
3. Vasanth Desai "Dynamics of Entrepreneurial Development and Management" Himalaya Publishing House, 6th edition, 2011.
4. N.P.Srinivasan & G.P. Gupta "Entrepreneurial Development" Sultanchand & Sons, 1999.
5. P.Saravanavelu "Entrepreneurship Development" Eskapee publications, 2008.
6. S.S.Khanka "Entrepreneurial Development" S.Chand & Company Ltd., 2008.

U14ME*T*E89 PROJECT ENGINEERING 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: Understand the concept of a project & its categories, roles and responsibilities of a Project leader

CO 2: Understand the concept of project planning and cost estimation

CO 3: Understand the project organization and staffing the project team

CO 4: Discuss tools and techniques of project management

CO 5: Know the performance indicators in project management and its role in the environment

Pre-requisite:

1. 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	M	
CO2											S	
CO3									S			
CO4					M						S	
CO5						M					M	

Course Assessment methods:

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

CONCEPTS OF PROJECT MANAGEMENT **9 Hrs**

Concept of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management.

PROJECT PLANNING AND ESTIMATING **9 Hrs**

Feasibility report, phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability.

ORGANIZING AND STAFFING THE PROJECT TEAM **9 Hrs**

Skills and abilities required of project manager, Authorities and responsibilities of project manager, Project organization and types, accountability in project execution, controls, tendering and selection of contractors.

TOOLS & TECHNIQUES OF PROJECT MANAGEMENT **9 Hrs**

Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Technique (PERT) and Critical path method (CPM) Planning.

PERFORMANCE MEASURES IN PROJECT MANAGEMENT **9 Hrs**

Performance indicators, Performance improvement for the CM & DM companies for better project management, Project management and environment.

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

REFERENCES:

1. Project Management a System approach to Planning Scheduling & Controlling, Harold Kerzner, CBS Publishers and Distributors.
2. Project Management - Beningston Lawrence-McGraw Hill-2001.
3. PERT & CPM - L.S. Srinath, Affiliated East West Press Pvl. Ltd.
4. A Management Guide to PERT and CPM, WEIST & LEVY, Eastern Economy of PHI
5. Project Management with PERT and CPM, Moder Josep and Phillips cerel R., 2nd edition, New York VAN Nostrand, Reinhold- 2002

U14ME*T*E90 **TRIBOLOGY**

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 basics of friction and wear.

CO 2: List types of wear and its measurement.

CO 3: Understand and discuss lubricant concepts testing methods and lubrication properties

CO 4: Explain the concept of fluid film, and various journal bearings its virtual coefficient of friction

CO 5: Discuss the various bearing materials and types of process involved in bearing material Coatings

Pre-requisite:

1. 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											
CO2	W											
CO3	M											
CO4	M											
CO5	M											

Course Assessment methods:

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

Topics covered:

SURFACES AND FRICTION **9 Hrs**

Surfaces and Friction- Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction -Adhesion Ploughint- Energy dissipation mechanisms, Friction Characteristics of metals - Friction of non-metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction. Source of Rolling Friction - Stick slip motion - Measurement of Friction.

WEAR **9 Hrs**

Wear- Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear. Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers – Wear Measurements.

LUBRICANTS AND LUBRICATION **9 Hrs**

Lubricants and Lubrication Types- Types and properties of Lubricants – Testing methods - Hydrodynamic Lubrication – Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

FILM LUBRICATION **9 Hrs**

Film Lubrication Theory- Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation, Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings –Virtual Coefficient of friction - The Somerfield diagram.

MATERIALS FOR BEARINGS **9 Hrs**

Surface Engineering and Materials for Bearings- Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

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

REFERENCES:

1. Hutchings, I.M. “Tribology, Friction and Wear of Engineering Material”, Edward Arnold, 2005
2. Stolarski, T.A. “Tribology in Machine Design” , Industrial Press Inc, 2006
3. Bowden, E. P.and Tabor.D., “Friction and Lubrication” , Heinemann Educational Books Ltd, 2002
4. Cameron, A. “Basic Lubrication theory” , Longman, U.K.., 2005.
5. Neale M. J. (Editor), “Tribology Handbook”, Newnes. Butter worth, Heinemann, U.K.
6. Friction, wear, lubrication : ATextbook I tribology Kenneth c Ludama, 2003.
7. Industrial Tribology : Tribosystems, friction, wear and surface engineering, lubrication, 2007.

U14ME*T*E91 PRODUCT LIFE CYCLE 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: Understand the background of product life cycle environment.
CO 2: Discuss product development methodologies.
CO 3: Understand and discuss product modeling and analysis tools
CO 4: Explain product data management
CO 5: Discuss the advanced product data base design

Pre-requisite:

1. 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										
CO2		M										
CO3		M			S							
CO4		M			S							
CO5			S									

Course Assessment methods:

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

INTRODUCTION TO PRODUCT LIFE CYCLE ENVIRONMENT 10 Hrs

Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement.

Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM.

PRODUCT DEVELOPMENT PROCESS & METHODOLOGIES 10 Hrs

Integrated Product development process - Conceive – Specification, Concept design, Design - Detailed design, Validation and analysis (simulation), Tool design, Realize – Plan manufacturing , Manufacture, Build/Assemble , Test (quality check) , Service - Sell and Deliver, Use , Maintain and Support, Dispose.

Bottom-up design, Top- down design, Front loading design workflow, Design in context, Modular design. Concurrent engineering - work structuring and team Deployment - Product and process systemization - problem, identification and solving methodologies. Product Reliability, Mortality Curve. Design for Manufacturing, Design for Assembly. Design for Six Sigma

PRODUCT MODELLING AND ANALYSIS TOOLS **10 Hrs**

Product Modeling - Definition of concepts - Fundamental issues - Role of Process chains and product models -Types of product models - model standardization efforts-types of process chains - Industrial demands, Design for manufacturing - machining - casting and metal forming - optimum design - Design for assembly and disassembly - probabilistic design concepts - FMEA - QFD - Taguchi Method for design of experiments -Design for product life cycle. Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity.

PRODUCT DATA MANAGEMENT (PDM) TECHNOLOGY **9 Hrs**

Product Data Management – An Introduction to Concepts, Benefits and Terminology, CIM data. PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation.

RECENT ADVANCES **6 Hrs**

Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process - Advanced database design for integrated manufacturing.

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

REFERENCES:

1. Antti Saaksvuori, Anselmi Immonen “Product Life Cycle Management”, Springer, 1st Edition Nov.5, 2003
2. Stark, John. “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN 1852338105
3. Kari Ulrich and Steven D. Eppinger “Product Design & Development”, McGraw Hill International Edns, 2005.
4. Stephen Rosenthol, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992 ISBN 1-55623-603-4.
5. Crnkovic, Ivica; Asklund, Ulf; & Dahlqvist, Annita Persson. Implementing and Integrating Product Data Management and Software Configuration Management, Artech House Publishers, 2003.

L	T	P	C
3	0	0	3

U14GS*T*006 PRODUCT DESIGN AND DEVELOPMENT

Course outcomes

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

CO 1: Understand the process to plan and develop products

CO 2: Understand the process of collecting information and developing product specifications

CO 3: Understand the concept generation, selection and testing processes

CO 4: Understand the concepts of product architecture, industrial design and design for manufacture

CO 5: Understand the basics of prototyping, economic analysis and project planning and execution process

Pre-requisite:

1. U14METE79- Design for Manufacture

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										
CO2		M										
CO3		M	M									
CO4			M									
CO5		M									S	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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. Ulrich, T. Steven D Eppinger,. Irwin “Product Design and Development”McGrawHill.-2008.
2. Chitale, A. C, and Gupta, R. C, “Product Design and Manufacturing” PHI, 2005
3. Timjones. Butterworth Heinmann, “New Product Development”,, Oxford. UCI.
4. Geoffery Boothroyd, Peter Dewhurst and Winston Knight.Product “Design for Manufacture and Assembly”,2003.

L	T	P	C
3	0	0	3

U14ME*T*E92 SOLAR ENERGY ENGINEERING

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 and interpret the solar charts.

CO 2: Describe the construction of various types of solar collectors and estimate their performance

CO 3: Discuss the factors to be considered to design a solar concentrator for various applications

CO 4: Explain the solar electrical energy conversion circuits with their construction details

CO 5: Explain the various solar energy storage mechanisms and heat recovery systems

Pre-requisite:

1. U14ME*T*E92- Renewable Energy Sources

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											
CO2	S	M										
CO3			S									
CO4	M											
CO5	M											

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

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. Energy Studies, Second Edition, by W. Shepherd and D. W. Shepherd, Imperial College Press, London, 2004.

L	T	P	C
3	0	0	3

U14ME*T*E93 RENEWABLE ENERGY SOURCES

Course outcomes

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

CO 1: Identify the various renewable energy sources with respect to national and international scenario.

CO 2: Calculate the Instantaneous collector efficiency of liquid flat plate collector

CO 3: Calculate axial thrust, power extracted by wind turbine

CO 4: Design digestor of a biogas plant

CO 5: Explain the working principle of direct energy conversion systems.

Pre-requisite:

1. 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										
CO2		S										
CO3		S										
CO4			S									
CO5	M											

Course Assessment methods:

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

ENERGY AND ENVIRONMENT **5 Hrs**

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.

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 and 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 **10 Hrs**

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

BIO ENERGY **7 Hrs**

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.

DIRECT ENERGY CONVERSION SYSTEM **8 Hrs**

Magneto hydrodynamic systems (MHD)and types-woking 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:45 Hrs**

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", 3rd Edition, TataMCGraw Hill, 2008.
4. S.Rao and Parul ehar, "Energy Technology – Non conventional, Renewable and Conventional, 3rd Edition (6th Reprint), Khanna Publishers, 2009.
5. Garg. H. P and Prakash. J., "Solar Energy - Fundamentals and applications", T1st revised edition, Tata Mc Graw Hill, 2000.
6. Non Conventional Energy Sources - G.D. Rai – Khanna Publishers, New Delhi, 1999.
7. Renewable Energy Sources - Twidell, J.W. and Weir, A. – 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 (4th edition), 2011.

L	T	P	C
3	0	0	3

U14ME*T*E94 SECURITY AND CYBER CRIME

Course outcomes

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

CO 1: Explain about information systems
CO 2: Discuss about e governors.
CO 3: Discuss network security concepts
CO 4: Understand and explain security metrices.
CO 5: Know ethical issues and cybercrime.

Pre-requisite:

1. 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							
CO2					M							
CO3					M							
CO4					M							
CO5					M			S				

Course Assessment methods:

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

INFORMATION SYSTEMS **9 Hrs**

History of Information Systems and its Importance, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

E GOVERNANCE **9 Hrs**

Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control-Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems.

NETWORK SECURITY **9 Hrs**

Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

SECURITY METRICES **9 Hrs**

Classification and their benefits Information Security & Law, Intellectual property rights, Patent Law, Copyright Law, Legal Issues in Data mining Security, Building Security into Software Life Cycle

ETHICS **9 Hrs**

Ethics- Ethical Issues, Issues in Data and Software Privacy, Cyber Crime Types & overview of Cyber Crimes

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

REFERENCES:

1. Godbole, “Information Systems Security”, Willey,2002
2. Merkov, Breithaupt, “Information Security”, Pearson Education, 2004
3. Yadav, “Foundations of Information Technology”, New Age, Delhi, 2003
4. Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill, 2001
5. Sood, “Cyber Laws Simplified”, Mc Graw Hill, 2003
6. Furnell, “Computer Insecurity”, Springer, 2003

L	T	P	C
3	0	0	3

U14ME*T*E95 MICRO ELECTRO MECHANICAL SENSORS

Course outcomes

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

CO 1: Discuss the overview of micro systems
CO 2: Explain the micro manufacturing techniques
CO 3: Discuss the principles and types of micro sensors and actuators.
CO 4: Understand the fundamentals of micro fluidics.
CO 5: Design microsystems

Pre-requisite:

1. U14MCT506-Mechatronics

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											
CO2	M											
CO3	M											
CO4		M										
CO5			S									

Course Assessment methods:

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

INTRODUCTION TO MICROSYSTEMS **9 Hrs**

Overview of Microsystems technology, Multi disciplinary nature of MEMS. Survey of materials central to micro engineering. Applications of MEMS in various industries.

MICRO MANUFACTURING TECHNIQUES **9 Hrs**

Photolithography, Film deposition, Etching processes, Bulk micro machining, silicon surface micro machining, L1GA process, Rapid micro product development.

MICRO SENSORS AND MICRO ACTUATORS **9 Hrs**

Transducer principles, various types of displacement force, vibration and temperature micro sensors, signal detection and processing. Energy conversion and force generation, Electromagnetic Actuators, Reluctance motors, piezoelectric actuators, bimetal-actuator Friction and wear.

INTRODUCTION TO MICRO NANO FLUIDS **9 Hrs**

Fundamentals of micro fluidics, Micro pump - introduction - Types - Mechanical Micro pump - Non Mechanical micro pumps, Actuating Principles, Design rules for micro pump – modeling and simulation, Verification and testing - Applications.

MICROSYSTEMS DESIGN AND PACKAGING **9 Hrs**

Design considerations, Mechanical Design, Process design, Realisation of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

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

REFERENCES:

1. Mohamed Gad "MEMS Handbook:" Edited by - el - Hak CRC Press 2002.
2. Sabrie Solomon "Sensors Handbook ", Mc Graw Hill 2003
3. Marc F Madou "Fundamentals of micro fabrication" CRC Press 2002 2nd Edition
4. Francis E.H. Tay and W.O.Choong "Micro fluidics and bio mems application"
5. Trimmer William S., "Micromachanics and MEMS" Ed., IEEE Press New York 2002
6. Boston "An introduction to Micro electro mechanical Systems Engineering" Maluf, Nadim AR Tech house, 2000.

L	T	P	C
3	0	0	3

U14ME*T*E96 POWER PLANT ENGINEERING

Course outcomes

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

CO 1: Describe layout of various types of power plants and working principle of boilers.
CO 2: Understand and explain the components used in steam power plant
CO 3: Illustrate the nuclear reactors and hydel power plants
CO 4: Discuss the working of diesel and various gas turbine power plants
CO 5: Explain the working of renewable power plants and discuss the economics of power plants.

Pre-requisite:

1. U14METE81-Nuclear Engineering

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										
CO2		M										
CO3	M											
CO4	M											
CO5	M											

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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 and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Fabric filters & Bag filters - Draught – different types - Surface Condenser and Cooling towers.

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**

Types of Diesel Plants, Components, and Selection of Engine Type, Applications Gas Turbine Power Plant – Fuels - Gas Turbine Material – Open and Closed Cycles – 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:45 Hrs**

REFERENCES:

1. EI- Wakil M.M, "Power Plant Technology", Tata McGraw-Hill, 1st Edition, 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, 15th Edition (7th Reprint) 2008.
4. Rai, G.D. "Introduction to Power Plant Technology", Khanna Publishers, 2009.
   Nag P.K, "Power plant Engineering", Tata McGraw-Hill, 3rd Edition, 2008

U14ME*T*E97 **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: Understand Indian money market, stock market and exchange rate management
CO 2: Discuss economic planning and policies in India
CO 3: Discuss Sustainable development & green marketing
CO 4: Discuss evolution of sustainable development
CO 5: Practice environment audit for sustainable development

Pre-requisite:

1. 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	M				
CO2						S						
CO3						S						
CO4						S						
CO5							S				M	

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

REFERENCES:

1. Bala Krishnamurthy, Environmental Management: Text and Cases, PHI, 2000.
2. Arindita Basak, Environmental Studies, Pearson Education.
3. Kaushik, Anubha, Environmental Studies, New Age International, 2001
4. Betz, Fredrick, Managing Technology, Prentice Hall, Englewood cliffs, New Jersey.
5. Rohatgi, P.K, Rohatgi K and Bowonder. B, Technological Forcasting, Tata Mc Graw Hill, 2002

U14ME*T*E98 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: Identify the energy conservation techniques in electrical and thermal systems.

CO 2: Outline the factors affecting the efficiency of energy efficient motors and lighting systems

CO 3: Calculate the efficiency of boiler and perform pinch analysis in heat recovery systems

CO 4: Understand and explain the conservation opportunities in various energy consuming equipments

CO 5: Analyze the economics in energy management.

Pre-requisite:

1. U14METE93- Renewable Energy Sources

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						
CO2	M											
CO3		S										
CO4	S					M						
CO5			S									

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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 :45 Hrs **Total:45 Hrs**

REFERENCES:

1. Witte, L.C. Schmidt, P.S. Brown, D.R. “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 2003.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 2001.
3. Dryden, I.G.C. “The Efficient Use of Energy” Butterworths, London, 2006
4. Turner W.C., “Energy Management Hand book” Wiley, New York, 2005.
5. Murphy W.R. and KAY, G. M, “Energy Management” Butterworths, London 2006.

U14ME*T*E99 SOFT COMPUTING TECHNIQUES

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 fundamentals of fuzzy logic systems.
CO 2: Summarize the applications of artificial neural networks in control system
CO 3: Utilize fuzzy system for extended applications in fuzzy reasoning and fuzzy clustering
CO 4: Model Neuro fuzzy systems and make use of GA in optimization
CO 5: Explain the principles of image processing and pattern recognitions.

Pre-requisite:

1. 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							
CO2					S							
CO3					S							
CO4					S							
CO5					S							

Course Assessment methods:

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

INTRODUCTION **9 Hrs**

Introduction- Introduction to soft computing; introduction to biological and artificial neural network; Introduction to fuzzy sets and fuzzy logic systems.

ARTIFICIAL NEURAL NETWORKS **9 Hrs**

Artificial neural networks and applications- Different artificial neural network models; learning in artificial neural networks; neural network applications in control systems.

FUZZY SYSTEMS **9 Hrs**

Fuzzy systems and applications- Fuzzy sets; fuzzy reasoning; fuzzy inference systems; fuzzy control; fuzzy clustering; applications of fuzzy systems.

NEURO-FUZZY SYSTEMS **9 Hrs**

Neuro-fuzzy systems- Neuro-fuzzy modeling; Neuro-fuzzy control, Genetic Algorithms- Simple GA, crossover and mutation, genetic algorithms in search and optimization.

APPLICATIONS **9 Hrs**

Applications- Pattern Recognitions, Image Processing, Biological Sequence Alignment and Drug Design, Robotics and Sensors, Information Retrieval Systems, Share Market Analysis, Natural Language Processing .

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

REFERENCES:

1. Konar, A Computational intellingence [i.e. intelligence]: principles, techniques, and applications: Springer, 2005
2. Friedman, M., & Kandel, A. Introduction to pattern recognition: statistical, structural, neural, and fuzzy logic approaches: World Scientific.
3. Jang, J. S. R., Sun, C. T., & Mizutani, E. Neuro-fuzzy and soft computing: a computational approach to learning and machine intelligence: Prentice Hall, 2003
4. Mitchell, M. An introduction to genetic algorithms: MIT Press, 2001
5. Ross, T. J. Fuzzy Logic with Engineering Applications: John Wiley & Sons, 2001.

U14ME*T*E100 **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: Know the working of various robot drive systems and end effectors
CO 3: Discuss the working principle of various sensors
CO 4: Write robot programming
CO 5: Understand the implementation of robotics in industries.

Pre-requisite:

1. U14MCT506-Mechatronics

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										
CO2		M										
CO3		M										
CO4		M			M							
CO5		M										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Internal Test III 4. Assignment 5. Seminar 6. 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:45 Hrs**

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.

U14ME*T*E101 MAINTENANCE 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: Describe the maintenance activities in industry and can build successful management for maintenance activity

CO 2: Explain the maintenance strategies and the process of achieving them in various industry sectors

CO 3: Discuss and apply the principles of temperature analysis for machinery condition monitoring for preventive maintenance

CO 4: Describe various techniques for contaminant monitoring and testing

CO 5: Discuss repair methods for various industrial equipment and to analyze failure & fault locations

Pre-requisite:

1. 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										
CO2		M										
CO3		M										
CO4		M										
CO5		M										

Course Assessment methods:

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

PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9 Hrs

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity - Types of maintenance - Benefits of sound Maintenance systems - Reliability and machine availability – MTBF, MTTR, MTTF and FIT– Factors of availability – Maintenance organization – Maintenance economics.

MAINTENANCE POLICIES AND DIAGNOSTIC MAINTENANCE 9 Hrs

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, Repair cycle - Principles and methods of lubrication – Total Productive Maintenance. Leak detection-wear monitoring-Temperature monitoring-Vibration monitoring-Signature analysis - Shock monitoring-Lubricant-Analysis-Methodology-Equipments-Applications

CONDITION MONITORING **9Hrs**

Condition Monitoring (CM) – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

CONTAMINANT MONITORING **9 Hrs**

Contaminant Monitoring: Ferrography – spectral oil analysis procedure – non destructive testing: liquid penetrant testing – radio graphic inspection – ultra sonic testing acoustic emission - Corrosion monitoring – resistance techniques – Other probe techniques-analytical techniques.

REPAIR METHODSAND FAILURE ANALYSIS **9 Hrs**

Repair methods for beds, slideways, spindles, gears, lead screws and bearings - Repair methods for Material handling equipment – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location-Use of computers in maintenance.

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

REFERENCES:

1. Srivastava S.K., “Maintenance Engineering & Management”, - S. Chand and Co., 2010.
2. Venkataraman, “Maintenance Engineering & Management”, PHI Learning, 2009.
3. White E.N., “Maintenance Planning”, I Documentation, Gower Press, 2001.
4. Garg H.P., “Industrial Maintenance”, S. Chand & Co., 2004.
5. Keithmobley L.R., “Maintenance Engineering Hand book”, McGraw Hill, 7th Edition, 2008.
6. Armstrong, “Condition Monitoring”, BSIRSA, 2000.
7. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 2005.
8. Collacott, " Mechanical Fault Diagnosis and Condition monitoring "- McGraw Hill-2003
9. Machinery Failure Analysis and Trouble shooting, Heinz P Bloch and Fred K Geitner-Gulf Publishing Co, Houston, 2001.
10.

U14MA*T*E03 MODELING AND ANALYSIS OF ENGINEERING SYSTEMS

L	T	P	C
3	1	0	4

Course outcomes

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

CO 1: Modeling real life systems of interest in order to predict its dynamic behavior

CO 2: Use simulation tools to determine dynamic response of system following external inputs

CO 3: Apply Fourier analysis to identify the different frequency components in signals used for monitoring system health

CO 4: Use frequency response techniques to appreciate inherent dynamics of linear systems and design suitable feedback controllers

CO 5: Take up advanced courses on system dynamics, monitoring and control with familiarity on terminology and techniques employed in the above.

Pre-requisite:

1. U14MAT304- Partial differential equations and Fourier Analysis

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							
CO2		S			S							
CO3		S										
CO4		S	M									
CO5		M										M

Course Assessment methods:

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

FUNDAMENTAL MODELING CONCEPTS **7 Hrs**

Systems, Modeling and Analysis – Abstraction of physical behaviour using laws of physics – Linearity and Superposition – Lumped system dynamic behaviour represented by ordinary differential equations – Conservation laws to form dynamic equations

MODELING ELEMENTARY SYSTEMS **10Hrs**

Modeling Translational Mechanical Systems, RLC Electrical Circuit, Electrical Analogues for Mechanical System Parameters, Modeling of rotational mechanical systems, hydraulic systems and thermal systems, Model Representation of time delay

SYSTEM DYNAMIC RESPONSE **10 Hrs**

Obtaining dynamic response of first order and second order linear systems for step inputs through analytical solution of governing equations – Transient response specifications – Delay time, rise time, peak overshoot, undamped natural frequency, damping factor, settling time – Experimental determination of above parameters.

Dynamic response of general (including non - linear) system models through numerical integration of ODEs using MATLAB.

FOURIER ANALYSIS OF SIGNALS **8 Hrs**

Obtaining trigonometric Fourier series – Exponential Fourier Series – Fourier Spectra – Parseval's Theorem – Fourier Transform pairs and equations relating them – Magnitude and Phase Spectra from Fourier Transforms

FREQUENCY RESPONSE OF LINEAR TIME–INVARIANT SYSTEMS **10 Hrs**

Excitation and response signals of systems – Transfer functions – The sinusoidal steady state – Magnitude and phase response – Bode plots from transfer functions – Contributions from first order poles and zeros and complex conjugate pole pairs in frequency response – Frequency filtering characteristics of simple electrical and mechanical systems.

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

REFERENCES:

1. Cha, P.D. Rosenberg J.J. & Dym, C.L. `Fundamentals of Modeling and Analyzing Engineering Systems', Cambridge University Press, 2000
2. Mrinal Mandal and Amrit Asif, `Continuous and Discrete Time Signals and Systems', Cambridge University Press, 2007 (for Unit IV only)
3. Jaluria, Y. `Design and Optimization of Thermal Systems', Mc Graw Hill, 2003
4. Chopra, A. K. `Dynamics of Structures: Theory and Applications to Earthquake Engineering', Pearson, 2007.
5. Phillips, W. F. `Mechanics of Flight', John Wiley & Sons, 2010.
6. Brockman J. B., ` Introduction to Engineering: Modeling and Problem Solving', John Wiley & Sons, 2009.

ONE CREDIT COURSES

U14MEI001 ADVANCED GEOMETRICAL DIMENSIONING AND TOLERANCING

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:

1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI002 IMPLEMENTATION OF STATISTICAL PROCESS AND CONTROL

Course outcomes

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

CO 1: Understand the Implementation of statistical process and control

Pre-requisite:

1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI003 LEAN FOR WORLD CLASS MANUFACTURING

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Understand the concepts of lean manufacturing

Pre-requisite:
1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI004 GOOD SHOP FLOOR PRACTICES FOR MANUFACTURING EXCELLENCE

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Understand the concepts of floor practices

Pre-requisite:
1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI005 TEAM DYNAMICS

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Understand the concepts of Team dynamics

Pre-requisite:
1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI006 LEAN MANAGEMENT TOOLS

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:
1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI007 VALUE STREAM MAPPING FOR IMPROVING PROCESS PERFORMANCE

Course outcomes

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

CO 1: Understand the concepts of value stream mapping for improving process performance

Pre-requisite:

1. 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.Assignment 2. Seminar 3.Examination	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

U14MEI008 VALUE ENGINEERING- CONCEPTS AND APPLICATIONS

Course outcomes
After successful completion of the course, the students should be able to
CO 1: Understand the concepts of value stream mapping for improving process performance

Pre-requisite:
1. 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.Assignment 2. Seminar 3.Examination	Course end survey

Course Content
a. Introduction: concept of value engineering, advantages and applications, problem recognition, role of creativity.
b. Analysis of Functions: Functions, use, esteem and exchange values, basic V/S secondary functions, using and evaluating functions.
c. 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