दिल्ली प्रौद्योगिकी विश्वविद्यालय

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

(Estd. By Govt. of NCT of Delhi vide Act 6 of 2009)

SCHEME OF TEACHING AND EXAMINATIONS

BACHELOR OF TECHNOLOGY

MECHANICAL ENGINEERING

W.E.F 2015

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Examinations
B. Tech. (Mechanical Engineering)
W.E.F. 2015

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

CONTENTS

VISION

To be a world class university through education, innovation and research for the service of humanity.

MISSION

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.
2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.
3. To create environment of collaboration, experimentation, imagination and creativity.
4. To develop human potential with analytical abilities, ethics and integrity.
5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To become a global hub of academic excellence, research and innovation in the field of Mechanical, Production & Industrial, and Automobile Engineering.

MISSION

To produce world class skilled Mechanical, Production & Industrial, and Automobile Engineers by imparting quality education through cutting edge technologies, and Research & Development enabling them to work towards sustainable professional development

Program Educational Objectives (PEOs)

PEO-1 Graduate shall have ability to understand and apply core mechanical engineering knowledge to various automobile engineering problems.

PEO-2 The graduates will be able to work in team, investigate the problem of automobile engineering and present an ecological sustainable solution.

PEO-3 The graduates shall be competent in engineering modeling and experimental capabilities to pursue research and higher education in automobile engineering.

PEO-4 The graduates shall have good communication skill, high ethical and social values.

DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING)

I Year: Odd Semester

Teaching Scheme					Contact Hours/Week			Exam Duration (h)		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Group A														
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC101	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME101	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME103	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU101	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
Total				**21**	16	1	7							
Group B														
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE101	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO101	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME105	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN101	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
Total				**21**	15	1	9							

I Year: Even Semester

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Group A														
1	MA102	Mathematics - II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE102	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO102	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME102	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN102	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
	Total			**21**	**15**	**1**	**9**							
Group B														
1	MA102	Mathematics – II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC102	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME104	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME106	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU102	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
	Total			**21**	16	1	7							

II Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	PE251	Engineering Materials & Metallurgy	AEC	4	3	0	2	3	0	15	15	30	40	
2.	ME201	Mechanics of Solids	DCC	4	3	0	2	3	0	15	15	30	40	
3.	ME203	Thermal engineering-I	DCC	4	3	0	2	3	0	15	15	30	40	
4.	ME205	Machine Drawing and Solid Modelling	DCC	4	0	0	6	0	3	0	50	-	-	50
5.	ME207	Engineering Analysis and Design	DCC	4	3	0	2	3	0	15	15	30	40	
6.	MG201	Fundamentals of Management	HMC	3	3	0	0	3	0	25		25	50	
Total				**23**										

II Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	PE252	Manufacturing Machines	AEC	4	3	0	2	3	0	15	15	30	40	
2.	ME 202	Thermal Engineering-II	DCC	4	3	0	2	3	0	15	15	30	40	
3.	ME 204	Fluid Mechanics	DCC	4	3	0	2	3	0	15	15	30	40	
4.	ME 206	Kinematics of Machines	DCC	4	3	0	2	3	0	15	15	30	40	
5.	ME 208	Manufacturing Technology-I	DCC	4	3	0	2	3	0	15	15	30	40	
6.	HU202	Engineering Economics	HMC	3	3	0	0	3	0	25		25	50	
Total				**23**										

III Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	ME301	Fluid Systems	DCC	4	3	0	2	3	-	15	15	30	40	-
2.	ME303	Dynamics of Machines	DCC	4	3	0	2	3	-	15	15	30	40	-
3.	ME305	Design of Machine Elements	DCC	4	3	0	2	3	-	15	15	30	40	-
4.	ME307	Manufacturing Technology-II	DCC	4	3	0	2	3	-	15	15	30	40	-
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	-	25	-	25	50	-
6.	HU301	Technical Communication	HMC	2	2	0	0	3	-	25	-	25	50	-
Total				**21**										

III Year: Even Semester

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	ME302	Heat And Mass Transfer	DCC	4	3	0	2	3	-	15	15	30	40	
2.	ME304	Production and Operations Management	DCC	4	3	0	2	3	-	15	15	30	40	
3.	MExxx	Departmental Elective Course -1	DEC/ GEC	4	3	0/1	2/0	3	-	15/ 25	15/-	30 /25	40/ 50	-
4.	MExxx	Departmental Elective Course-2	DEC/ GEC	4	3	0/1	2/0	3	-	15/ 25	15/-	30 /25	40/ 50	
5.	MExxx	Departmental Elective Course-3	DEC/ GEC	4	3	0/1	2/0	3	-	15/ 25	15/-	30 /25	40/ 50	
6.	HU304	Professional Ethics &Human Values	HMC	2	2	0	0	3	-	25		25	50	
Total				**22**										

IV Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	ME401	B. Tech Project-I	DCC	4										
2.	ME 403	Training Seminar	DCC	2										
3.	ME 407	Refrigeration & Air Conditioning	DCC	4	3	0	2	3	-	15	15	30	40	
5.	ME4xx	Departmental Elective Course-4	DEC/ GEC	4	3	0/ 1	2/ 0	3	-	15/ 25	15/-	30 /25	40/ 50	
6.	ME4xx	Departmental Elective Course -5	DEC/ GEC	4	3	0/ 1	2/ 0	3	-	15/ 25	15/-	30 /25	40/ 50	
7.	ME4xx	Departmental Elective Course -6	DEC/ GEC	4	3	0/ 1	2/ 0	3	-	15/ 25	15/-	30 /25	40/ 50	
Total				**22**										

IV Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	ME 402	B. Tech Project-II	DCC	8										
2.	ME 404	Industrial Engineering	DCC	4	3	0	2	3		15	15	30	40	
3.	ME 4xx	Departmental Elective Course -7	DEC/ GEC	4	3	0/ 1	2/ 0	3	0	15/ 25	15/-	30 /25	40/ 50	
4.	ME4xx	Departmental Elective Course -8	DEC/ GEC	4	3	0/ 1	2/ 0	3	0	15/ 25	15/-	30 /25	40/ 50	
Total				**20**										

List of Departmental Elective Courses

S.No.	Subject Code	Subject	
1.	ME -306	Finite Element Method	DEC -1
2.	ME -308	Gas Dynamics & Jet Propulsion	
3.	ME -310	Automation in Manufacturing	
4.	ME -312	Quality Management & Six Sigma Applications	
5.	ME -314	Mechanical Vibrations	DEC -2
6.	ME -316	Power Plant Engineering	
7.	ME -318	Computer Aided Manufacturing	
8.	ME -320	Reliability & Maintenance Engineering	
9.	ME -322	Design of Mechanical Assemblies	DEC-3
10.	ME -324	System modeling, simulation and analysis	
11.	ME -326	Pressure vessels and Piping Technology	
12.	ME -328	Composite Material Technology	
13.	ME -409	Mechatronics & Control	DEC -4
14.	ME -411	I.C. Engines	
15.	ME -413	Metrology	
16.	ME -415	Project Management	
17.	ME -419	Robotics & Automation	DEC -5
18.	ME -421	Computational Fluid Dynamics	
19.	ME -423	Advanced Manufacturing Processes	
20.	ME -427	Operations Research	
21.	ME -429	Industrial Tribology	DEC -6
22.	ME -431	Non-conventional Energy Sources	
23.	ME -433	Computer Integrated Manufacturing	
24.	ME -435	Optimization techniques	
25.	ME -406	Elastic & Plastic Behaviour of Materials	DEC -7
26.	ME -408	Combustion Generated Pollution	
27.	ME -410	Advances in Welding & Casting	
28.	ME -412	Operations and Manufacturing Strategy	
29.	ME -414	Fracture Mechanics	DEC-8
30.	ME -416	Nuclear Energy	
31.	ME -418	Supply Chain Management	
32.	ME -420	Materials management	

List of Open Elective Courses

S.No.	SUBJECT CODE	SUBJECTS
1.	CO351	Enterprise & Java Programming
2.	CO353	E-commerce & ERP
3.	CO355	Cryptography & Information Security
4.	CO357	Operating System
5.	CO359	Intellectual Property Rights & Cyber Laws
6.	CO361	Database Management System
7.	EC351	Mechatronics
8.	EC353	Computer Vision
9.	EC355	Embedded System
10.	EC 357	Digital Image Processing
11.	EC359	VLSI Design
12.	EE351	Power Electronic Systems
13.	EE353	Electrical Machines and Power Systems
14.	EE355	Instrumentation Systems
15.	EE357	Utilization of Electrical Energy
16.	EE359	Non-conventional Energy Systems
17.	EE361	Embedded Systems
18.	EN351	Environmental Pollution & E- Waste Management
19.	EN353	Occupational Health & Safety Management
20.	EN355	GIS & Remote Sensing
21.	EP351	Physics of Engineering Materials
22.	EP353	Nuclear Security
23.	HU351	Econometrics
24.	MA351	History Culture & Excitement of Mathematics
25.	ME351	Power Plant Engineering
26.	ME353	Renewable Sources of Energy
27.	ME355	Combustion Generated Pollution

28.	ME357	Thermal System
29.	ME359	Refrigeration & Air Conditioning
30.	ME361	Industrial Engineering
31.	ME363	Product Design & Simulation
32.	ME365	Computational fluid dynamics
33.	ME367	Finite Element Methods
34.	ME369	Total Life Cycle Management
35.	ME371	Value Engineering
36.	MG351	Fundamentals of Financial Accounting and Analysis
37.	MG353	Fundamentals of Marketing
38.	MG355	Human Resource Management
39.	MG357	Knowledge and Technology Management
40.	PE351	Advance Machining Process
41.	PE 353	Supply Chain Management
42.	PE355	Work Study Design
43.	PE357	Product Design & Simulation
44.	PE359	Total Life Cycle Management
45.	PE361	Total Quality Management
46.	PT361	High Performance Polymers
47.	PT363	Separation Technology
48.	PT365	Non-Conventional Energy
49.	PT367	Polymer Waste Management
50.	PT369	Nanotechnology in Polymers
51.	PT371	Applications of Polymer Blends and Composite
52.	IT 351	Artificial Intelligence and Machine Learning
53.	IT 353	Data Structures and Algorithms
54.	IT 355	Communication and Computing Technology
55.	IT 357	Internet and Web Programming
56.	IT 359	Java Programming
57.	CE351	Geoinformatics and its applications

SYLLABUS

1. Subject Code: **ME 101/104** : Course Title: **Basic Mechanical Engineering**
2. Contact Hours : L: 04 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 3 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of thermodynamics, fluid mechanics, power plants, engineering materials, manufacturing processes and metrology.
10. Details of Course :

S. No.	Contents	Contact Hours
	PART A	
1	**Introduction:** Introduction to Thermodynamics, Concepts of systems, control volume, state, properties, equilibrium, quasi-static process, reversible & irreversible process, cyclic process. Zeroth Law and Temperature, Ideal Gas. Heat and Work.	05
2	First Law of Thermodynamics for closed & open systems. Non Flow Energy Equation. Steady State, Steady Flow Energy Equation. Second Law of Thermodynamics-Kelvin and Plank's Statements, Clausius inequality, Definition of Heat Engines, Heat pumps, Refrigerators. Concept of Energy and availability. Carnot Cycle; Carnot efficiency, Otto, Diesel, Dual cycle and their efficiencies.	12
3	Principles of power production, basic introduction about thermal power plant, hydroelectric power plant and nuclear power plant.	04

4	Properties & Classification of Fluids, Ideal & real fluids, Newton's law of viscosity, Pressure at a point, Pascal's law, Pressure variation in a static fluid, General description of fluid motion, stream lines, continuity equation, Bernoulli's equation, Steady and unsteady flow.	07
PART B		
5	Introduction to engineering materials for mechanical construction. Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.	12
6	Introduction to Manufacturing processes for various machine elements. Introduction to Casting & Welding processes. Sheet metal and its operations. Introduction to machining processes – turning, milling, shaping, drilling and boring operations. Fabrication of large and small assembles – examples nuts and bolts, turbine rotors etc.	12
7	Introduction to quality measurement for manufacturing processes; standards of measurements, line standards, end standards, precision measuring instruments and gauges: vernier calliper, height gauges, micrometer, comparators, dial indicator, and limit gauges.	04
Total		**56**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
TEXT BOOKS:		
1	Engineering Thermodynamics, P. K. Nag, Tata McGrawa-Hill	2005
2	Fundamentals of Classical Thermodynamics, G. J. Van Wylen and R. E. Santag.	1994
3	Manufacturing Processes, Kalpakjian	2013
4.	Basic Mechanical Engineering,1/e, Pravin Kumar, Pearson Education, Delhi	2013

REFERENCE BOOKS:		
1	Introduction to Fluid Mechanics and Fluid Machines, S. K. Som and G. Biswas	2013
2	Fluid Mechanics and Hydraulic Machines, R. K. Bansal	2010
3	Workshop Practices, K. Hazara Chowdhary	2007
4	Workshop Technology, W. A. J. Chapman	1972
5	Production Engineering, R. K. Jain, Khanna Publishers	2001

1. Subject Code: **AC 101/102** : Course Title: **Chemistry**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of Engineering Chemistry, Material characterization and green Chemistry.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Conventional Analysis**: Volumetric Analysis, Types of Titrations, Theory of Indicators.	06
2.	**Spectral Methods of Analysis**: UV-visible, IR, NMR & MS: Principles and Applications.	08

3.	**Thermal Methods of Analysis**: Thermo-gravimetry, Differential thermal analysis and Differential Scanning Calorimetry: Principles and Applications.	04
4.	**Polymers & Plastics**: Functionality and Degree of Polymerization, Mechanism of Polymerization, Molecular Weights of Polymers, Methods of polymerization, Functional Polymers, Industrial applications of Polymers.	06
5.	**Electrochemistry**: Electrochemical cells, components, characteristics of batteries. Primary and Secondary battery systems, Zinc-Carbon cells, Lead storage and lithium batteries. Fuel Cells, Electro-deposition, Electrical and chemical requirements. Electroplating bath and linings. Agitation, Circulation and filtration equipment.	08
6.	**Phase Equilibrium**: Definitions of Phase, component and degree of freedom, Gibb's phase rule. One component systems: Water and sulphur. Two component systems: Pb-Ag and Cu-Ni.	06
7.	**Green Chemistry**: Principles of Green Chemistry, Examples of Green Methods of Synthesis, Reagents and Reactions, Evaluation of feedstocks, Future trends in Green Chemistry.	04
Total		**42**

11. Suggested Books:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1	Introduction to Thermal Analysis/ Michael E. Brown/ Springer Netherlands	2001
2	Vogel's Quantitative Chemical Analysis/ J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas / Prentice Hall/6 edition	2000
3	Green Chemistry: Theory & Practice/P.T. Anastas & J.C. Warner/ Oxford Univ Press	2000
4	Polymer Science and Technology/ Fried Joel R./ PHI; 2 edition	2005
5	Electrochemistry/ Philip H. Rieger / Springer	2009

1. Subject Code: **AP 101** : Course Title: **Physics – I**

2. Contact Hours : L: 03 T: 00 P: 02

3. Examination Duration (Hrs.) : Theory:03 Practical: 00

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00

5. Credits : 04

6. Semester : I

7. Subject Area : ASC

8. Pre-requisite : NIL

9. Objective : To impart knowledge of basic concepts in applied physics and make the students familiar with topics like interference, diffraction, polarization, fiber optics, lasers, wave mechanics, etc. This course is also aimed at enhancing the analytical capability of the engineering students.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**RELATIVITY**: Review of concepts of frames of reference and Galilean transformation equation, Michelson – Morley experiment and its implications, Einstein's special theory of relativity, Lorentz transformation equations, Law of addition of velocities, Mass variation with velocity, Concept of energy and momentum, Mass energy relation.	08
2.	**OSCILLATIONS & WAVES:** Damped and forced oscillations, Resonance (amplitude and power), Q – factor, Sharpness of resonance. Equations of longitudinal and transverse waves and their solutions, Impedance, Reflection and transmission of waves at a boundary, Impedance matching between two medium.	07

3.	**PHYSICAL OPTICS:** Interference by division of wave front and amplitude, Multiple beam interference and Fabry-Perot interferometer, Fresnel diffraction through a straight edge, Zone plate, Fraunhoffer diffraction, single slit and N-slit / grating, Resolving power of telescope, prism and grating. Polarization by reflection and by transmission, Brewster's law, Double refraction, elliptically and circularly polarized light, Nicol prism, Quarter and half wave plates.	12
4.	**OPTICAL INSTRUMENTS:** Cardinal points of co-axial lens systems, spherical and chromatic aberrations and their removal, Huygens and Ramsden's eyepiece.	05
5.	**Lasers:** Coherence and coherent properties of laser beams, Brief working principle of lasers, Spontaneous and stimulated Emission, Einstein's co-efficient, Ruby laser, He-Ne laser.	06
6.	**Optical Fiber:** Classification of optical fibers, Refractive index profile, Corecl adding refractive index difference, Numerical aperture of optical fiber, Pulse dispersion in optical fiber (ray theory).	04
Total		**42**

11. Suggested Books:

S.No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Physics of Vibrations and Waves, by H.J. Pain.	2005/ John Wiley & Sons Ltd
2.	Vibrations and Waves, by A.P. French.	1971/CRC Press
3.	Perspective of Modern Physics, by Arthur Beiser	1981/ McGraw-Hill
4.	Optics, by A. Ghatak.	2006/Tata McGraw-Hill
5.	Berkley Physics Course Vol – 1.	2009/ Tata McGraw-Hill

1. Subject Code: **AP 102** : Course Title: **Applied Physics-II**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04

6. Semester : II

7. Subject Area : ASC

8. Pre-requisite : NIL

9. Objective : This course gives a balance account of the fundamentals of Physics as well as some of recent developments in this area best suited to the Engineering applications in different branches and to provide the knowledge and methodology necessary for solving problems in the field of engineering.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Quantum Physics :** Failure of classical physics ,Compton effect , Pair production, de-broglie relation, wave function, Probability density, Schrodinger wave equation, operators, expectation values and eigen-value equation, particle in a box, simple harmonic oscillator problem, concept of degeneracy.	10
2.	**Classical Statistics:** Microscopic-macroscopic systems, concept of phase space, basic postulates of statistical mechanics, Maxwell—Boltzmann distribution law.	05
3.	**Quantum Statistics:** Fermi—Dirac and Bose–Einstein Distribution, Fermi- Dirac probability function, Fermi energy level.	05
4.	**Nuclear Physics:** Nuclear properties, constituent of the nucleus, binding energy, stable nuclei, radioactive decay law (alpha and beta spectrum), Q-value of nuclear reaction , nuclear models: liquid drop and shell model, nuclear fission and fusion, elementary ideas of nuclear reactors.	06
5.	**Electrodynamics:** Maxwell's equations, concept of displacement current, Derivation of wave equation for plane electromagnetic wave, Poynting vector. Poynting theorem, Energy density, wave equation in dielectric & conducting media.	09

6	**Semiconductor Physics:** Concept of intrinsic and extrinsic semiconductors, Fermi level, characteristics of PN Junction, static and dynamic resistance, zenar diode and LED, diode as a rectifier, transistor (PNP and NPN) characteristics, current and voltage gain.	07
Total		**42**

11. Suggested Books:

S.No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Nuclear Physics, by Erwin Kaplan	2002/Narosa
2.	Concept of Nuclear Physics, by Bernard Cohen	2001/ McGraw-Hill
3.	Perspective of Modern Physics, by Arthur Beiser	1969/ McGraw-Hill US
4.	Electrodynamics, by Griffith	2012/PHI Learning
5.	Electricity & magnetism, by Rangawala& Mahajan.	2012/ McGraw-Hill

1. Subject Code: **EE-101/102** : Course Title: **Basic Electrical Engineering**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of electrical circuits, magnetic circuits, transformer and measuring instruments.

10. Details of Course :

S. No.	Contents	Contact Hours
1	**Introduction:** Role and importance of circuits in Engineering, concept of fields, charge, current, voltage, energy and their interrelationships. V- I characteristics of ideal voltage and ideal current sources, various types of controlled sources, passive circuit components, V-I characteristics and ratings of different types of R, L, C elements. DC Network: Series and parallel circuits, power and energy, Kirchhoff's Laws, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Tellgen's theorem.	10
2	**Single Phase AC Circuits:** Single phase emf generation, average and effective values of sinusoids, complex representation of impedance, series and parallel circuits, concept of phasor, phasor diagram, power factor, complex power, real power, reactive power and apparent power, resonance in series and parallel circuits, Q-factor, bandwidth and their relationship, half power points.	10
3	**Three-Phase AC Circuits:** Three phase emf generation, delta and star connection, line and phase quantities, solution of three phase circuits: balanced supply and balanced load, phasor diagram, three phase power measurement by two wattmeter method.	05
4	**Magnetic Circuits and Transformers:** Amperes circuital law, B-H curve, concept of reluctance, flux and mmf, analogies between electrical and magnetic quantities, solution of magnetic circuits, hysteresis and eddy current losses, mutual inductance and dot convention, single phase transformer – construction and principle of working, auto transformer and their applications.	12
5	**Measuring Instruments:** Analog indicating instruments, PMMC ammeters and voltmeters, damping in indicating instruments, shunt and multipliers, moving iron ammeter and voltmeters, dynamometer type instruments, multimeters, AC watt-hour meters. digital voltmeters, ammeters and watt meters.	05
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham , Arvin Grabel, Tata McGraw-Hill Publishing Company; 5th Edition.	2009
2	Electrical and Electronic Technology, Edward Hughes, Ian Mckenzie Smith, John Hiley, Pearson Education, 10th edition.	2010
3	Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches Raymond A. De Carlo, Pen-Min Lin, Oxford University Press, 2nd Edition.	2001
4	Hayt, Kemmerly & Durbin, "Engineering Circuit Analysis", Tata McGraw Hill Publishing Company Ltd.	2007
5	Electrical Engineering Fundamental V. Del Toro, Prentice-Hall, 2nd Edition.	1989
6	Basic Electrical Engineering, C.L. Wadhwa, New Age International Pvt Ltd Publishers	2007
7	Introduction to Electrical Engineering, Mulukutla S. Sarma, Oxford University Press Inc.	2001

1. Subject Code: **ME-102/105** : Course Title: **Engineering Graphics**
2. Contact Hours : L: 00 T: 00 P: 03
3. Examination Duration (Hrs.) : Theory: 0 Practical: 03
4. Relative Weight : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50
5. Credits : 02
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with drafting and engineering drawing practices.

10. Details of Course :

S. No.	Contents	Contact Hours
	PART A	
1	**General:** Importance, Significance and scope of engineering drawing Lettering, Dimensioning, Scales, Sense of Proportioning, Different types of Projections, B.I.S. Specification, line symbols, rules of printing.	03
2	**Projections of Points and Lines:** Introduction of planes of projection, Reference and auxiliary planes, projections of points and lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on auxiliary planes, shortest distance, intersecting and non-intersecting lines.	03
3	**Planes Other than the Reference Planes:** Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points lines in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.	03
4	**Projections of Plane Figures:** Different cases of plane figure (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one or both reference planes). Obtaining true shape of the plane figure by projection.	03
5	**Projection of Solids:** Simple cases when solid is placed in different positions, Axis, faces and lines lying in the faces of the solid making given angles.	03
6	**Isometric and Orthographic Views:** First and Third angle of system of projection, sketching of Orthographic views from pictorial views and vice –versa, Sectional views.	09
7	Principles of dimensioning.	03
8	Development of lateral surfaces of simple solids.	06
9	Introduction to available drafting softwares like AutoCAD	09
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
	TEXT BOOKS:	
1	Engineering Graphics, Narayana, K.L. and Kannaiah, P, Tata McGraw Hill	2005
	REFERENCE BOOKS:	
1	Engineering Graphics, Naveen Kumar and S C Sharma	2013
2	Engineering Graphics, Chandra, A.M. and Chandra Satish, CRC Press	2003

1. Subject Code: **EN-101/102** : Course Title: **Introduction to Environmental Science**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 0
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To introduce basic fundamentals of Environmental Science.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Introduction to Environment** Definition, Scope, and importance of environmental studies; need for public awareness; Segments of environment- lithosphere, hydrosphere, atmosphere, and biosphere; Environmental degradation; Role of individual in environmental conservation; sustainable lifestyle.	06
2.	**Natural Resources** Forest Resources : Deforestation, mining, dams and their effects on forest and tribal people; Water resources: over-utilization, floods, drought, conflicts over water, dams-benefits and problems; Mineral resources: Use and exploitation, environmental effects; Food resources : World food problems, changes caused by modern agriculture, fertilizer-pesticide problems, water logging, salinity**;** Energy resources : Growing energy needs, renewable and non renewable energy sources; Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.	09
3.	**Ecosystems and Biodiversity** Concept of an ecosystem, Structure and function, Energy flow, Ecological succession, ecological pyramids; Types, characteristic features, structure and function of the Forest, Grassland, Desert, and Aquatic ecosystems Concept of Biodiversity, definition and types, Bio-geographical classification of India; Value of biodiversity; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity.	09
4.	**Environmental Pollution** Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, 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.	09

5.	**Social Issues and Environment** Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products, Environment Laws and Acts, Issues involved in enforcement of environmental legislation, Public awareness. Population growth, variation among nations, Family Welfare Programme.	09
Total		**42**

1. Subject Code: **MA-101** : Course Title: **Mathematics – I**
2. Contact Hours : L: 03 T: 01 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : I
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To acquaint the students with the knowledge of series & sequence, single & multiple variable calculus, knowledge of vector calculus and their applications.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Infinite series**: Tests for convergence of series (Comparison, Ratio, Root, Integral, Raabe's, logarithmic), Alternating series, Absolute convergence, Conditional convergence.	06
2.	**Differential & Integral Calculus of single variable:** Taylor's & MaClaurin's expansion, Radius of curvature, Tracing of some standard curves, Applications of definite integral to Area, Arc length, Surface area and volume (in cartesian, parametric and polar co-ordinates).	07
3.	**Calculus of several variables**: Partial differentiation, Euler's theorem, Total differential, Taylor's theorem, Maxima-Minima, Lagrange's method of multipliers, Application in estimation of error and approximation.	07
4.	**Multiple Integrals**: Double integral (Cartesian and polar co-ordinates), Change of order of integration,Triple integrals (Cartesian, cylindrical and spherical co-ordinates), Beta and Gamma functions, Applications of multiple integration in area and volume.	08
5.	**Vector Differential Calculus**: Continuity and differentiability of vector functions, Scalar and Vector point function, Gradient, Directional Derivative, Divergence, Curl and their applications.	07
6.	**Vector Integral Calculus**: Line integral, Surface integral and Volume integral, Applications to work done by the force, Applications of Green's, Stoke's and Gauss divergence theorems.	07
Total		**42**

11. Suggested Books:

S. No.	Name of Books/Authors Publishers	Year of Publication/ Reprint
1.	Advanced engineering mathematics: Kreyszig; Wiley-India. 9th Edition ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. 2nd Edition. ISBN: 81-7319-541-2	2003

3.	Advanced engineering mathematics: Taneja; I K international ISBN: 978-93-82332-64-0	2014
4.	Advanced engineering mathematics: Alan Jeffery; Academic Press ISBN: 978-93-80501-50-5	2010
5.	Calculus and analytic geometry: Thomas/Finney; Narosa. ISBN : 978-81-85015-52-1	2013

1. Subject Code: **MA-102** : Course Title: **Mathematics – II**
2. Contact Hours : L: 03 T: 01 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To impart knowledge of matrices and applications closed form and series solutions of Differential equations, Laplace Transform, Fourier series, Fourier Transform & their applications.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Matrices**: Rank of a matrix, Inverse of a matrix using elementary transformations, Consistency of linear system of equations, Eigen-values and Eigenvectors of a matrix, Cayley Hamilton theorem, Diagonalization of matrix.	07

2.	**Ordinary differential equations:** Second & higher order linear differential equations with constant coefficients, General solution of homogenous and non - homogenous equations, Method of variation of parameters, Euler-Cauchy equation, Simultaneous linear equations, Applications to simple harmonic motion.	08
3.	**Special Functions**: Power series method, Frobenious method, Legendre equation, Legendre polynomials, Bessel equation, Bessel functions of first kind, Orthogonal property.	08
4.	**Laplace Transforms**: Basic properties, Laplace transform of derivatives and integrals, Inverse Laplace transform, Differentiation and Integration of Laplace transform, Convolution theorem, Unit step function, Periodic function, Applications of Laplace transform to initial and boundary value problems.	08
5.	**Fourier series** : Fourier series, Fourier Series of functions of arbitrary period, Even and odd functions, half range series, Complex form of Fourier Series, Numerical Harmonic analysis.	06
6.	**Fourier Transforms**: Fourier Transforms, Transforms of derivatives and integrals, Applications to boundary value problem in ordinary differential equations (simple cases only).	05
Total		**42**

11. Suggested Books:

S. No.	Name of Books/Authors Publishers	Year of Publication/ Reprint
1.	Advanced engineering mathematics: Kreyszig; Wiley. ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. ISBN: 81-7319-541-2	2003
3.	Advanced engineering mathematics: Taneja; I K international ISBN: 978-93-82332-64-0	2014
4.	Advanced engineering mathematics: Alan Jeffery; Academic Press ISBN: 978-93-80501-50-5	2010

5.	Advanced engineering mathematics: Peter V. O'Neil Cengage Learning. ISBN : 978-81-315-0310-2	2007

1. Subject Code: **HU 101/102** : Course Title: **Communication Skills**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : I / II
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To impart essential skills required for effective communication in English language.
10. Details of Course :

Sl. No.	Contents	Contact Hours
1	Communication Communication: Process, Features, Barriers Language, Technology and Communication	02
2	Unit II: Grammar and Usage Vocabulary-Words/Word Formation, Confusing Word Pairs Sentence Construction, Sentence Types, Direct/Indirect Speech Punctuation, Error Spotting, Idioms and Phrases	06
3	Unit III: Oral Communication Phonetics of English, Vowels, Consonants, syllables, transcription of words and simple sentences using IPA: Speech Sounds and their articulation; phonemes, Syllable, Stress, Transcription of words and Simple Sentences Language Lab Practice for Oral Communication: Project Presentations, Group Discussions, Debates, Interviews etc.	12

4	Unit IV: Written Technical Communication Composition- Descriptive, Explanatory, Analytical and Argumentative Writing Paragraphs (Essay, Summary, Abstract) Reading and Comprehension, Providing working mechanism of instruments, appliances, description of processes, their operations and descriptions; Drawing Inferences from graphs, charts, Diagrams etc.	12
5	Unit V: Texts for Appreciation and Analysis Improve your Writing by V. N. Arora and Lakshmi Chandra (OUP) Vijay Seshadri. *3 Sections* (2014) **or** *Gestures: Poetry from SAARC Countries* Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8 Ursula K. Leguin. *The Telling*, Harcourt Inc. 2000 **or** *Animal Farm* by George Orwell (1945) ISBN: 9781502492791 **or** *Frankenstein* by Mary Shelley (1818) Harper Collins India Ltd.: NOIDA ISBN: 9780007350964	10
Total		**42**

Text Books:

Sl.No.	Name of Books, Authors, Publishers	Year of Publication/ Reprint
1.	*Improve your Writing* by V.N.Arora and Lakshmi Chandra OUP: Delhi ISBN 13: 978-0-19-809608-5	1981, 2013 (Revised Edition)
2.	*Technical Communication: Principles and Practice* by Meenakshi Raman and Sangeeta Sharma OUP: Delhi. ISBN-13: 9780-19-806529-6	2011, Reprinted in 2014
3.	*English Phonetics and Phonology: A Practical Course*. By Peter Roach. Cambridge: Cambridge University Press. (Fourth Edition) ISBN: 978-0-521-14921-1	2009, 2014 (Reprinted)
4.	Vijay Seshadri. *3 Sections*, Harper Collins India Ltd.: India. ISBN: 9789351367734. **or** *Gestures: Poetry from SAARC Countries* Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8	2014 1996, Reprint 2007

5.	Ursula K. Leguin. *The Telling*, Harcourt Inc. 2000 **or** *Animal Farm* by George Orwell (1945) ISBN: 9781502492791 **or** *Frankenstein* by Mary Shelley (1818) Harper Collins India Ltd.: Noida ISBN: 9780007350964	2000 1945/ 2014 Reprint 1818/ Latest Reprint 2012

11. Suggested Books

Sl.No.	Name of Books, Authors, Publishers	Year of Publication / Reprint
1.	Maison, Margaret M. ***Examine Your English.*** Orient Blackswan: Delhi,	2009
2.	Sharma, Sangeeta & Binod Sharma. ***Communication Skills for Engineers & Scientists***, PHI.	2012
3.	Swan, Michael, Catherine Walter. ***Oxford English Grammar Course****. OUP: Delhi,*	2011
4.	Kumar, E Suresh & P Sreehari ***A Handbook for English Language Laboratories***, 2nd Edition, Cambridge University Press,Foundation Books,	2014
5.	Dutt, P Kiranmai, Geetha Rajeevan & CLN Prakash ***A Course in Communication Skills****. Cambridge University Press (*Foundation Books).	2013
6.	Mitra, Barun K. ***Personality Development and Soft Skills***.OUP: Delhi.	2011
7.	Apps for Phonetics- Advanced English Dictionary for Windows phone & OALD for Android phone	Latest

1. Subject Code: **CO 101/102** : Course Title: **Programming Fundamentals**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory : 3 Practical : 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04

6. Semester : I / II

7. Subject Area : AEC

8. Pre-requisite : NIL

9. Objective : To introduce fundamentals of Programming using C and C++, concepts of program development and object Oriented Programming.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction: Concepts of algorithm, flow chart, Introduction to different Programming Languages like C, C++, Java etc. Elementary Programming in C: Data types, assignment statements, Arithmetic, unary, logical, bit-wise, assignment and conditional operators, conditional statements and input/output statements.	06
2.	Iterative programs using loops- While, do-while, for statements, nested loops, if else, switch, break, Continue, and goto statements, comma operators. Concept of subprograms.	06
3.	Array representation, Operations on array elements, using arrays, multidimensional arrays. Structures & Unions: Declaration and usage of structures and Unions. Defining and operations on strings.	06
4.	Pointers: Pointer and address arithmetic, pointer operations and declarations, using pointers as function argument. File: Declaration of files, different types of files. File input/ output and usage-, File operation: creation, copy, delete, update, text file, binary file..	08
5.	Concept of macros and pre-processor commands in C, Storage types: Automatic, external, register and static variables. Sorting and searching algorithms: selection sort, bubble sort, insertion sort, merge sort, quick sort and binary search.	08
6.	Introduction to Object Oriented Programming: OOPS concepts: class, encapsulation, inheritance, polymorphism, overloading etc. C++ introduction, Concept of class, methods, constructors, destructors, inheritance.	08
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	The C Programming Language, 2nd Edition, Brian W. Kernighan, Dennis M. Ritchie, PHI, (ISBN-978-8120305960)	1988
2.	Let Us C, 13th Edition, YashavantKanetkar, BPB Publications, (ISBN: 978-8183331630)	2013
3.	Mastering C, Venugopal K R, Sudeep R Prasad, Edition 1,McGraw Hill Education. (ISBN- 9780070616677)	2006
4.	Programming in ANSI C , Sixth Edition, McGraw Hill Education (India) Private Limited E Balagurusamy (ISBN: 978-1259004612)	2012
5.	Object Oriented Programming with C++, Sixth edition , E. Balagurusamy, McGraw Hill Education (India) Private Limited (ISBN: 978-1259029936)	2013

1. Subject Code: **ME 103/106** : Course Title: **Workshop Practice**
2. Contact Hours : L: 00 T: 00 P: 03
3. Examination Duration (Hrs.) : Theory : 00 Practical : 03
4. Relative Weight : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50
5. Credits : 02
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with manufacturing shops like Carpentry, Foundry, Welding, Machining, Fitting and Smithy.

10. Details of Course :

Sl. No.	Shop	Description	Contact Hours
1.	Carpentry	Study of Different Carpentry Tools and Pattern Making of a given job (pulley/screw jack body)	03
2.	Foundry	Study of Different Foundry Tools and Furnaces Making a green sand mould of a given pattern (pulley/ screw jack body) and its casting	06
3.	Welding	Arc welding of butt joint, T-joint and lap joint Study of other welding/ joining Techniques	09
4.	Machining	Study of lathe, milling, drilling machine, shaper, planer and grinding machine. Demonstration of a job on lathe	09
5.	Fitting	Study of various fitting hand tools, marking and measuring devices Preparation of a given job (box / funnel)	09
6.	Smithy	Study of different forming tools and power press Preparation of a given job (bolt / chisel)	06
Total			**42**

1. Subject Code: **PE 251** CourseTitle: **Engineering Materials and Metallurgy**

2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : III

7. Subject Area : AEC

8. Pre-requisite : NIL

9. Objective : To understand how and why the properties of materials are controlled by structure and bonding at the atomic-scale, and by features at the micro-structural and macroscopic levels. 2. To understand the design, selection and processing of materials for a wide range of applications in engineering and elsewhere.3. To understand how and why the structure and composition of a material may be controlled by processing.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Structure of metal**: Crystal structure, miller indices for cubic and HCP crystals. Crystal imperfections and their effect on Mechanical properties of the material. Plastic deformation of single and Poly crystalline materials.	7
2	**Materials**: Plain Carbon steels, effect of alloying elements, properties and uses, tool steels, stainless, wear resisting steels. Composition, properties, and use of non-ferrous alloys e.g. Aluminum, Copper and Zinc alloys. **Corrosion**: Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.	

3	**Solidification**: Phases in metal system, lever rule, solidification of metal and alloys, solid solution, eutectic, eutectoid and inter-metallic compounds, Iron carbon equilibrium diagram, TTT-diagram.. **Heat Treatment**: Heat treatment of Ferrous and Nonferrous materials, case hardening . **Strengthening mechanisms**	7
4	**Fracture**: Types of Fracture of metals and alloys, brittle and ductile, fracture, fatigue failure, effect of alloying elements, design consideration. **Creep**: Basic consideration in the selection of material for high and low temperature service, Creep curve, effect of material variables on creep properties, brittle failure at low temperature	7
5	**Composite materials:** Classification of the Composite materials based on the reinforcement, characteristics, applications of composite materials in industry.	7
6	**Powder Metallurgy**: Principles, techniques, application and advantages. Surface treatment.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Materials science and engineering : An introduction, William D. Callister, Jr,6e, John Wiley & Sons, Inc, ISBN-13: 978-0470556733
2	Material Science &Engineering, V.Raghavan; 5e; Prentice Hall India learning Pvt. Ltd.,ISBN:978-81-203-2455-8
3	Material Science &Engineering, William F. Smith, JavedHashemi, Ravi Prakash, 5e, McGraw Hill Edn(India) Pvt. Limited; ISBN: 978-1-25-906275-9
4	Materials & Processes in Manufacture, Degarmo E. Paul et.al, Prentice Hall India, New Delhi, ISBN-13-978-81-265-1336-9.3
5	Engineering Metallurgy Part 1, Raymond A Higgim, Prentice Hall India, New Delhi, ISBN-13: 978-0340046401
6	Principles of Engineering Metallurgy , L. Krishna Reddy, New Age Publication, New Delhi, ISBN: 978-81-224-2202-3
7	Engineering Materials & Properties, Budinski et al, Prentice Hall India, New Delhi, ISBN-13: 978-0137128426

8	Material science, metallurgy and Engineering materials, 1e, Dr.K.M.Gupta, Umesh Publications, ISBN:978-933-80117-69-0
9	Mechanical Metallurgy, George E. Deiter, 1e, McGraw Hill Book company, ISBN: 0-07-100406-8
10	Elements of Material science and Engineering, Lawrence H. Van.Vlack, 6e, Pearson education Inc, ISBN: 978-81-317-0600-8

1. Subject Code: **ME 201** Course Title: **Mechanics of Solids**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To make students understand how principle of equilibrium helps in calculating stresses in different loading situations like uni-axial load for a bar, bending, torsion and buckling etc.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Review of statics:** Force, moment of a force, couple, equilibrium of a particle and rigid bodies, free body diagram, equivalent force system, D'Alembert's principle, truss, inertia tensor.	3
2	**Simple stresses and strains**: Concept of stress and strain; stress and strain diagram, Hooke's law, Young's modulus, Poisson's ratio, stress and strains in bars subjected to axial loading, stress produced in compound bars subject to axial loading. Temperature and pre-strain effects. Strain Energy: Strain Energy due to axial loads, stresses due to sudden and impact loads	7

3	**Compound stresses and strains**: State of stress at a point, stress tensor, stress invariants, principal stresses and principal planes, plane stress, plane strain, Mohr's circle, Saint Venant's principle, strain tensor, Generalized Hooke's law, Theories of failure.	8
4	**Bending**: Theory of bending, derivation of bending formula: its application to beam of rectangular, circular and channel sections, strain energy in bending, **Slope and deflection**: Relationship between moment, slope and deflection, Moment area method, Castigliano's theorems, Macaulay's method, Use of all these methods to calculate slope and deflection for the following: a) Cantilevers b) Simply supported beams with and without overhang. c) Under concentrated loads, uniformly distributed loads or combination of concentrated and uniformly distributed loads.	8
5	**Torsion**: Derivation of torsion equation and its assumptions, Applications of the equation of the hollow and solid circular shafts, torsional rigidity, strain energy due to torsion, principal stresses and maximum shear stresses under combined loading of bending and torsion, torsion of thin-walled non-circular tubes, torsion of non-circular solid sections. **Springs**: Deflection of springs, Close-coiled helical spring, spiral and leaf springs.	7
6	**Columns and struts**: Columns of different end conditions and failure of columns, Euler's formula; Rankine-Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications. **Cylinders and spheres**: Thin Cylinders and spheres; Derivation of formulae and calculation of hoop stress, longitudinal stress in a thin cylinder and sphere subjected to internal pressure. **Thick cylinders:** Hoop, radial and longitudinal stresses in thick cylinders due to internal and external pressures, Compound cylinders, Stresses in shrink fits. Rotating disc of uniform thickness, disc of variable thickness, Rotating cylinder.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Gere J. M., Timoshenko S.P., Mechanics of materials, CBS Publication, 2nd edition, ISBN- 8123908946.

2	Popov Eger P.,"Engg. Mechanics of solids", Prentice Hall, New Delhi, 2nd edition, ISBN- 0135713560.
3.	Hibbeler R.C.,"Mechanics of Materials", Prentice Hall, New Delhi, 9th edition, ISBN-0133254429.
5.	Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi
6.	Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 817409048,2013

1. Subject Code: **ME 203** Course Title: **Thermal Engineering - I**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To familiarise the students with the process of thermodynamic analysis of engineering systems and to enhance critical thinking and prepare them for facing any challenge in the subject.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Fundamentals:** Properties of pure substance in solid, liquid and vapour phases, PVT behavior of simple compressible system, T-S and H-S diagram, steam tables, determination of quality of steam, throttling calorimeter, combined separating & throttling calorimeter, Maxwell and other thermodynamics relations, mixture of non reactive ideal gases, real gases, compressibility chart, law of corresponding state, air water vapor mixture, calculation of properties of air water vapour mixture	10

2	**Rankine Cycle and Analysis:** Rankine cycle and its representation on T-S and H-S diagrams; effect of low back pressure and high entry pressure and temperature and its limitations; necessity of re-heating, ideal and actual regenerative feed water heating cycle and its limitations, typical feed water heating arrangements for various capacity power plants.	8
3	**Introduction to Boilers:** Classification of boilers, boiler mountings and accessories; draft systems, circulation system; combustion and its calculations, and boiler performance.	6
4	**Steam Nozzles:** Types of nozzles, flow of steam through nozzles; condition for maximum discharge through nozzle; nozzle efficiency, effect of friction and supersaturated flow through nozzle.	6
5	**Steam Turbines:** Working principle and types of steam turbines; velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; optimum velocity ratio and maximum efficiency, blade twisting, comparison of impulse and reaction turbines, condition line and reheat-factor, losses in steam turbines; governing of steam turbines	8
6	**Steam Condensers:** Types and working of condensers, types and performance of cooling towers	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Engineering Thermodynamics** by P.K.Nag, Tata McGraw Hill Publishing Company Limited, ISBN – 1259062562, 2013.
2	**Engineering Thermodynamics** by Rogers, Pearson Education, ISBN- 631197036.
3	**Thermodynamics** by Kenneth Wark, McGraw-hill Book Company, 5th edition, ISBN-0070682860, 1988.
4.	**Engineering Thermodynamics: work and heat transfer** by Gordon Rogers and Yon Mayhew, Longman, 4th edition, ISBN – 0471861731, 1992.

5.	**Fundamentals of Classical Thermodynamics** by Van Wylen and Sonntag, John Wiley & Sons Inc., 3rd edition, ISBN – 0471861731, 1986.
6.	**Fundamentals of Engineering Thermodynamics** by Moran and Shaprio, **John Wiley & Sons, Inc., 7th edition, ISBN – 0470917687, 2010.**
7.	**Thermodynamics: An Engineering Approach** by Cengel and Boles, The McGraw-Hill Companies, 8th edition, ISBN: 0073398179, 2014.
8.	**Applied Thermodynamics for Engineering Technologists** by T.D. Eastop, Prentice Hall, 5th edition, ISBN- 05820919344, 1993.
9.	**Treatise on Heat Engineering** by V. P.Vasandani and D.S. Kumar, Metropolitan Book Co. (p) Ltd., ISBN- 810003500.

1. Subject Code: **ME 205** Course Title: **Machine Drawing and Solid Modelling**

2. Contact Hours : 42+42=84 L: 0 T: 0 P: 6

3. Examination Duration (Hrs.) : Theory: 0 Practical: 3

4. Relative Weight : CWS: 0 PRS: 50 MTE: 0 ETE: 0 PRE: 50

5. Credits : 4

6. Semester : III

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective: To teach students the conventional representation of different machine elements and make them draw different orthographic views of mechanical assemblies. To teach them solid modelling on various CAD softwares**.**

10. Details of Course:

S. No.	Contents	Contact Hours
1	Engineering Drawing as per IS-696:SP- 46, conventional representation of various machine elements.	6
2	Free- hand sketching & Scale drawing, Free- hand exercises for drawing three views from various models.	3
3	Drawing of Two/Three views of: Cotter Joint, Knuckle Joint, Rivets & Riveted joints, Types of Screw threads and their representation, Screws/Bolts and nuts, rigid coupling, Flexible coupling, simple bush Bearing, Plummer Block, ball & Roller bearing, Steam Engine parts, I.C engine parts,i.e Connecting rod, Piston.	33
4	Solid Modelling using CADsoftwares.	42
Total		**84**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	IS-696 Code Of Practice Of Engineering Drawing Publisher BIS
2	SP -46 Engineering Drawing for School And Colleges Publisher BIS
3	Machine Drawing by P.S. Gill, S K Kataria& Sons, ISBN- 9788185749792, 2010.

1. Subject Code: **ME 207** Course Title: **Engineering Analysis and Design**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective: To familiarize the students with the process of design and analysis of engineering systems and to enhance critical thinking and prepare them for facing design challenges. To familiarize them with statistical, decision making and optimization tools.

10. Details of Course:

S. No.	Contents	Contact Hours
	PART A	
1	**Introduction:** Design, Specification of design objectives and constraints, Different phases of design process.	1
2	**System modeling:** Modelling of multi-energy systems like mechanical, electrical, hydraulic, thermal etc.	2
3	**Engineering Analysis**: Role of analysis, Design spiral, Computer Aided Engineering Analysis, Introduction to FEM softwares and simulation tools, Visualization, Iterative process in design, Analysis and testing of design projects, Instrumentation.	3
4	**Learning from failure**: Types of failure, Failure of machine components, Famous case studies of failure, e.g., Liberty ships, Comet aircraft, Challenger space shuttle etc.	2
5	**Engineering Design**: Projects for design of machine elements.	4
6	**Communication of Technical information:** written and oral presentation, posters, report writing.	1
7	Engineering Ethics, Social responsibility, Sustainable design, Environmental issues	1
	PART B	
8	Statistics: Introduction, Role of statistics in design and management, measures of central tendency and dispersion, kurtosis, moments.	3
9	Probability: Introduction, Relevance of probability for failure analysis, jointly distributed random variables, distributions- continuous and discrete, Sampling distributions	5

10	Hypothesis testing: Estimation and hypothesis testing, Parametric tests, t-test, chi-square test, correlation and regression analysis, Application of statistical packages.	5
11	Optimization: Optimal design, Linear programming, Solution through graphical and Simplex methods, Transportation problem, assignment models.	12
12	Decision theory: Decision making, Decision tree. Use of OR software packages.	3
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	J L Yowell and D W Carlson, Eds., Introductory Engineering Design: A Projects-Based Approach, Third Edition
2	A H Burr and J B Cheatham, Mechanical Analysis and Design, 2nd Ed., Prentice Hall
3	J R Dixon, Design Engineering: Inventiveness, Analysis and Decision Making, TMH, New Delhi
4.	Budynas-Nisbett, Shigley's Mechanical Engineering Design, Eighth Edition
5.	Mike W Martin, Roland Schinzinger, Ethics in Engineering. McGraw-Hill 4th Edition
6.	Quantitative Methods, J K Sharma, MacMillan Publishers.
7.	Quantitative Methods for Business, Anderson, Cengage Learning
8.	Business statistics, Bajpai, Pearson India

Practicals on SPSS, TORA, LINDO : statistical and Operations research softwares

1. Subject Code: MG201 Course Title: Fundamentals of Management
2. Contact Hours: 42 L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 3

6. Semester : III

7. Subject Area : HMC

8. Pre-requisite : NIL

9. Objective : The basic objective of this paper is to acquaint the students with the basic concepts of management necessary to deal with emerging business environment besides sensitizing them about societal challenges.

10. Details of Course:

S.No.	Detail Contents	Contact Hrs.
1	Definition of management, importance of management, management principals, managerial roles, managerial ethos, management vs administration, managerial functions, task and responsibilities, organizational structure, motivation: meaning, theories and techniques.	8
2	Concept of business environment, corporate social responsibility and corporate governance, managerial values and ethics.	8
3	Objectives and importance of financial management, basics of capital budgeting, cost of capital, emerging sources of funds for new projects, introduction to stock market.	9
4	Functions of marketing, marketing Vs sales, interface of marketing with other departments, customer life time value, new product development, unethical issues in marketing.	8
5	Introduction to knowledge management, knowledge society, knowledge economy, building knowledge assets, sources of knowledge, technology innovation process, E-governance: definition, objectives and significance; challenges in Indian context, Digital India programme.	9
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011(ISBN:9780273755869)
2	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005 (ISBN: 8125918523)
3.	Management, James A F Stonner, Pearson Education,2010 (ISBN: 9788131707043)
4.	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, 2013 (ISBN: 9788131767160)
5	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press, 2013 ISBN: 9780199691937.

1. Subject Code: **PE 252** Course Title: **Manufacturing Machines**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarise students with different machine tools.
10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to Machine Tools:** Classification, similarities; various cutting tools and cutting fluids: speed of cutting, feed rate, machining rate and machining time.	7

2	**Lathe**: Construction, important mechanisms viz. apron, tail stock, head- stock, feed box; specification, operations e.g., taper turning, eccentric turning, screw cutting.	7
3	**Drilling machine**: Construction, feed mechanism: Specification, geometry and nomenclature of twist drill, operations e.g. reaming, boring, tapping.	7
4	**Milling machine**: Construction, types specifications; cutters, dividing head, simple compound and differential indexing; various operations: Slab milling, angle cutting, slot milling, fly milling, slit gear milling, spur and bevel, T- slot milling, nature of operations, up and down milling.	7
5	**Shaper, Slotter, Planer**: Construction, automatic feed mechanism, quick return mechanisms: operations e.g., horizontal, vertical and inclined machining, spline cutting, keyway cutting, contour machining.	7
6	**Grinding Machines**: M, N types and construction features, Operations e.g. Plane, cylindrical, internal and centreless grinding, tool and cutter grinding, grinding wheels- specifications, shapes, setting, dressing, truing.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Fundamentals of Metal Cutting & Machine Tools by B.L.Juneja, G.S.Sekhon&Nitin Seth, New Age International Publications.
2	Manufacturing Technology: Metal Cutting & Machine Tools by P.N.Rao, Tata McGraw Hill Publications.
3	Introduction to Machining Science by G.K.Lal, New Age International Publications.
4.	Workshop Technology Vol.2, by B.S.Raghuwanshi, DhanpatRai& Sons, Publications**.**
5.	Elements of Workshop Technology Vol.2, by HazraChandhari, Media Promoters

1. Subject Code: **ME 202** Course Title: **Thermal Engineering-II**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : IV

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with gas power cycles. To teach them principles of compressors and turbines. To teach them principles of gas dynamics and jet propulsion.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Reciprocating Air Compressor:** Steady flow analysis, isothermal, adiabatic and polytropic compression; single- and multi-stage compression, ideal intermediate pressure; compressor clearance, volumetric and isothermal efficiency; minimum work requirement of a compressor.	7
2	**Centrifugal compressor:** Velocity diagrams, efficiency of compressor stage, choice of reaction stage pressure rise, surging, multi-stage compressor, compressor performance, vaccum pump.	5
3	**Gas Power Cycles** Air standard cycle, Otto, diesel and dual cycles, P-V and T-s diagrams of these cycles, efficiency, mean effective pressure. comparison of Otto, diesel, dual cycles for same compression ratio and heat input, stirling cycles, ericsson cycle, atkinson cycle, basic gas turbine (Brayton) cycle (for open and closed systems), efficiency of gas turbine cycle	8
4	**Gas Turbines:** Simple open and close cycle gas turbine, efficiency and specific output of simple cycle, effects of regeneration, re-heating and inter-cooling on efficiency and work output, effect of operating variables on thermal efficiency, air rate, work ratio; water injection, Advantages and disadvantages of gas turbine; gas turbine components, performance and application of gas turbine	10

5	**Gas Dynamics:** Fundamentals of gas dynamics, energy equation, stagnation properties, isentropic flow through nozzle and diffusers, Introduction to shock waves.	6
6	**Jet Propulsion:** Introduction to jet propulsion, advantages and disadvantages of jet propulsion, turbojet engine with and without after burner, turboprop, ram jet, pulse jet, rocket engines – operation, solid and liquid propellants.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Engineering Thermodynamics** by Gordon Rogers and Yon Mayhew, Pearson publisher, ISBN- 0582045665, 1992.
2	**Thermal Engineering** by S. Domkundwar, DhanpatRai& Co (p) Ltd, ISBN-8177000217.
3	**Applied Thermodynamics** by Onkar Singh, New Age International (p) Limited, ISBN- 2122425036.
4.	**Gas Turbines** by Cohen & Rogers, Pearson Prentice Hall, ISBN- 9780582236325.
5.	**Fundamentals of Gas Dynamics** By Robert D. Zucker and Oscar Biblarz, John Wiley & Sons, Inc.
6.	**Fundamentals of Gas Dynamics**by Robert P. Benedict, John Wiley & Sons, Inc.

1. Subject Code: **ME 204** Course Title: **Fluid Mechanics**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To understand and use differential equations to determine pressure and velocity variations in internal and external flows. To understand the conservation principles of mass, momentum, and energy for fluid flow. To learn to use equations in combination with experimental data to determine losses in flow systems. To learn to use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity. To apply the basic applied-mathematical tools that support fluid mechanics.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction:** Fluid and flow definition and types, continuum, fluid properties. **Fluid Statics:** Pressure variation in a static fluid; hydrostatic manometry; forces on planes and curved surfaces, stability of submerged and floating bodies.	4
2	**Fluid kinematics**: General description of fluid motion, steady flow, uniform flow; stream, streak and path lines; Lagrangian and Eulerian approach; Continuity equation, particle acceleration; rotational and irrotational flow; stream function; velocity potential function, flow nets; circulation; simple flows; source, sink, vortex, doublet, free and forced vortex.	9
3	**Fluid Dynamics:** Concept of system and control volume; Reynold's transport theorem, Euler's equation, Bernoulli's equation, Navier Stokes equation; Flow measurement- Venturimeter, Orfice meter, Pitot- tube, flow meters, notches. **Dimensional analysis:** Buckingham's π- Theorem. Non-dimensional parameters, similarity and its application to fluid problems.	7
4	**Viscous flow:** Laminar flow between parallel surfaces and through the circular pipes, Momentum and Kinetic energy correction factors; power absorbed in viscous resistance, film lubrication.	7

5	**Turbulent flow:** Transition from laminar to turbulent flow, turbulence and turbulence intensity, turbulence modeling, Prandtl mixing length hypothesis; flow losses in pipes- major and minor losses, pipes in series and parallel, hydraulically smooth and smooth and rough pipes, friction factor charts.	8
6	**Laminar and Turbulent Boundary Layer flows**: Boundary layer concept, boundary layer thickness, displacement, momentum and energy thickness. Momentum integral equation; drag on flat plate. Boundary separation. Flow around immersed bodies- drag and lift.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Introduction to Fluid Mechanics and Fluid Machines, Som.S.K&Biswas.G, Tata McGraw-Hills Publishing Company Limited, ISBN- 0074633716, 2003.
2	Fluid Mechanics, Cengel&Cimbala, Tata McGraw-Hills. Third Edition, ISBN-0070700346, 2015.
3	Fluid Mechanics, White F.M, Tata McGraw-Hill Publishing Company Limited. Seventh Edition, ISBN-0071333126, 2011.
4.	Fundamental of Fluid Mechanics by Munson, young, Okiishi, Huebsch, 6th Edition, Wiley, ISBN- 9788126523924, 2013.
5.	Introduction to Fluid Mechanics, Fox and Pritchard, Seventh Edition. Wiley India, ISBN- 9788126523177.

1. Subject Code: **ME 206** Course Title: **Kinematics of Machines**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4

6. Semester : IV

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To teach students kinematic analysis and synthesis of mechanisms. To make them understand basics of cams, gear trains, belt and rope drives so that they can make a correct choice of power transmission element.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Review of mechanics:** Kinematics of a particle, time derivative of a rotating vector, vector derivatives in a rotating system, kinematics of a rigid body, Chasle's theorem, Coriolis acceleration, Euler's equation. **Introduction to mechanisms**: Mechanisms and machines, Plane and space mechanisms, different types of kinematic pairs, kinematic chain, kinematic diagram, degrees of freedom, Grubler's equation, Grashof's criterion, kinematic inversions of 4R, 3R-P, 2R-2P chains, velocity and acceleration diagrams, instantaneous center method, Kennedy-Arnold theorem.	7
2	**Cams:** Classification, Follower diagrams, construction of Cam profile. High speed Cams. Cams with specified contours. Analysis of a rigid Eccentric Cam.	7
3	**Toothed Gearing**: Law of gearing, spur gears, geometry of tooth profiles, cycloidal and involute profile, minimum number of teeth on pinion, interference, arc of contact, terminology of helical gears. **Gear trains:** Simple, compound and epicyclic gear trains.	7
4	**Mechanisms with lower pairs:** Straight line mechanisms like Peaucellier's mechanism and Hart mechanism, Engine indicator mechanism, Steering mechanism of vehicles, Hooke's joint etc.	7
5	**Friction:** Pivot and Collar friction, clutches, belt and rope drives, boundary friction, film lubrication, rolling friction.	7
6	Introduction to synthesis of linkages, use of software for motion and interference analysis.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Kinematics and Dynamics of Machinery, R.L. Norton, Tata McGraw-Hill, ISBN-9780070144804, 2009.
2	Theory of mechanisms and machines, A Ghosh and A K Mallik, East-West Press, ISBN- 8185938938, 2012.
3	Theory of Machines and Mechanisms, J. E. Shigley, J. J. Uicker, McGraw Hill, 2nd edition, ISBN- 0071137475, 1995.
4.	The Theory of Machines, Thomas Bevan, CBS publishers and distributers, 3rd edition, ISBN- 8123908741, 2005.

1. Subject Code: **ME 208** Course Title: **Manufacturing Technology-I**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To familiarise students with directional solidification during casting of different metals. To enable the students to understand the joining of metals by fusion or non-fusion or by application of pressure. To familiarise the students with forming behaviour of different metals at different temperatures.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Casting:** Properties of moulding sand, Sand testing, Gating and risering system, Principle, process and applications of Die casting, Centrifugal casting, Investment casting, and Continuous casting, Melting of metal for casting, Casting defects their causes and remedies, Cleaning and Inspection of castings, Foundry mechanization and layout.	7
2	**Welding:** Principle, equipment, and applications of Submerged Arc Welding (SAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Plasma Arc Welding,	7
3	Ultrasonic Welding, Electron Beam Welding (EBW) and Laser Beam Welding (LBW).Gas cutting and arc cutting of metals, Welding defects their causes and remedies.	7
4	**Metal Forming:** Mechanical behaviour of metals in elastic and plastic deformation, stress-strain relationships, Yield criteria, Concept of flow stress by true stress-strain curves	7
5	Hot Forming and Cold Forming, Analysis of important metal forming processes like Forging, Rolling, Extrusion, Wire Drawing by slab method, Sheet metal forming processes. Introduction to High Energy rate forming processes.	7
6	**Powder Metallurgy:** Powder metallurgy process and operations, Advantages, Applications and Limitations of powder metallurgy.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Manufacturing Technology by P.N.Rao, Tata McGraw Hill Publications
2	Manufacturing Processes and Automation by R.S.Parmar, Khanna Publications
3	Workshop Technology Vol.1, by B.S.Raghuwanshi, DhanpatRai Publications
4.	Processes & Materials of Manufacture by R.A.Lindberg, Prentice Hall Publication
5.	Principle of Metal Casting by Heine & Rosenthal, Tata McGraw Hills Publication

6.	Welding Processes and Technology by R.S.Parmar, Khanna Publications
7.	Welding & Welding Technology by Richard L Little, Tata McGraw Hill Publications
8.	Metal Forming Processes by G.R.Nagpal, Khanna Publications.

1. Subject Code: **HU202** Course Title: **Engineering Economics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : IV
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To enable the students to understand the economic theories which may be applied to maximize return and the economic environment in which they have to operate.
10. Details of Course:

S.No.	Contents	Contact Hours
1.	**Introduction:** Nature and significance of economics, Goods and Utility, Basic Concept of Demand and Supply, Elasticity of Demand- Price elasticity of Demand, Cross elasticity of Demand, Production - Production Function, Production Process and Factors of Production, Market – Introduction to Monopoly, Perfect Competition, Oligopoly and Monopolistic Competition, Cost Concepts- Opportunity Cost, Total Cost, Average Cost; Marginal Cost; Life Cycle cost, Sunk Cost; Preparation of Cost Sheet Profit Maximisation- numerical problem.	10

2.	**Money- its evaluation and function, Bank- Commercial Bank and Central Bank and brief idea about function of banking system:**. Tax and Subsidy, Type of Tax- Direct and Indirect, Monetary and fiscal policy, Inflation and Business cycle, International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection, Dumping, Balance of Payment.	10
3.	**Role of Science, Engineering and Technology in Economic Development:** Seven salient Features of the Indian Economy; Inclusive Growth; relevance for the Indian Economy; Globalisation & opening up of the Indian Economy; GDP- definition and Its measurement; How knowledge of engineering and technology may be used to improve life at slums; Green Revolution and White revolution. Reasons for their success and can we replicate them. Appropriate Technology & Sustainable Development. Entrepreneurship: Macro environment for promotion of entrepreneurship: How environment has changed after advent of IT and Globalisation.	12
4.	**Elementary Economic Analysis:** Interest formulas and their Applications; Calculations of economic equivalence, Bases for Comparison of Alternatives: Present Worth Method, Future worth method, Annual equivalent, Internal Rate of Return; Business Risk; Factors which should be taken care while deciding price of the product in the market.	10
TOTAL		**42**

11. Suggested References:

S.No.	Name of Books / Authors/ Publishers
1.	G.J. Thuesen, & W.J. Fabrycky, Engineering Economy, Pearson Education, 2007, ISBN 013028128X
2.	William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, Prentice Hall,(First Indian reprint). 2009, ISBN 0131486497
3.	Donald G. Newman, Jerome P. Lavelle & Ted G. Eschenbach, Engineering Economic Analysis, Oxford University Press, USA , 2004, ISBN 0195168070
4.	Seema Singh, Economics for Engineering Students, IK International Publishing House Pvt. Ltd, 2014, ISBN 8190777041

1. Subject Code: **ME 301** Course Title: **Fluid Systems**

2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : V

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To provide an understanding of the fundamentals of fluid mechanics, and appreciation of the design principles in fluid systems, the ability to analyse existing fluid systems and capablity to think new hydraulic system.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**INTRODUCTION:** Euler's equation of turbo machines; impulses and reaction forces due to fluid systems on stationary and moving systems of vanes; jet propulsion.	7
2	**WATER TURBINES:** Classification; Pelton, Francis, propeller and Kaplan turbines; Velocity triangles, efficiency, draft tubes.	7
3	**Pumps:** Centrifugal pumps; velocity triangles, efficiency, turbine pumps, axial and mixed flow pumps, positive displacement pumps; reciprocating, gear and wave pumps. **Performance of Fluid Machines:** Similarity laws applied to roto-dynamic machines, specific speed, unit quantities, characteristic curves, use of models, cavitation and attendant problems in turbo machines, selection of turbines, hydroelectric plants.	7

4	**Hydraulic power transmission:** Transmission of hydraulic power through pipe lines; water hammer; precaution against water hammer in turbines and pump installations, hydraulic ram.	7
5	**Miscellaneous Hydraulic Machines:** Accumulators, intensifiers, presses, cranes, fluid coupling, torque converter. Hydraulic and Pneumatic Power: Simple Hydraulic circuits, hydraulic control valves, Pneumatic power.	7
6	Introduction to Computational Fluid Dynamics and its Application for simple problems of incompressible, compressible, laminar, turbulent flows, flows with heat transfer and flow with free surface.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Introduction to Fluid Mechanics and Fluid Machines, Som.S.K&Biswas.G, Tata McGraw-Hills Publishing Company Limited, ISBN- 0074633716, 2003.
2	Fluid Mechanics ,Yunus A. Cengel and John M Cimbala, Third Edition, McGraw-Hill, ISBN- 0070700346, 2015.
3	Hydraulic Machines- by K Subramanya , Mc Graw Hill, ISBN- 1259006840, 2014.
4.	Fluid Power with Applications by Anthony Esposito, 6th Edition, Pearson, ISBN-9788177585803, 2003.
5.	Fluid Flow Machines, GovindaRao.N.S, Tata McGraw-Hills Publishing CompanyLimited, ISBN- 0074518542, 2008.

1. Subject Code: **ME 303** Course Title: **Dynamics of Machines**
2. Contact Hours: 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4

6. Semester : V

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To make students understand the forces involved in a mechanism, and the principles involved in flywheel, governors and gyroscopes. To understand vibration, balancing and wear related problems.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Flywheels:** Turning moment diagrams for I.C. engines; steam engine and power presses, speed and energy fluctuations.	7
2	**Governors:** Function of a governor, types of governors, weight loaded, spring loaded, efforts and power of a governor, controlling diagrams.	7
3	**Gyroscopes:** Principles of Gyroscope, gyroscopic couple and its effect on two wheel and four wheel vehicles and ships.	7
4	**Balancing:** Dynamic analysis of slider-crank mechanism, Balancing of rotating parts and primary balancing of reciprocating parts, primary and secondary balancing of in-line engines, partial balancing of locomotive engines and its effect, balancing machines.	7
5	**Vibrations:** Free vibration of a body, single degree of freedom system; transverse vibration of beams with uniform and concentrated loads by Rayleigh method; torsional free vibration of two rotor system, three rotor system and geared systems; free vibrations with viscous damping; logarithmic decrement; response of damped spring mass system to harmonic forces; whirling of shafts, vibration isolation and vibration of mass supported on foundations subject to vibrations; vibration simulation.	7
6	**Introduction to Tribology**: Theory of friction wear and lubrication.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	Kinematics and Dynamics of Machinery, R.L. Norton, Tata McGraw-Hill, ISBN-9780070144804, 2009.
2	Theory of mechanisms and machines, A Ghosh and A K Mallik, East-West Press, ISBN- 8185938938, 2012.
3	Theory of Machines and Mechanisms, J. E. Shigley, J. J. Uicker, McGraw Hill, 2nd edition, ISBN- 0071137475, 1995.
4.	The Theory of Machines, Thomas Bevan, CBS publishers and distributers, 3rd edition, ISBN- 8123908741, 2005.

1. Subject Code: **ME 305** Course Title: **Design of Machine Elements**
2. Contact Hours: 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To enable the students to formulate and analyse the stresses and strains in various machine elements under static and dynamic loads. Students will be able to select a suitable material and factor of safety depending upon the design parameters.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction to Mechanical Engineering Design, design process, Interaction between design process elements, Design-economics, Uncertainty, Stress and strength, Codes and Standards, Factors of safety (FOS), selection of FOS, Probabilistic approach to Design, Engineering materials-ferrous and non-ferrous, Designation of steels as per IS and ASTM standards. Selection of materials- the basics, selection strategy, computer aided selection. Manufacturing considerations in design, interchangeability, Limits, Fits, and Tolerances as per Indian Std. System.	7
2	Failures resulting from static loading, static strength, and stress concentration. Failures resulting from variable loading, introduction to fatigue in metals, Strain life relationship, stress life relationship. Endurance limit modifying factors, stress concentration and notch sensitivity, Cumulative damage in fatigue, design factors in fatigue.	7
3	Design of Cotter joints and knuckle joints. Riveted joints: Stresses in riveted joints; failure analysis on strength basis; Riveted joints in boilers and pressure vessels; structural riveted joints, eccentric loading of structural rivets.	7
4	Threaded fasteners: Thread standards; stresses in screw threads; preloading of bolts; bolted joints; eccentric loading; design of screw jack, Pipe joints: Design of Oval, square and round flanged pipe joints under low and high pressure. Welded joints: Types of welded joints; stresses in butt and fillet welds; torsion and bending in welded joints; welds subjected to fluctuating loads.	7
5	Springs: Stresses in helical springs; deflection of helical springs; extension, compression and torsion springs; design of helical springs for static and fatigue loading; critical frequency of helical springs; stress analysis and design of leaf springs.	7
6	Design of shafts: Stresses in shafts; design for static loads; reversed bending and steady torsion; design for strength and deflection; design of shafts under fatigue loading; Design of keys and couplings: rigid and flexible coupling. Design of spur gears using Lewis and Buckingham equation and AGMA design standards. Design of mechanical elements using solid modeling and finite element analysis using available softwares in CAD Laboratory.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Mechanical Engineering Design,Shigley, J. E., Mischke, C. R. and Budynas, R. G., McGraw Hill, 7th Edition, ISBN- 0071077839, 2004.
2	Fundamental of Machine Component Design, " Juvinall, R. C., and Marshek, K. M., John Wiley and Sons, ISBN- 0471448443, 2000.
3	Fundamentals of Machine Elements Hamrock, B. J., Jacobson, B. Schmidt, S. R., McGraw Hill, ISBN- 9781482247480, 1999.
4.	An Integrated Approach,Norton, R. L., Machine Design: Pearson Education, ISBN- 9788131705339, 2001.
5.	Machine Design Bhandari TMH
6.	Machine Design D. K. Aggarwal and P. C. Sharma, Dhanpat Rai, ISBN-9789350142813.

1. Subject Code: **ME 307** Course Title: **Manufacturing Technology-II**
2. Contact Hours: 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To familiarise the students with theory of metal cutting, and principles involved in conventional and non-conventional machining. To understand the design features involved in machine tools, jigs and fixtures, and importance of limits, fits and tolerances.

10. Details of Course:

S . No.	Contents	Contact Hours
1	**Theory of Metal Cutting:** Mechanics of metal cutting- Orthogonal and oblique cutting, Chip formation, Types of chips, Chip control, Merchants theory of cutting forces at tool point, Limitations and modifications of Merchants theory, Plowing forces and the 'Size effect', Heat generation in metal cutting, Cutting fluids and their physical action, Tool wear, Tool life and Machinability, Nomenclature of cutting tools and Cutting tool materials, Economics of machining, Analysis of milling and grinding processes.	7
2	**Design Features of Machine Tools:** Design requirements of machine tools, Kinematic drives of machine tools, Types of machine tool drives	7
3	Design of machine tool spindle.	7
4	**Non conventional machining:** Studies on basic principle, working and effects of process parameters of the following processes: Ultrasonic machining (USM), Abrasive jet machining (AJM), Electro-discharge machining (EDM), Electro-chemical machining (ECM), Electron beam machining (EBM), Plasma arc machining (PAM) and Laser beam machining (LBM).	7
5	**Metrology:** Introduction to Metrology and its relevance, Limits, fits, and tolerances, Linear and angular measurements.	7
6	**Jigs & Fixtures**: Important considerations in jigs and fixture design. Main principles of designing of jigs and fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Fundamentals of Machining & Machine Tools by Geoffrey Boothroyd & Winston A. Knight, Marcel & Dekker Publications.
2	Fundamentals of Metal Cutting & Machine Tools by B.L.Juneja, G.S.Sekhon&Nitin Seth, New Age International Publications

3	Manufacturing Technology by P.N.Rao, Tata McGraw Hill Publications
4.	Production Engineering Sciences by P.C. Pandey& C.K. Singh, Standard Publications.
5.	Engineering Metrology by R.K. Jain, Khanna Publications
6.	Engineering Metrology by I.C.Gupta

1. Subject Code: **HU301** Course Title: **Technical Communication**
2. Contact Hours : 28 L: 2 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 2
6. Semester : V
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To train students for business communication to enhance employability skills with special emphasis on placement interviews and public speaking.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	English for Professional Purposes: Technical Communication- Methods, Strategies and Skills Communication in Global Contexts- Social, Cultural, Political and Technical, especially in formal set up	 1 2
2.	Communication at the Workplace: Oral and Written: **Written Communication**- Letters, Orders (Sale/Purchase) Report Writing, Technical proposals, Resume, SOP, Memo, Notice, Agenda, Minutes, Note Taking/Making, **Oral Communication**: Seminars, Conferences, Meetings, Office Etiquettes/ Netiquettes, Presenting Written Material Negotiation, Demonstration, Group Discussion, Interview	 6 6

3.	**Group Discussion** and **Report Writing:** Group Discussion (Continous assessment through the semester) Minor Report Writing(to be submitted before Mid- Semester Examination) Major Report writing (To be submitted before End Semester Examination)	13
Total		**28**

11. Suggested Books& References:

Sl.No.	Name of Books, Authors, Publishers
1	Technical Communication: Principles and Practice Raman, Meenakshi and Sangeeta Sharma, Oxford University Press, 2014, ISBN-13: 978-0-19-806529-6
2	Writing to Get Results, (3rd Ed) Blicq, Ron S., Lisa A. Moretto, John Wiley and Sons, Inc.,2001, ISBN 0-7803-6020-6
3	Effective Technical Communication: A Guide for Scientists and Engineers , Mitra, Barun K. OUP: Delhi, 2006, ISBN-13: 978-0-19-568291-5
4	Personality Development and Soft Skills, Mitra, Barun K. New Delhi: Oxford University Press.,2014, ISBN-9780198060017
5	The Essence of Effective Communication**,** Ludlow, Ron and Fergus Panton. Prentice Hall: PHI.,1996, ISBN-81-203-0909-X
6	Advanced Technical Communication, Gupta, Ruby. Foundation Books,2011, CUP. ISBN 978-81-7596-733-5
8	Soft Skills: Enhancing Employability, Rao, M.S. Connecting Campus with Corporate, 2011, ISBN: 978-93-80578-38-5
9	Developing Communication Skills (2nd Ed), Mohan, Krishna and Meera Banerji, Macmillan Publishers India Ltd.,2009 ISBN 13: 978=0230-63843-3

1. Subject Code: **ME 302** Course Title: **Heat and Mass Transfer**
2. Contact Hours: 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To familiarise the students with the modelling of different transport phenomena. To enable them to make calculations of heat transfers that will help them in design and analysis of any thermal system.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction and Conduction:** Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's Law, combined modes of heat transfer, thermal diffusivity, and overall heat transfer coefficient, thermal conductivity of solids, liquids and gases, factors influencing conductivity, measurement, general differential equation of conduction, one dimensional steady state conduction, linear heat flow through a plane and composite wall, tube and sphere, critical thickness of insulation, effect of variable thermal conductivity, conduction with heat sources, heat transfer from extended surfaces, fin performance, concept of corrected fin length/ error in temperature measurement by thermometer well, transient heat conduction- lumped system analysis, transient temperature charts (Heisler and Grober charts), transient heat conduction in multidimensional systems.	7
2	**Convection (Forced):** Introduction, laminar boundary layer equations for internal and external flows; laminar forced convection on a flat plate and in a tube, Reynolds-Colburn analogy/Dimensional analysis and physical significance of the dimensionless parameters	7
3	**Convection (Natural):** Dimensional analysis of natural convection; empirical relationship for natural convection, convection with phase change, description of condensing flow, theoretical model of condensing flow, introduction to heat pipe, regimes of boiling heat transfer, empirical relationships for convection with phase change.	7

4	**Thermal Radiation:** Introduction, absorption and reflection of radiant energy, emission, radiosity and irradiation, black and non black bodies, Kirchoff's law; intensity of radiation, radiation exchange between black surface, geometric configuration factor, grey body radiation exchange between surfaces of unit configuration factors, radiation shields, electrical analogy to simple problems, non-luminous gas radiation, errors in temperature measurement due to radiation.	7
5	**Heat Exchangers:** Different types of heat exchangers; design of heat exchangers, LMTD and NTU methods, fouling factor and correction factor, Introduction to compact and plate heat exchangers.	7
6	**Mass Transfer:** Mass and mole concentrations, molecular diffusion, Fick's law; eddy diffusion, molecular diffusion from an evaporating fluid surfaces, introduction to mass transfer in laminar and turbulent convection, dimensionless parameters in convective mass transfer, combined heat and mass transfer	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Fundamentals of Engineering Heat and Mass Transfer** by R.C.Sachdeva, New Age International Publishers.
2	**Fundamentals of Heat and Mass Transfer** by P Frank. Incropera and David P. DeWitt, John Wiley and Sons.
3	**Heat Transfer** by A. Bejan, John Wiley and Sons.
4.	**Heat Transfer** by M.N. Ozisik, McGraw Hill Book Co.
5.	**Heat Transfer A Practical Approach** by A.CenegelYunus, Tata McGraw Hill.
6.	**Engineering Heat and Mass Transfer** by Mahesh M. Rathore, Laxmi Publications.

7.	**Heat and Mass Transfer** by J.P Holman, Tata McGraw Hill.
8.	**Fundamentals of Momentum, Heat and Mass Transfer** by James R.Welty; John Wiley & Sons (Pvt). Ltd.

1. Subject Code: **ME 304** Course Title: **Production and Operations Management**
2. Contact Hours : 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To understand the concepts of production and service systems. To apply various principles and techniques in the design, planning and control of production systems to optimise best use of resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to POM** Introduction to POM, Operations strategy, strategy design process, corporate and operations strategies, Operations competitive dimensions, Process of decision making under- certainty, uncertainty and risk.	7
2	**Product and Process Design** Product design and development processes, product life cycle, Process flow chart, Types of processes, Process performance, Learning curve.	7

3	**Facility location and Layout** Factors affecting the location decisions, methods of facility location-factor rating systems, centroid method, and profit volume analysis; Types of layout, Block diagram and Assembly Line Balancing.	7
4	**Demand Forecasting** Qualitative and quantitative forecasting, Time series and regression models, Measures of forecasting errors.	7
5	**Inventory model** Importance of inventory, understocking and overstocking, Fixed order quantity models and fixed time period models (EOQ models), Selective inventory management- ABC, VED, and FSN analysis, JIT manufacturing system, Toyota production systems- KANBAN model, and elimination of waste.	7
6	**Project Management** Defining and organizing projects, feasibility study of projects, project planning, project scheduling- work breakdown structure, PERT & CPM, analyzing cost-time trade off, monitoring and controlling of projects.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Operations Management, Jay Heizer, Barry Render; Pearson learning, ISBN-0132863308, 2013.
2	Operations management for competitive advantage; Chase, Jacob, and Aquilano; TMH, ISBN- 0070604487, 2000.
3	Modern Production/Operations Management, Buffa and Serin, John Weily India, ISBN- 8126513721, 2007.
4.	Operation Management, Krajewski and Ritzwan, Pearson Education.
5.	Production and Operations Management, Adam, Jr. Elbert, PHI

1. Subject Code: **HU304** Course Title: **Professional Ethics and Human Values**

2. Contact Hours : 28 L: 2 T: 0 P: 0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS:0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 2

6. Semester : VI

7. Subject Area : HMC

8. Pre-requisite : NIL

9. Objective : To make students aware of the ethics and codes of conduct required by Engineers and Professionals.

10. Details of the Course:

Sl No.	Contents	Contact Hours
1	**Human Values and Ethics:** Morals, Values, Ethics and Integrity, Need for Value Education for Engineers, Happiness, Prosperity, Harmony.	6
2.	**Code of Ethics and Professionalism:** Professionalism and the Code of Ethics, Technical Education, Human Values and Coexistence, Universal Human Order, Natural acceptance.	6
3.	**Professional Ethics and Technology:** Science, Technology and Professional Ethics, Engineering Ethics, Environmental Ethics, Safety, Responsibility and Rights	8
4.	**Case Studies:** Holistic Technologies, Eco-friendly production systems, The role of responsible engineers and technologists, Global Issues concerning Engineers	8
Total		**28**

11.Suggested Reference:

Sl.No.	Name of Books, Authors, Publishers
1.	Professional Ethics, Subramanian, R, Oxford University Press, 2011 ISBN13: 978-0-19-808634-5
2.	Professional Ethics and Human Values,Govindarajan, M. S. Natarajan, V.S. Senthilkumar PHI, 2013**ISBN: 978-81-203-4816-5**
3.	Constitution of India and Professional Ethics, Reddy, G.B. and Mohd. Suhaib, IK International Publishing House. 2006 ISBN: 81-89866-01-X
4.	Introduction to Engineering Ethics (2nd Ed.) Martin, Mike W. and Roland Schingzinger McGraw-Hill, 2010 ISBN 978-0-07-248311-6

1. Subject Code: **ME 401** Course Title: **B. Tech. Project-1**

2. Contact Hours : 0 L: 0 T: 0 P: 0

3. Examination Duration (Hrs.) : Theory: 0 Practical: 0

4. Relative Weight : CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To familiarize the students to work in a group and provide solution to an engineering problem. They should also be able to write and present the work done during the course.

1. Subject Code: **ME 403** Course Title: **Training Seminar** (Duration eight weeks in summer vacations at the end of VIth semester)

2. Contact Hours: 0 L: 0 T: 0 P: 0

3. Examination Duration (Hrs.) : Theory: 0 Practical: 0

4. Relative Weight : CWS: - PRS: - MTE: - ETE: - PRE: -

5. Credits : 2

6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with working culture of the industrial system. They should also be able to write and present the work done during the training.

1. Subject Code: **ME 407** Course Title: **Refrigeration and Air Conditioning**
2. Contact Hours: 42+28=70 L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To learn properties of different refrigerants, and thermodynamic cycles of refrigeration. To understand comfort parameters and air conditioning.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to Refrigeration**: Necessity and applications, unit of refrigeration and C.O.P., types of Ideal cycles of refrigeration, air-refrigeration, bell coleman cycle, open and dense air systems, actual air-refrigeration system problems, refrigeration needs of aircrafts, actual refrigeration system	8
2	**Vapour Compression Refrigeration**: Working principle and essential components of the plant, simple vapour compression refrigeration cycle - COP, Representation of cycle on T-S and p-h charts - effects of sub cooling and super heating - cycle analysis - Actual cycle, Influence of various parameters on system performance – necessity of multistaging, multistage compression system, and their analysis, necessity and working of cascading system	10
3	**Refrigerants and Absorption Refrigeration:** Desirable properties of refrigerants , classification of refrigerants used, nomenclature, ozone depletion, global warming, vapor absorption system, calculation of max COP, description and working of NH3 - water system and Li Br –water, three fluid absorption system and its salient features, steam jet refrigeration system - working principle, basic components and analysis, principle and operation of vortex tube or hilsch tube.	8

4	**Air Conditioning**: Psychometric properties & processes, comfort air-conditioning, summer and winter air-conditioning, cooling & dehumidification systems, load calculation and applied psychrometry	8
5	**Human Comfort:** Requirements of human comfort and concept of effective temperature, comfort chart, comfort air-conditioning, requirements of industrial air-conditioning, air-conditioning load calculations.	6
6	**Control:**Refrigeration and air-conditioning control, air handling, air distribution and duct design	2
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Refrigeration and Air Conditioning** by C. P. Arora, Tata McGraw Hill, ISBN-9788120339156.
2	**Refrigeration and Air Conditioning** by A. R .Trott and T. C. Welch, Butterworth-Heinemann, ISBN- 9780080540436.
3	**Refrigeration and Air ConditioningTechnology** by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, ISBN- 1111644470.
4	**Refrigeration and Air Conditioning** by Abdul Ameen, Prentice Hall of India Ltd, ISBN- 9789303206560..
5	**Basic Refrigeration and Air Conditioning** by P. N. Ananthanarayan, Tata McGraw Hill, ISBN- 9789383286560.
6	**Refrigeration and Air Conditioning** by Wilbert F. Stoecker and Jerold W. Jones, Tata McGraw Hill, ISBN- 007061623X.
7	**Refrigeration and Air Conditioning by** Richard Charles Jordan, Gayle B. Priester, Prentice hall of India Ltd, ISBN-9780406269313.
8	**ASHRAE Handbook – Refrigeration 2010,** ISBN- 9781933742922.

1. Subject Code: **ME-402** Course Title: **B.Tech project-II**

2. Contact Hours : L: 0 T: 0 P: 0

3. Examination Duration (Hrs.) : Theory: 0 Practical: 0

4. Relative Weight : CWS: 0 PRS: 0 MTE: 0 ETE:0 PRE: 0

5. Credits : 8

6. Semester : VIII

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

1. Subject Code: **ME 404** Course Title: **Industrial Engineering**

2. Contact Hours: 42+28=70 L: 3 T: 0 P: 2

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To train the students for applying Industrial Engineering concepts.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction** Introduction, Definition and objectives of Industrial Engineering, Scope of Industrial Engineering, Production systems and their classifications; Productivity-Total and partial productivity, Reasons and remedy for poor productivity.	7

2	**Job analysis and Work Measurement Systems** Work System Design: Taylor's scientific management, Gilbreth's contributions; method study, micro-motion study, principles of motion economy; work measurement - stop watch time study, micro motion and memo motion, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering.	7
3	**Production Planning and Control** Types and characteristics of production systems, Objectives and functions of Production, Planning & Control, Routing, Scheduling and Operations scheduling, production scheduling, job shop scheduling problems, sequencing problems, scheduling tools and techniques, Loading, Dispatching and its sheets & Gantt charts.	7
4	**Quality Engineering** Quality concept and costs; statistical quality control, Concept of specification limits, statistical control limits, process capability, Process control and control charts for both attributes and variable data. Acceptance Sampling- Single and double sampling.	7
5	**Reliability and Maintenance** Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; Maintenance management and its objectives, Various types of Maintenance Planning, House Keeping, 5S concepts.	7
6	**Material Handling** Principles, functions, and objectives of Material Handling; Selection and classification of Material Handling Equipments; Relation of material handling with plant layout.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Industrial Engineering and Management; B. Kumar, Khanna Publication, ISBN-8174091963, 2011.
2	Introduction to work Study, International Labour Office, Geneva, 3rd edition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, ISBN- 8120406028, 2008.
3	Industrial Engineering and Management, Pravin Kumar, Pearson Education, 1st edition, ISBN- 9789332543560, 2015.

Departmental Elective Courses

1. Subject Code: **ME 306** Course Title: **Finite Element Method (DEC-1)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To enable students to apply Galerkin method and virtual work principle to problems in solid mechanics. To teach them numerical solution of differential equations with finite element method. To enable them to use standard softwares like ABAQUS and ANSYS etc.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Fundamental concepts of the Finite Element Method. One Dimensional Problem(Bar of uniform and variable cross sections), Galerkin approach, Potential energy approach, shape functions, Derivation of stiffness matrix and load vector for the element and for the entire domain. Evaluation of displacement, stresses and reaction forces.	10
2	**Trusses**:-. Introduction, Plane Trusses, Local and Global coordinate Systems, Element Stiffness Matrix and Stress calculations	4
3	**Beams and Frames:-**Finite element formulation for stiffness matrix, load vector, boundary conditions, Plane frame problems.	7
4	Two –Dimensional problem using Constant strain triangles(CST), Two dimensional isoparametric elements and numerical integration ,element stiffness matrix, Force vector. Axisymmetric solids subjected to axisymmetric loading.	9

5	Applications of finite element method to fluid mechanics and heat transfer.	7
6	**Dynamic analysis**:- Element mass matrices, Evaluation of Eigenvalues and Eigenvectors. Use of Softwares such as MAT LAB/ABAQUS/ANSYS/ NASTRAN/ IDEAS. Basic feature of these softwares.	5
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Finite Element Procedures, K.J. Bathe, Prentice Hall of India.
2	Finite Elements in Engineering by Chandrupatla and Belegundu.
3	Finite element Method by J.N.Reddy.
4.	Finite element Method,O.C. Zienkiewicz& R.A. Taylor
5.	Finite element Analysis,C.S. Krishnamurthy
6.	Finite element Method, Kenneth H. Hubener
7.	Finite Element Method, Desai & Abel

1. Subject Code: **ME 308** Course Title: **Gas Dynamics and Jet Propulsion (DEC-1)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To familiarise students with compressible flow and its applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Continuity equation, Momentum equation, Energy equation, stagnation properties	7
2	Isentropic flow with variable area, wave motion; Flow with normal shock waves, oblique shock waves	7
3	Flow in constant area duct with friction and with heat transfer	7
4	Measurement of fluid properties, anemometer, flow visualization.	7
5	Aircraft propulsion theory, Ramjet engine, Pulsejet engine; Rocket propulsion and its theory	7
6	Liquid propellant, solid propellant, rocket applications, space flights.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	S.M. Yahya, " Fundamentals of Compressible Flow ", New Age International (P) Limited, New Delhi, ISBN- 9788122426687, 1996.
2	P.Hill and C. Peterson, " Mechanics and Thermodynamics of Propulsion ", Addison -Wesley Publishing Company, ISBN- 0201146592, 1992.
3	N.J. Zucrow, " Aircraft and Missile Propulsion, Vol. I & II ", John Wiley, ISBN- 9780758104519, 1975.
4.	N.J. Zucrow, " Principles of Jet Propulsion and Gas Turbines ", John Wiley, New York, ISBN- 1258694360, 1970.
5.	H.Cohen, G.E.C.Rogers and Saravanamuttoo, " Gas Turbine Theory ", Longman Group Ltd, ISBN- 0582236320, 1980.
6.	G.P.Sutton, " Rocket Propulsion Elements ", John Wiley, New York, ISBN- 9780470080245, 1986.

7.	A.H.Shapiro, " Dynamics and Thermodynamics of Compressible Fluid Flow Vol.kl ", John Wiley, New York, ISBN- 0471066915, 1953.
8.	V.Ganesan, " Gas Turbines ", Tata McGraw Hill Publishing Co., New Delhi, ISBN-0070681929, 1999.

1. Subject Code: **ME 310** Course Title: **Automation in Manufacturing (DEC-1)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To understand the importance of automation using hydraulic and pneumatic systems. To familiarise the students with pneumatic and hydraulic circuits, electrical controls and logic circuits in automation.
10. Details of Course:

S. No.	Contents	Contact Hours
1	**Basic Principles:** Introduction to Automation. Productivity v/s automation materials handling systems. Evaluation of automatic production. Designing for automation.	6
2	**Hydraulic System:** Hydraulic Principles. Hydraulic pumps: Characteristics, Pump Selection, Pumping Circuits. Hydraulic Actuators: Linear, Rotary, Selection, Characteristics. Hydraulic Valves: Pressure, Flow, Direction Controls, Applications. Servo and Proportional Valves, Hydraulic Fluids: Symbols.	6

3	**Pneumatic Systems:** Pneumatic fundamentals.Production of compressed air. Types of cylinders. Control valves: direction, pressure and flow-air hydraulic equipments. Actuators. General approach to control system design. Symbols and drawing. Schematic layout. Cascade, Karnaugh, Veitch mapping method. air hydraulic control.	6
4	**Pneumatic and hydraulic circuits:** Hydraulic circuits: Reciprocating, Quick return, Sequencing synchronizing. Accumulator circuits. Safety circuits. Pneumatic circuits: Classic, Cascade, Step-counter, Karnaugh-Veitch mapping, Combination Methods.	6
5	Electrical control of fluid power: components and circuits. Micro-electronic control of fluid power: PLC-Microprocessors uses and selection criteria for components.	6
6	Logic Circuits: Position, Pressure Sensing, Switching, Electro Pneumatic, Electro Hydraulic, Robotic Circuits. Case studies: conveyor feed system, power pack, Bunker automatic circuits, etc.	6
7	Automation in machine tools,Mechanized feeding. Automatic assembly. Automatic machine tool control. Transfer lines. Factory automation	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Hydraulic and Pneumatic Controls, R Srinivasan, Vijay Nicole imprints Pvt. Ltd., Chennai.
2	Introduction to Hydraulic and Pneumatic S. Ilango and V. Soundararajan, Prentice-Hall of India, Delhi
3	Oil Hydraulic Systems : Principles and Maintenance", S. R. Majumdar, " Tata McGraw-Hill, Delhi
4.	" Pneumatic Systems : Principles and Maintenance", S. R. Majumdar, Tata McGraw-Hill, Delhi
5.	Power Hydraulics ",J.Michael, Pinches and John G.Ashby, " Prentice Hall
6.	Hydraulics and Pnematics (HB) ", Andrew Parr, " Jaico Publishing House

7.	Basic Fluid Power “, Dudleyt, A. Pease and John J. Pippenger, “ Prentice Hall
8.	Fluid Power with Applications “, Anthony Esposite, Prentice Hall

1. Subject Code: **ME 312** Course Title: **Quality Management & Six Sigma Applications (DEC-1)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To introduce the fundamental concepts of statistical process control and six sigma. To create an awareness of the quality-management-problem-solving tools currently in use.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to Quality** Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs-optimization of quality costs, Quality in manufacturing, services, health care, educational systems, the seven tools of quality.	7
2	**Philosophies in Quality Management Systems** Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi.Comparison of Quality Philosophies; Quality Management awards- Deming prize, Malcolm Baldrige National Quality Award, Kirloskar Award.	7

3	**Statistical Process Control** Introduction to Quality characteristics- variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	7
4	**Acceptance Sampling** Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	7
5	**ISO 9000:2000** Structure of ISO standards, Factors leading to ISO, Implementation and registration, Benefits of ISO.	7
6	**Six Sigma** Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	The Management and Control of Quality by J R Evans and W M , Lindsay, Cengage learning, India, ISBN- 0538882425, 1998.
2	Quality Management by KanishkaBedi, Oxford
3	Total Quality Management by Besterfield, Pearson Education.
4.	Jura's Quality Planning and Analysis for Enterprise Quality, by F M Gryna, R C H Chua, J A Defeo, Tata McGrawHill

1. Subject Code: **ME 314** Course Title: **Mechanical Vibrations (DEC-2)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To learn governing equations and solutions of single- and multi- degree of freedom vibrating systems. To familiarise with techniques of vibration isolation and measurements.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Basics of vibration, Mathematical modeling of vibrating systems- Discrete and Continuous systems, Conservative and Non conservative system with reference to Vibrations.	7
2	Single degree of freedom systems: Force-Balance and Moment-Balance methods, damping factor, Governing equations for different types of Damping and for different types of applied forces, Lagrange's equations.	7
3	Single Degree of freedom systems subjected to periodic excitations: Response to Harmonic Excitation, frequency-response function, System with rotating Unbalanced masses, system with base excitation.	7
4	Single Degree of Freedom system subjected to Transient Excitation: Response to impulse Excitation, response to: Step input, Ramp input, Spectral Energy of the responses, Response to: Rectangular pulse excitation, Half- sine wave pulses.	7
5	Two degree of Freedom systems: Free undamped vibrations, Static and dynamic coupling, Principal modes of vibration, dynamic vibration absorber, centrifugal absorber, Vehicle suspension system response.	7
6	Introduction to Vibration measuring Instruments: Vibration meters, vibration signatures, standards, vibration testing equipment, balancing of rotors.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Fundamentals of vibrations; Balachandran,Magrab,Cengage Learning.
2	Mechanical vibrations; Rao.S.S, Pearson Education.
3	Mechanical Vibrations; Srinivas P, Tata Mcgraw Hill company Limited.
4.	Fundamentals of Vibrations; Roger A A, Amerind Publisher Company Pvt Ltd.
5.	Engineering Vibration; Daniel J Inman, Prentice Hall, New Jersey.
6.	Mechanical Vibrations: T. Thomson

1. Subject Code: **ME 316** Course Title: **Power Plant Engineering (DEC-2)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To familiarise the students with thermodynamic cycles and various components of power plants.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Indian energy scenario, Indian coals: formation, properties, analysis, benefication and heating value calculation of coals; coking and non-coking coals, fuel handling systems; coal gasification. Classification of power plants, base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria,.	7

2	**Steam Generators:** High pressure utility boiler, natural and forced circulation, fuel handling, coking and non-coking coal, coal benefication, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, placement of evaporator, economizers, super heaters, re-heaters, air pre-heater in the boiler, de-aeration, boiler blow- down, ash collection by bag house, gravity separation, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment: external and internal treatment	7
3	**Combined Cycle Power Plants:** Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD- Steam power plant, thermionic steam power plant, integrated coal combined cycle (IGCC) power plant	7
4	**Other power plants:** Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, tidal power plants, diesel and gas power plants.	7
5	**Instrumentation and Controls in power plants:** Important instruments used for temperature, flow, pressure, water/steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS), interlocks and protection of turbines.	7
6	**Environment Pollution and Energy conservation:** Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/management of nuclear power plant waste, concept of energy conservation and energy auditing	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Power Plant Engineering** by M.M. Elwakil, Tata McGraw Hill, ISBN- 0070662746.
2	**Power Plant Engineering** by P.K Nag, Tata McGraw Hill, ISBN- 0070435993.
3	**Steam and Gas turbines** by A Kostyuk and V Frolov, MIR Publishers, ISBN-9785030000329.

4.	**Modern Power Plant Engineering** by J Wiesman and R Eckart, Prentice hall India Ltd, ISBN- 97801359725.
5.	**Planning Fundamentals of thermal Power Plants** by F.S Aschner, John Wiley, ISBN- 07065159X.
6.	**Applied Thermodynamics** by T.D Eastop and McConkey, Longman Scientific and Technical, ISBN- 0582305351.
7.	**CEGB volumes on power plant, Central Electricity Generation Board, ISBN-0080155680.**
8.	**NTPC/NPTI publications on Power plants**, ISBN- 9788132227205.

1. Subject Code: **ME 318** Course Title: **Computer Aided Manufacturing (DEC-2)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To understand the importance of solid modelling and part programming in manufacturing using group technology and robotic applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction**: Introduction to CAD. Elements and essential requirements of CAD hardware. Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications. Computer Graphics: CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display.	4

2	**Geometric Modeling**: Fundamentals of Geometric Modeling. Its application in analysis and manufacturing. Two Dimensional and Three dimensional line, surface and volume models; Constructive Solid Geometry (CSG); basics of boundary presentation- spline, Bezier, B-spline, and NURBS; sculpture surfaces, classification, basics of coons, Bezier, B-spline and ruled surfaces; tweaking, constraint based parametric modeling; wire-frame modeling, definition of point, line and circle; polynomial curve fitting. Introduction to rapid prototyping.	14
3	**Numeric control and part programming:** Principles of NC machines, CNC, DNC; NC modes of point to point, -line and 2D, 3D contouring; NC part programming; ISO standard for coding, preparatory functions (G)- motion, dwell, unit, preset, cutter compensation, coordinate and plane selection groups; miscellaneous (M) codes; CLDATA and tool path simulation; adaptive control, sequence control and PLC; simple part programming examples.	8
4	**Group Technology:** Importance of batch and job shop production; merits of converting zigzag process layout flow to smooth flow in cellular layout, Production Flow Analysis (PFA) and clustering methods; concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; FMS; material handling; robots, AGV and their programming; agile mfg; Introduction to Computer Aided Process Planning (CAPP).	8
5	**Robotics:** Introduction to robots. Types and generations of Robots, Classification of Robots. Structure and operation of Robot, Robot applications in manufacturing industries. Robot languages and programming methods. Introduction to Artificial Intelligence for Intelligent manufacturing.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Principles of Computer Aided Design and Manufacturing ;FaridAmirouche ; Pearson.
2	CAD/CAM Theory and Practice by Ibrahim Zeid.
3	CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.

4.	CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
5.	Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

1. Subject Code: **ME320** Course Title: **Reliability and Maintenance Engineering (DEC-2)**

2. Contact Hours: 42+14=56 L: 3 T: 0 /1 P: 2/0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To develop ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system. To equip with essential system diagnosis techniques so that one can identify and take appropriate actions on error symptoms and causes of failures.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction and Reliability Mathematics:** Relevance of reliability, availability and maintainability, definition of reliability, factors influencing system effectiveness, laws of probability, probability distributions: exponential, Weibull, normal, log normal; data collection, recovery of data, Statistical analysis of failure data.	8

2	**Fundamentals of Reliability:** Various reliability related functions; probability density function, cumulative distribution function, reliability function and hazard rate; reliability models; constant rate, Weibull, normal and lognormal model.	7
3	**System Reliability Assessment:** Types of systems- series, parallel, series-parallel, parallel-series, stand by and complex; method of reliability evaluation; cut set and tie set methods, event trees and fault trees methods, Markov method, Reliability of repairable systems.	7
4	**Reliability Improvements -** Methods of reliability improvements, low level and high level redundancy, active, stand by and K-out-of-N redundancy, effect of maintenance.	8
5	**Availability and Maintainability Assessments:** Point, mission and steady state availability. Availability assessment, Maintainability and its assessment. Maintenance policies.	6
6	**Design for Reliability** - Reliability allocation, Design for reliability and maintainability, optimization of reliability and maintainability and their trade-off, Practical applications of RAM Engineering to systems, products and processes; Monte Carlo simulation	6
Total		**42**

11. Suggested books:

1.	EbelingCharlesE.,"An introduction to Reliability and Maintainability Engineering",Tata McGraw-Hill Publishing Co. Ltd.,New Delhi, [ISBN 10 0070421382], 2000.
2	Srinath,L.S." Reliability Engineering",Affiliated East –West Press Ltd., New Delhi,[ISBN 10 8176710482],2011
3	Dhillon,B.S.,"EngineeringMaintainbility",Prentice Hall of India, New Delhi,2000.
4	Blanchard, Benjamin,S.,"Logistics Engineering and Management", Pearson,[ISBN 10 1292027134], 2013.

1. Subject Code: **ME 322** Course Title: **Design of Mechanical Assemblies (DEC-3)**

2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To develop basic understanding of stresses in the assemblies and their design based on concepts of static and dynamic loads.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Design of Friction clutches, uniform wear, and uniform pressure assumptions, centrifugal clutches. Brakes: Design of internal expansion elements, assumptions, design of external contraction elements, Band brakes.	7
2	Bearings and Lubrication: Types of Lubrication, viscosity, journal bearing with perfect lubrication, hydrostatic and hydrodynamic lubrication theory, journal bearing design. Selection, and applications of rolling element bearings with axial and radial loads, bearing materials, bearing seals, mounting of bearings.	7
3	Mechanical drives: selection of transmission, Belt and Chain drives: Flat belts, V Belts, Roller chains.	7
4	Design of Gears: Helical, Bevel, and Worm gears, design stresses, stress concentration, overload factors, velocity factors, bending strength of gear tooth, Buckingham equation for dynamic loads, and wear characteristics, AGMA design equations, Design of an automobile gear box.	7
5	Hoisting elements: Theory of curved beams, Crane hooks, Snatch block assembly elements.	7
6	Design of Engine parts: Connecting rod, crank shaft, piston	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Mechanical Engineering Design Shigley, J. E., Mischke, C. R. and Budynas,R. G., , McGraw Hill, 7th Edition, ISBN- 0071077839, 2004.
2	Fundamental of Machine Component Design,Juvinall, R. C., and Marshek, K. M., John Wiley and Sons, ISBN- 0471448443, 2000.
3	Fundamentals of Machine ElementsHamrock, B. J., Jacobson, B. Schmidt, S. R.,.McGraw Hill, ISBN- 9781482247480, 1999.
4.	Machine Design: An Integrated Approach Norton, R. L., , Pearson Education, ISBN- 9788131705339, 2001.
5.	Machine Design, Bhandari TMH
6.	Machine Design, D. K. Aggarwal and P. C. Sharma DhanpatRai, ISBN- 9789350142813.

1. Subject Code: **ME 324** Course Title: **System Modelling, Simulation and Analysis (DEC-3)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To enable the students to model and simulate any multi-energy system.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction:** A review of basic probability and statistics, random variables and their properties, Est imation of means, variances and correlation.	3
2	**Physical Modelling**: Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic activities, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation	6
3	**Modeling of Physical System Dynamics: A Unified Approach** Physical systems, Introduction to Bond graphs, Ports, Bonds and Power; Elements of Bond graphs:1-port elements – resistor R, Stiffness C, and Inertia I, Source of Effort Se and Flow SF; 2-port elements – Transformer TF and Gyrator GY, with modulation, Junction elements 1 and 0; Causality, Causality for basic 1-port and multi-ports. Derivation of System equations from Bond graphs in first order state space form.	8
4	**Bond Graph Modeling of Multi-energy Systems** Mechanical Systems, Translation and rotation (about a fixed axis)	6
5	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages.	7
6	**System Dynamics**: Growth and Decay models, Logistic curves, System dynamics diagrams. Probability Concepts in Simulation: Stochastic variables, discrete and continuous probability functions, Random Numbers, Generation of Random numbers, Variance reduction techniques, Determination of length of simulation runs.	6
7	**Simulation of Mechanical Systems**: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**System Simulation**- Geoffrey Gordon -Prentice Hall
2	**System Simulation: The Art and Science** -Robert E. Shannon -Prentice Hall
3	**System Modelling and Control** -J. Schwarzenbach and K.F. Gill Edward Arnold
4.	**Modelling and Analysis of Dynamic Systems** -Charles M Close and Dean K. Frederick Houghton Mifflin
5.	**Simulation of Manufacturing** -Allan Carrie John Wiley & Sons
6.	**Bond Graph in Modeling, Simulation and Fault Identification**-Amalendu Mukherjee, RanjitKarmakar, ArunSamantary-I.K. Int. Pub. House

1. Subject Code: **ME 326** Course Title: **Pressure Vessels and Piping Technology (DEC-3)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To learn theory of plates and shells and to apply it to pressure vessels.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Stresses in pressure vessels** Membrane stresses, dilation of pressure vessels, thick cylinder and thick sphere, bending of plate, discontinuity stresses in pressure vessels, thermal stresses.	12

2	**Factors influencing the design of pressure vessels** Design criterion of elliptical, hemispherical, conical, Autofrettage.	7
3	**Design of pressure vessel components such as shells, heads, nozzles, flanges as per ASME and IS codes** Localised stresses, stress concentration about a circular and an elliptical opening, theory of reinforced openings, nozzle reinforcement, welded joints.	7
4	**Fracture Control** Fatigue of various components of pressure vessels, Fatigue life prediction, thermal stress fatigue, criteria for design with defects.	7
5	**Piping elements, Dynamic analysis of piping**	7
6	**Use of FEM softwares for stress calculations**	2
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Pressure vessel design** byHarvey J. F., CBS Publication, ISBN- 812391041X.

1. Subject Code: **ME 328** Course Title: **Composite Material Technology (DEC-3)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To learn fabrication and mechanics of a composite laminate.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to Composite Materials:** Definition, Classification, Types of matrix materials and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction.	5
2	**Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Invariant properties. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.	7
3	**Micro Mechanical Analysis of a Lamina:** Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems.	5
4	**Biaxial Strength Theories:** Maximum stress theory, Maximum strain theory, Tsa-Hill theory, Tsai, Wu tensor theory, Numerical problems.	5
5	**Macro Mechanical Analysis of Laminate:** Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Numerical problems.	5
6	**Manufacturing:** Lay up and curing - open and closed mould processing, Hand lay, Up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance, Introduction, material qualification, Types of defects, NDT methods.	5
7	**Application Developments:** Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites.	5
8	**Metal Matrix Composites:** Re-inforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications.	5
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Composite Materials handbook,** Mein Schwartz Mc Graw Hill Book Company, 1984.
2	**Mechanics of composite materials,** Autar K. Kaw CRC Press New York.
3	**Mechanics of Composite Materials,** Rober M. Joness Mc-Graw Hill Kogakusha Ltd.
4	**Stress analysis of fiber Reinforced Composite Materials,** Michael W, Hyer Mc-Graw Hill International.
5	**Composite Material Science and Engineering,** Krishan K. Chawla Springer.
6	**Fibre Reinforced Composites,** P.C. Mallik Marcel Decker.

1. Subject Code: **ME 409** Course Title: **Mechatronics and Control (DEC-4)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To understand and use pneumatic and electo-pneumatic systems. To use PLC and other logic devices. To model and simulate a system on MATLAB.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction to mechatronic systems and components; Sensors and transducers; Actuators- electrical, electromechanical, electromagnetic, hydraulic, pneumatic, smart material actuators, micro actuators, nano actuators. Active actuators- piezoelectric, shape memory alloys(SMA), electro active polymers(EAP), magneto restrictive, magneto rheological fluid(MR).	7
2	Stepper and servo motors, Encoders and resolvers.	7
3	Modeling, analysis and simulation of dynamic systems; use of MATLAB; Bode, Nyquist and root-locus plot	7
4	Feedback systems: Open and closed loop control systems; Stability and sensitivity; PID, phase lag and phase lead compensation	7
5	Sampled data systems and Digital controllers; DA/AD converters, microprocessors, interfacing with computers	7
6	Digital logic: Analysis and synthesis of mechatronic systems with application to robotics, CNC systems and others	7
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Introduction to Mechatronics and Measurement systems,(special Indian edition), Alciatore ,David Tata-McGraw Hill India Ltd.
2	Mechatronics: Principles, Concepts and applications,Mahalik.N, Tata-McGraw Hill India Ltd.
3	Mechatronics: Principles and applications, Onwubolu,Elsevier India Pvt Ltd.
4	Mechatronics by Hindustan Machine Tools Ltd.,McGraw- Hill Ltd.
5	Mechatronics: Electronic Control systems in Mechanical and Electrical Engineering. 3/e, Pearson Education.
6	DanNecsulescu, “Mechatronics”,Pearson Education Asia,2002(Indian reprint)
7	Mechatronics – W. Bolton , Pearson Education

1. Subject Code: **ME 411** Course Title: **I. C. Engines (DEC-4)**

2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To understand the basic principles of IC Engines. To know about different components in IC Engine. To know the basics of power generation in IC Engine. To analyse the combustion process in SI and CI engine. To understand and evaluate the auxiliary system in IC engine such as supercharger/ turbocharger. To apprise the theory of combustion and cause of emission and their control.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to I.C Engines**: Classification; two and four stroke, SI and CI engines parts, working principle and valve and port timing diagram	7
2	**Combustion Phenomenon in SI engines:** Principles of combustion in SI engine, effect of engines and operating variables on ignition delay & flame propagation, combustion chamber for SI engines, cycle to cycle variation, pre-ignition, abnormal combustion, theory of detonation, effect of engine and operating variables on detonation, surface ignition, adiabatic flame temperature, ignition systems	7

3	**Combustion phenomenon in CI engines:** Principles of combustion in CI engine, delay period, variables affecting delay period, diesel knock, methods of controlling diesel knock, combustion process & combustion chambers for CI engines	7
4	**Fuel system and Mixture requirement in SI and CI Engine:** Carburetion- working principles, chemically correct air-fuel ratio and load variation, compensating devices, venture and jet dimension calculation, modern fuel induction system, multi point fuel injection system, fuel injection: common rail direct injection	7
5	**Engine Testing, Supercharging, Lubrication and Engine Cooling:** Engine performance and testing , measurement of power, supercharging limits of SI &CI engines methods of supercharging, superchargers, turbo charging, lubrication principles, function of lubricating system, properties of lubricating oil, additives, cooling system, air cooling, water cooling	7
6	**Introduction to Automotive Fuels:** Petroleum based fuels and their properties, knock rating of engine fuels, necessity of alternative fuels, LPG, CNG, producer gas, biogas, H_2, biodiesel and alcohols	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**I.C Engines and Air Pollution** by E.F.Obert, Intext Educational Publishers, ISBN-9780700221837.
2	**I.C Engines** by Ferguson, John Wiley & Sons, ISBN- 0471356174.
3	**Fundamentals of I.C Engines** by J.B Heywood, Tata McGraw-Hill Companies, ISBN- 9780070286375.
4	**I.C Engines** by Mathur& Sharma, DhanpatRai and Sons, ISBN- 9383182428.
5	**The Internal Combustion Engine - Theory and Practice Vols. I & II** by C.F.Taylor, MIT Press, ISBN- 02627002711.

1. Subject Code: **ME 413** Course Title: **Metrology (DEC-4)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : The objective of the course is to familiarize the student with techniques being adopted in industry for Dimensional inspection, quality checks and studying about the logic behind various methods of measurement

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Principles of measurement**: Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, errors in measurement of a quality which is function of other variables. **Length Standards:** Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numericals based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges. **Limits, fits and tolerances**: Various definitions, IS919-1963, different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919- 1993. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges, Numericals.	7

2	**Comparators:** Characteristics, Uses, Limitation, Advantages and Disadvantages. Mechanical Comparators: JohansonMikrokator and Signma Mechanical Comparator. Mechanical - optical comparator. Electrical and electronic comparators. Pneumatic comparators – Systems of Penumatic gauging: Flow type and back pressure type, different type of sensitivities and overall magnification. Solex Pneumatic gauge and differential comparators. Numericals.	7
3	**Angular Measurement**: Sine Bar – different types of sine bars, use of sine bars in conjuction with slip gauges, precautions and calibration of sine bars. Use of angle gauges, spirit level, errors in use of sine bars. Numericals. Principle and working of Micro-optic autocollimator. Circular Division: dividing head and circular tables, circular division by precision Polygons. Caliper Principle, Calibration of polygons. Numerical based on circular division. **Straightness and flatness**: Definition of Straightness and Flatness error. Determination of straightness error of straight edge with the help of spirit level and auto collimator. Determination of flatness error of a surface plate with the help of spirit level or auto collimator. Numericals.	7
4	**Screw Thread Measurement:** Errors in threads, Measurement of elements of screw threads – major diameter, minor diameter, pitch, flank angle and effective diameter (Two and three wire methods). Effect of errors in pitch and flank angles and its mathematical derivation. **Gear Measurement**: Measurement of tooth thickness – Gear tooth verniercaliper, Constant chord method, base tangent method and derivation of mathematical formulae for each method. Test plugs method for checking pitch diameter and tooth spacing. Measurement of Gear Pitch, Parkinson Gear Tester.Numericals.	7
5	**Machine Tool Alignment**: Machine tool tests and alignment tests on lathe. Alignment tests on milling machine. Alignment tests on a radial drilling machine. **Interferometry:** Principle of measurement, Interferometry applied to flatness testing, surface contour tests, optical flats, testing of parallelism of a surface with the help of optical flat. Quantitative estimate of error in parallelism, Flatness Interferometer, NPL-Gauge length interferometer for checking the error in slip gauges. Numericals based on Interferometry.	7

6	**Surface texture**: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Engineering Metrology", R.K. Jain, Khanna Publishers, Delhi. ISBN-13-9788174091536
2	Engineering Metrology, I.C. Gupta, DhanpatRai Publications, Delhi ISBN : Released : 9788189928452
3	Metrology for Engineers",.F.W. Galyer& C.R. Shotbolt, "ELBS edition. ISBN-13: 978-0304318445
4	Fundamentals of Mechanical Inspection", R. Jenkins, McGraw Hill. (OCoLC)600502978
5	"Fundamentals of Dimensional Metrology", C. Dotson ISBN-13: 9781418020620. Cengage Learning
6	A.S.T.M.E., "Handbook of Industrial Metrology", Prentice Hall. ISBN: 9783527406661

1. Subject Code: **ME 415** Course Title: **Project Management (DEC-4)**
2. Contact Hours: 42+14=56 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To develop practical project management skills, and prepare the students to apply proven methodologies to projects.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction** Definitions, classifications, and scope of project management; project life cycle and uncertainty.	7
2	**Project planning** Scope, problem statement, project goals, objectives, success criteria, assumptions, risks, obstacles, approval process, projects and strategic planning.	7
3	**Project implementation** Project resource requirement, types of resources: men, materials, finance, resource distribution.	7
4	**Project monitoring** Evaluation, control, project network technique, planning for monitoring and evaluation, project audits, project management information system, Nature of project inventory, supply and transportation of materials, use of Material Requirement Planning. Project scheduling, PERT & CPM, project communication.	7
5	**Project team management** Recruitment, organizing, human resources: team operating rules, project organization, various forms of project organizations, project organization charting, project contracts, principles, compilation of contracts, practical aspects, legal aspects, global tender, negotiations, insurance.	7
6	**Project completion** Closing the project, types of project termination, strategic implications, project in trouble, termination strategies, evaluation of termination possibilities, termination procedures, post project reviews.	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Beenet P Lientz, Kathyn P rea , Project Management for 21st Centrury, - Academic Press, ISBN 012449983X, 2001.

2	Project Management –Dennis Lock , Gower Publishing Ltd; 9th Revised edition edition; ISBN 0566087693, 2007
3	David I Cleland , Project management, Mcgraw Hill International Edition,ISBN 0442221142,1988.
4	Gopalakrishnan, Project Management, Mcmillan India Ltd, ISBN 0333926218,1993

1. Subject Code: **ME 419** Course Title: **Robotics and Automation (DEC-5)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To familiarise the students with robotics programming and applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction to Robotics, Classification of Robots, Characteristics of Robots, performance, advantages and disadvantages of a Robot, industrial applications of a Robot.	7
2	Fundamentals of a Robot: Various system, structure and definition, terms relating to industrial Robots, basic terms related to Robot performance and Characteristics, Control volume of a Robot.	7
3	Robot languages and programing.	7

4	Controlling the Robot systems: Introduction to drives, Mechanical, Hydraulic, Pneumatic, electric drives, feedback control	7
5	Sensing system for a robot: Introduction, types of sensors, machine vision, Artificial intelligence, Control techniques.	7
6	Robot safety: Introduction, potential safety hazards, safety planning check lists, safety guidelines, latest development in safety measurement.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Introduction to Robotics: Mechanics and Control, John j Craig, Pearson education, ISBN- 0201543613, 2005.
2	Robotics for Engineers, Y.Koren, McGraw Hill Publications, ISBN- 0070353999, 1985.

1. Subject Code: **ME 421** Course Title: **Computational Fluid Dynamics (CFD) (DEC-5)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To provide basic concepts of CFD in terms of comprehensive theoretical study and its computational aspects.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction to CFD, Historical background, Impact of CFD	3
2	The Governing Equations of Fluid Dynamics Derivation, Discussion of physical meanings and Presentation of forms particularly suitable to CFD	7
3	Mathematical classification and physical Behavior of Partial Differential Equations: Elliptical, parabolic and hyperbolic equations. Impact on CFD	7
4	Basic Aspects of Discretization: Taylor series expansion, Introduction to Finite Difference, Finite Elements and Finite Volume Methods. Detailed treatment of Finite Difference method, explicit and implicit methods, errors and stability analysis.	9
5	Grids with Appropriate Transformations, Adaptive grids and unstructured meshes. Lift reduction, down force generation and drag reduction. An introduction to the aerodynamics of airflows for cooling.	8
6	Commercial codes (e.g. FLUENT). Grid generation, techniques and application. Basic principles and concepts and the characteristics of wings and diffusers	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Computational Fluid Dynamics",John Anderson," McGraw- Hill Ltd.
2	Computational Fluid Dynamics",Tu, Elsevier.
3	Introduction to Computational Fluid Dynamics,Niyogi, Pearson Education, Delhi

1. Subject Code: **ME 423** Course Title: **Advanced Manufacturing Processes (DEC-5)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To familiarise the students with non-conventional machining of different materials with precision.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: mechanical advanced machining processes, need of advanced machining processes, hybrid processes Ultrasonic machining (USM): Introduction, mechanics of cutting, parametric analysis, process capabilities, applications.	7
2	Abrasive jet machining (AJM): Introduction, AJM setups, gas propulsion system, abrasive feeder, machining chamber, AJM nozzle, abrasive parametric analysis, process capabilities, applications.	7
3	Water jet machining: Introduction, process characteristics, process performance, applications. Abrasive Water jet machining: Working principle, parametric analysis, process capabilities and applications. Abrasive finishing process: Working principle, material removal and surface finish parametric analysis, process variables and applications.	7
4	Electro discharge machining (EDM): Introduction, Working principle, parametric analysis, process variables, process characteristics, applications, hybrid processes such as electro discharge grinding, diamond grinding, wire EDM, Laser beam machining: production of laser, working principle, types of laser, process characteristics and applications. Electron beam machining: Working principle, process parameter, process characteristics, applications. Ion beam machining: Working principle, process parameter, process characteristics, applications. Plasma arc machining: Working principle, Plasma arc cutting system, applications.	7

5	Electro-chemical machining: Working principle, ECM systems, parametric analysis, advantages and limitations, process performance, hybrid process such as EC grinding and chemical machining.	7
6	Ultra precision machining for higher accuracy and surface quality, micro machining, nano finishing and future trends in advanced machining processes.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Advanced machining process, Dr.V.K.Jain
2	Non traditional methods of manufacturing, shah &Pandey

1. Subject Code: **ME 427** Course Title: **Operations Research (DEC-5)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To apply the most widely used quantitative techniques in decision making. To realize the importance of certain mathematical techniques in getting the best possible solution to a problem involving limited resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction:** Nature, Scope and Historical developments, Linear programming- Model formulation, Graphical and simplex methods, Duality, Degeneracy, sensitivity analysis.	7
2	**Transportation:** North-West corner rule, Least cost method, VAM, Methods to check the optimality, Assignment- Hungarian method and Sequencing models: Johnson Rule for n- job two- machine, n- job m-machine.	7
3	**Queuing theory :**Assumptions and applications of waiting line theory, M/M/1: /FCFS, M/M/K: /FCFS, M/M/K	7
4	**Game theory and its applications**: Pure and mixed strategy, dominance principle, Algebraic, arithmetic, and graphical methods to solve GT problems.	7
5	**Replacement models:** Replacement policy for the items that deteriorate over time, replacement policy for the items that deteriorate over time when time value of money is declining, replacement policy for the items that fails suddenly.	7
6	**Network Planning :** PERT, CPM, Project crashing, Shortest path problem, Maximum flow problem, Minimum **spanning tree problem, minimum cost flow problem, Resource levelling.**	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Operations Research: Theory and Applications by J K Sharma, Macmillan, ISBN-9789350593363, 2013.
2	OperationsResearch: An introduction by H A Taha, Pearson Education
3	Operations Research: Concepts and cases by F S Hiller and G J Liebermaan, TMH
4	Quantitative Technique in Management by N D Vohra, TMH

1. Subject Code: **ME 429** Course Title: **Industrial Tribology (DEC-6)**

2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To explain the different wear processes in contacts between surfaces, and processes of lubrication in all regimes.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Surface interactions, science of rubbing surface, general consideration of parameters involved, wear rate, modeling and solution of simple problems.	7
2	Material properties influencing interactions: Introduction, elastic properties, plastic deformation properties, relation between the strength and other properties of solids, chemical reactivity of surfaces, absorbed surface layer, Surface energy, relation between surface energy and hardness, Surface Interfacial Energies of Solids under engineering condition.	7
3	Surface Interaction: Size of real contact area and effect of surface energy, size of junction, rheologial properties, Wear in tribological joints - classification, calculation methods with allowance for stiffness, wear limits, reliability of joints, simple examples, detail study of manufacturing methods for highly reliable joints. Economic role of wear, measurement, types, and use of radiotracer techniques.	7

4	Adhesive wear: Mechanism, size, shapes of transferred and wear particles, quantitative laws, equilibrium calculation of fragments under different conditions, minimum load for loose particle formation, Quantitative expression for abrasive wear, of hardness and particle size on abrasive wear rate, surface fatigue wear, brittle fracture wear, corrosive wear with types,	7
5	Friction: Introduction, laws, function, properties of uncontaminated metals in air, outgassed metal surface, calculation of flash temperature using surface energy, stick-slip and its prevention.	7
6	Lubrication: Solid film lubrication, boundary lubrication with single and multiple penetration models, properties of lubricants, effectiveness of lubrication-intermediate temperature, behavior of a solid lubrication below melting point; effect of speed, load on lubrication. Lubricants, their properties lubrication technique in vacuum, lubricant coating and its stability. Theory of elastohydrodynamic lubrication film thickness, frictional stress heat flow & temperature, service life of roller bearings.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Engineering Tribology byGwidonStachowiak, Butterworth Heinemann, ISBN-0750673044, 2000.
2	Experimental Methods in Tribology by GwidonStachowiak, Elsevier, ISBN-0444515895, 2004.
3	Engineering Tribology by John Williams, Cambridge University Press, ISBN-0521609887, 2005.

1. Subject Code: **ME 431** Course Title: **Non-Conventional Energy Resources (DEC-6)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives,	7
2	Solar radiation: Origin, nature and availability of solar radiation, estimation of solar radiation, Photovoltaic cells. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors. Effects of receiving surface location and orientation.	7
3	Devices for solar thermal collection and storage. Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems. Heat transfer considerations relevant to solar energy. Characteristics of materials and surfaces used in solar energy absorption.	7
4	Application systems for space heating, solar water pumps, solar thermal pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning, other solar energy utilization.	7
5	Solar PV systems. Fuel Cell Technologies. Generation and utilization of biogas, design of biogas plants, Wind energy systems.	7
6	Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations. Role of the nonconventional energy sources in power planning.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	G. D. Rai, “Energy Technolgy”, Khanna Publishers, ISBN- 97881740907438.
2	S.P. Sukhatme, “ Solar Energy”, Tata-Mcgraw hill, New Delhi, ISBN- 0074624531.
3	“Solar Energy thermal process” JADuffie and W.A. Beckman, John Wiley& sons, New York, ISBN- 1118418123.
4	Solar energy, Frank Kaieth& Yogi Goswami, Taylor and Francis, ISBN- 1560327146.
5	Treatise of Solar Energy, H.P. Garg, John Willey & sons, ISBN- 9027719306.

1. Subject Code: **ME 433** Course Title: **Computer Integrated Manufacturing (DEC-6)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To understand the operations and programming of NC, CNC and DNC machines. To understand the concepts of reverse engineering, computer-aided process planning and unmanned manufacturing.

10. Details of Course:

S. No.	Contents	Contact Hours
1	NC/CNC/DNC terminology, Operations of NC/CNC machine tools. Control cycles in CNC machine tools and how do these reduce operator’s activities, Central Processing Unit (CPU) , Input Devices , Storage Devices , System Configuration , Feasible report to introduce CAM technology for the first time in the industry , advantages &limitations of using CNC technology.	7

2	Parameters for adaptation of CAM technology, Advantages and disadvantages of CAM, Part programming, Manual & CAP, APT& its statements/programming with suitable examples to machine the components on CNC lathe, CNC milling machine , CNC jig boring machine , etc, Parallel programming& its advantages , Post etc.	7
3	Canned cycles, linear/circular , parabolic interpolation, online/offline programming, unidirectional, bidirectional approach, point to point and continuous control, Buffer storage , adaptive control, Nesting, opti-part, opti-route , precision sheet metal processing , CNC turret punch press , CNC press brake & its programming to machine the sheet metal components , Auto indexing , safety aspects in CNC machine tools . Tool length/ cutter compensation , Computer optimized manufacturing , etc.	7
4	Reverse engineering, Reasons for reverse engineering, importance of reverse engineering, Process of reverse engineering, Applications of reverse engineering. Integration of reverse engineering with CAM, Flexible Manufacturing System ,Elements of FMS , tool management systems , FMS control , Typical layouts of FMS , Benefits of FMS in the industries. Production planning and operation of FMS , Computer Aided Design , Concept and Description , Origin of CAD, Representations &Simulations , Various models of CAD, Analytical programs, Different models of CAD , Advantages of CAD & its limitations , etc.	7
5	CAPP, Types of CAPP, Group technology , Merit/ Demerits, Database management in the development of CAPP, CAD-CAM integration , Essential elements of CAPP , Future trends in CAPP, Importance of CAPP in CAM/CIM, etc. Introduction to Robots, its types , Laws of robotics , Symbolic modelling of robots , Robotic sensors , Configurations of robot, Applications of Robots in engineering industries.	7
6	Basic concepts of CIM, Evolution of CIM, Unmanned manufacturing, Elements of CIM, CIM implementation , CIM hardware and CIM software. Product development through CIM, Sequential engineering, Concurrent engineering, Comparison of sequential and concurrent engineering, implementation of concurrent engineering, concurrent engineering and information technology, Characteristics of concurrent engineering. Soft computing in CIM: Artificial neural networks/Artificial intelligence, Fuzzy, Fuzzy AHPBenefits of CIM , Lean manufacturing , comparison of lean manufacturing with conventional manufacturing , applications of lean manufacturing , etc.	7
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Automation, Production system and computer intergrated manufacturing by Groover
2	Computer Aided Design and Computer Aided Manufacturing by Groover Zimmer
3	Computer Aided Manufacturing by P.N. Rao
4	NC/CNC Technology by Kundra, Rao, Tiwari
5	Craig J John, Introduction to Robotics: Mechanics and Control, , Pearson education, ISBN- 0201543613, 2003.
6	Y.Koren , Robotics for Engineers, , McGraw Hill Publications, ISBN-0070353999,1985.

1. Subject Code: **ME 435** Course Title: **Optimization techniques (DEC-6)**
2. Contact Hours: 42+14=56 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To apply mathematical techniques to optimize a linear or non-linear function subject to constraints.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction to Optimization -** Introduction, Engineering Applications, Problem Statement, Classification of optimization problems.	2
2	**Classical Optimization techniques -** Unconstrained Optimization: Optimizing Single- Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi- Variable Functions. Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Lagrange Multipliers Method. Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.	10
3	**Non-Linear Programming-** One-Dimensional Methods: Elimination Methods, Interpolation Methods, Direct Root Methods; Quasi-Newton Method, Secant Method. Docotomous search method, Fabonacci method, Golden section method, Unconstrained Optimization Techniques: Direct search methods, Descent Methods. Constrained Optimizations: Direct and Indirect methods.	10
4	**Dynamic Programming:** Concept of Dynamic Programming, Multi stage Decision Process, Calculus Method and Tabular Method.	6
5	**Integer Programming –** Branch and bound Method, Cutting Plane Method.	4
6	**Introduction to Advanced Optimization Techniques** - Genetic Algorithms (GA), Simulated Annealing, Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Neural Network, Separable Programming, Stochastic Programming, Monte Carlo Simulation.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Operations Research**, Taha, H . A., PHI
2	**Optimization of Engineering Design**, “Deb, K.” PHI

3	**Operations Research**, “D.S. Hira, P. K. Gupta” S. Chand
4	**Optimization techniques**, “ Rao” New Age international
5	**Introduction to optimal design,** Jasbir Singh Arora, McGraw Hill International

1. Subject Code: **ME 406** Course Title: **Elastic and Plastic Behavior of Materials (DEC-7)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To develop basic understanding of theory of elasticity and plasticity, behaviour of materials during yielding, fatigue and creep leading to fracture.
10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction:** Stress and strain tensor, three invariants, transformation rules, equilibrium equations, Study of stress-strain diagrams of various materials under states of tensile, compressive, shearing and bending stress.	7
2	**Basic theory of elasticity:** Constitutive law, Generalized Hooke’s law, work of elastic deformation, plane stress and plane strain conditions, simple shear, elastic change in volume and shape, specific work of elastic deformation	7

3	**Fundamentals of plastic deformation:** General information about structure of metals, single crystal and its deformation, geometry and movement of dislocations, Burger's vectors, circuits and dislocation loops, deformation of metals: slip and twinning, effect of hot and cold working on properties of metals. Micro and macro hardness tests, Erichsen cupping test, Limit dome height test, forming limit diagram. **Elements of plasticity:** Flow curves, true stress-true strain, yielding criteria in metals, strain hardening and discontinuous yielding, combined stress states, yield locus, anisotropy in yielding, yield surface and normality, Octahedral shear stress and shear strain, plastic stress-strain relations.	7
4	**Fracture:** Study of ductile and Brittle fractures, Griffith theory of brittle fracture, ductile fracture, ductile - Brittle transition behaviour, notch effect and notch sensitivity, effect of hydrostatic pressure on fracture and methods of protection against fracture. Strain energy release rate, stress intensity factor, fracture toughness and design, plane strain toughness testing, plasticity corrections, Crack opening displacement, J-integral.	7
5	**Fatigue:** Stress cycles, The nature of fatigue: low cycle and high cycle fatigue, S-N curve, mechanism of fatigue, fatigue strength of metals and statistical nature of fatigue, effect of mean stress on fatigue, strain life equations, fatigue crack propagation, stress concentration, size and surface effects on fatigue, fatigue failure under combined stress, cumulative fatigue damage due to varying amplitude of stress, other factors affecting fatigue strength, local strain approach.	7
6	**Creep:** Time dependent mechanical behaviour, creep curve, design curves, Constant-temperature creep tests, mechanism of creep rupture: dislocation, diffusion and grain boundary sliding, deformation mechanism maps, activation energy for steady state creep, empirical relation for creep behavior, plastic flow rules for creep, metallurgical factors affecting creep behaviour, selection of creep resistant materials and applications.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Mechanical metallurgy, George E. Dieter, 1988, Mc Graw Hill, New York, ISBN-0071004068.
2	Metal forming- Mechanics and Metallurgy. Hosford, W.F., Cadell, R. M., 2007. Cambridge University Press, ISBN- 0521881218.
3	Dislocations and mechanical behaviour of materials, Shetty, M.N., 2013, PHI Learning, New Delhi, ISBN- 9788120346383.

1. Subject Code: **ME 408** Course Title: **Combustion Generated Pollution (DEC-7)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To introduce the students to different types of fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Engine fundamentals: Fuels, alternative fuels for IC engines, Type of hydro carbons. Gasoline specifications. Effect of Engine parameters on performance, fuel injection for SI engines, Engine vehicle road performance, road performance and fuel economy.	7
2	Emissions and air pollution: Automotive Emissions and their role in air pollution. Photo chemical smog. Chemistry of smog formation. Combustion in Homogeneous mixtures, emission formation. incomplete combustion, formation of hydro carbons, Carbon monoxide and oxides of nitrogen. Aldehyde emissions.	7

3	Influence of design and operating variables on gasoline engine exhaust emissions. Hydrocarbon Evaporative Emissions: Various sources and methods of their control. Canisters for controlling evaporative emissions. Emission control systems for gasoline engines: Blow by control closed PCV system design.	7
4	Exhaust treatment devices: Air injection into exhaust system.	5
5	Thermal reactors, Catalytic convertor. Stratified charge engines. Honda CVCC engine. Diesel engine combustion Emissions: Sources of emissions during combustion. Effect of air fuel ratio, speed, injection timing on performance and emission formation. D.I. and I.D.I engine emissions.	9
6	Methods of reducing emissions, exhaust gas recirculation, smoke emission from diesel engines. Emission Instruments: Non- dispersive Infrared analyzer, Gas chromatography, flame ionization detector, Chemiluminescent analyzer	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Combustion generated air pollution, Earnest S Starkman, Springer, ISBN-9780306305302.
2	Fundamentals of Air pollution engineering, Richard C. Hagan, Prentice Hall, ISBN-0133325371.
3	Air pollution threat & response, David Alym, Addison-Wesley Publication, ISBN-0201043556.

1. Subject Code: **ME410** Course Title**: Advances in Welding & Casting (DEC-7)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with the advances in welding and casting technology.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**CASTING DESIGN** Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering	9
2	**CASTING METALLURGY** 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.	8
3	**RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT** 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.	9
4	**WELDING METALLURGY AND DESIGN** Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.	8
5	**RECENT TRENDS IN WELDING** Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding-narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers (TEXT BOOKS)
1	ASM Handbook, Vol 15, Casting, ASM International, 2004, ISBN 978-0871707116
2	ASM Handbook vol.6, welding Brazing & Soldering, ASM International, 2003, ISBN 978-0871703828
3	Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002, ISBN9788174090287
4	Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002, ISBN 8174091599
5	HEINE, LOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2001, ISBN 0070993483
6	Jain P.L., Principles of Foundry Technology,TataMcGrawHill Publishers, 2003, ISBN 0070447608
7	Howard B. Cary, Scott C. Helzer , Modern Welding Technology, Pearson Prentice Hall Pvt Ltd., 2011, ISBN 0131836919
8	J. Piotrowski, W. Randolph , Robotic welding – A guide to selection and application, Society of Manufacturing, 1987, ISBN 0872632660
10	CORNU.J. Advanced welding systems – Volumes I, II and III, Springer Publishing, 2013, ISBN 3662110512
11	LANCASTER.J.F., Metallurgy of welding , Springer Publishing, 1987, ISBN 0046690107

1. Subject Code: **ME 412** Course Title: **Operations & Manufacturing Strategy (DEC-7)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To apply the principles and techniques in the design, planning and control of the production systems to optimize or make best use of resources in achieving their objectives.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Productivity:** Production systems and their classifications; Productivity variables and measurement, Productivity-Total and partial productivity, Reasons and remedy for poor productivity.	7
2	**Work Study:** Work System Design: Taylor's scientific management, Gilbreth's contributions; method study, micro-motion study, principles of motion economy; work measurement - stop watch time study, micro motion and memo motion, work sampling, standard data, PMTS; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering, introduction to ergonomics and its applications.	7
3	**Production Planning and Control:** Types and characteristics of production systems Objective and functions of Production, Planning & Control, Routing, Scheduling and Operations scheduling, production scheduling, job shop scheduling problems, sequencing problems, scheduling tools and techniques, Loading, Dispatching and its sheets & Gantt charts.	7
4	**Quality Management:** Concepts of quality, total quality management, cost of quality; statistical quality control, Concept of specification limits, statistical control limits, process capability, Process control and control charts for both attributes and variable data. Acceptance Sampling-Single and double sampling, six sigma, ISO 9000 & ISO 14000.	7
5	**Resource Planning:** Enterprise resource planning (ERP), material required planning (MRP), manufacturing resource planning (MRP II), aggregate planning.	7
6	**Reliability and Maintenance:** Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; Maintenance management and its objectives, Various types of Maintenance Planning, House Keeping, 5S concepts.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Introduction to work Study; Oxford and IBH publishing Co. Pvt. Ltd, New Delhi
2	Industrial Engineering and Management; B. Kumar, Khanna Publication.
3	Operation Management, Krajewski and Ritzwan, Pearson Education.
4	Work study and ergonomics, S.K. Sharma & Savita Sharma, Katson, Delhi.
5	Industrial Engineering & Management, Ravi Shanker, Galgotia Publication, Delhi

1. Subject Code: **ME 414** Course Title: **Fracture Mechanics (DEC-8)**
2. Contact Hours: 42+28=70 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To distinguish between conventional design and design based on fracture mechanics approach. To distinguish between linear elastic fracture mechanics (LEFM) and elastic plastic fracture mechanics (EPFM).

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction**: Introduction and overview Inter-disciplinary approaches in fracture mechanics, modes of deformation and failure, Griffith theory.	7

2	**Linear Elastic Fracture Mechanics**: Stress concentration in the vicinity of notches and cracks, concept of stress intensity factor (SIF), Stress intensity factor for different types of cracks and geometry. Irwin's stress intensity approach, fracture toughness.	7
3	**General Yielding Fracture Mechanics:** Crack tip plastic zones and its evaluation, Wall's crack opening displacement**.** Barenblatt and Dugdale's models	7
4	**Evaluation of Fracture Mechanics Parameters:** Plane strain fracture toughness testing i.e., Kic .Concepts of crack tip opening displacements (CTOD)	7
5	**J-Integral and fatigue crack :-**J integral and its evaluation, application of J-integral. Mechanics of fatigue crack propagation	7
6	**Fracture Safe Design Principles:** Fail-safe design. **Fractured surfaces:** Acquaintance with some common fracture surfaces of various materials, like steels, C.I, non ferrous alloys etc.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Prashant Kumar; 'Elements of Fracture Mechanics"; Tata McGraw- Hill Publishing Company Limited.
2	D.Breok; 'Elementry Fracture Mechanics"; Noordhoff International,1985
3	T.L.Anderson; 'Fracture Mechanics"; 3rd edition, Taylor & Francis, ISBN-0849316561, 2005.
4	Knott.J.F; "Fundamentals of Fracture Mechanics", John Wiley & Sons, Newyork.
5	Gdoutos.E.E; "Fracture Mechanics- An introduction"; Springer.
6	Ramesh.K; "e-Book on Engineering Fracture Mechanics"; IIT Madras.

1. Subject Code: **ME 416** Course Title: **Nuclear Energy (DEC-8)**

2. Contact Hours: 42+14=56 L: 3 T: 0 /1 P: 2/0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To understand the importance and challenges of using nuclear energy in meeting energy needs of the country.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Nuclear Physics: Atomic number and mass numbers, Isotopes, Nuclear energy and nuclear forces, Binding Energy, Nuclear Stability, Radioactivity, Nuclear reactions, Radioactive isotopes, Law of radioactivity, Interaction of radiation (alpha, beta, gamma) with matter, Interaction of neutrons with matter, Absorption radiative capture, Transmutation Fission, Cross section for nuclear reactions. Fission process, Mechanism of nuclear fission, fission cross section, fission products, Basic radio chemistry.	8
2	Reactor Physics: Neutron balance, Neutron diffusion, Diffusion equation, and its solution, Slowing down of neutrons, Showing down power and moderating ratio. Reactor theory: Multiplication factors, Four factor formula, One group critical equation, Age, Diffusion method, Non-leakage probabilities and effective multiplication factor, Multi group diffusion theory, Homogeneous and heterogeneous reactor systems, Time dependent reactor behaviour.	8
3	Nuclear Reactor Engineering: Types of reactors, Ordinary water moderated reactors (BWR, PWRO), Heavy water cooled and moderated reactors, Gas cooled reactors (HTGR, AGR), Fast reactors design, Construction and control of nuclear reactors.	7
4	Heat transfer in nuclear reactors: Heat transfer techniques in nuclear reactors, Design and operation, Thermal stresses, Reactor shielding.	7

5	Reactor materials: Nuclear fuels, Moderators, Coolants, Reflectors and structural materials. Reprocessing: Nuclear fuel cycle, Spent fuel characteristics, Reprocessing techniques, role of solvent extraction in reprocessing.	6
6	Waste management and radiation protection: Types of waste, Waste management philosophy and disposal, ICRP recommendations, Radiation hazards and their prevention, Radiation dose units. Status of nuclear technology in India: Indian nuclear power program, Nuclear reactors in India, India's commitment to nuclear non-proliferation.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Nuclear Reactor Engineering, S. Glasstone and A. Seronske, Van Nostrand – Reinhold, ISBN- 0442200579, 1963.
2	Nuclear Chemical Engineering, M. Bendict and T.A. Pigtor, McGraw Hill, ISBN-0070045313, 1981.
3	Basic Principles of Nuclear Science and Reactors, L. C. MerriteWiley Hill, ISBN-0070045313, 1981.
4	Introduction to Nuclear Reactor Physics, S. E. Liverhandt.

1. Subject Code: **ME 418** Course Title: **Supply Chain Management (DEC-8)**
2. Contact Hours: 42+14=56 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that the overall organizational performance may improve.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction** Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management.	7
2	**Inventory Management and Risk Pooling** Inventory management, Classification of inventory, Centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect.	7
3	**Resource planning** Aggregate Production Planning- Chase and leveling strategies, MRP, MRP-II, Agile manufacturing Systems	7
4	**Procurement and Outsourcing strategies** Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation.	7
5	**Strategic Alliances** Introduction, Third party logistics, Demand driven strategies, Distribution strategies- direct shipment, cross docking, transshipment, Supplier relationships management, Customer relationship management.	7
6	**International Issues in Supply Chain Management** Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Designing and Managing the Supply Chain: concepts, strategic and case studies by David Simchi-Levi, Philip kaminsky, Edith Simchi-Levi, Ravi Shankar, Tata McGraw-Hill, ISBN- 0072357568.
2	Supply Chain Management by Chopra S. and Meindl P., Pearson, ISBN- 8131789209, 2012.
3	Supply Chain Management: Text and Cases by ShahJanat, Pearson Education, ISBN- 8131715175, 2009.

1. Subject Code: **ME 420** Course Title: **Materials Management (DEC-8)**
2. Contact Hours: 42+14=56 L: 3 T: 0 /1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : The key objective of this course is to acquaint the students with the decision-making for effective and efficient purchase, storage and flow of materials in manufacturing and service organizations.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction** Scope of materials management, primary and secondary objectives, integrated materials management, relation with other functional areas of organization; Organizing for materials management, basis for forming organizations, conventional and modern approaches to organizing materials management.	8

2	**Materials identification** Classification of materials, codification of materials, standardization, simplification and variety reduction of materials, Inventory control, techniques: FSN, VED, ABC; working capital management with reference to inventory.	7
3	**Management of stores** Location, different types of stores, methods of storing, safety and security of materials, stores equipment, materials handling equipment, factors affecting materials handling, stores issues and receipts, procedures, forms and policies in stores transactions, stores accounting, stores organization, materials safety and security.	6
4	**Management of surplus, obsolete and scrap materials** Management of surplus obsolete and scrap materials, reasons for accumulation of surplus obsolete and scrap materials, methods of disposal, regulations and procedures.	7
5	**Purchasing** Planning purchasing materials, norms of vendor rating, CEI methodology, Japanese industry: selection and development, purchasing procedures and methods, legal aspects, insurance of materials, supply management, sources of supply, outsourcing.	8
6	**Sub contracting** Sub contracting, reasons for subcontracting, criteria for selecting sub contractors, rating, factors affecting subcontract rate fixing – internal and external subcontract.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Integrated materials management-A. K. Datta-PHI Learning, ISBN- 8120312511, 2009.
2	Purchasing and Supply Management-Dobbler, Burt D.N., McGraw Hill Education, 6th edition, ISBN- 0071141383, 2004
3	Materials Management – P Gopalakrishnan – PHI Learning, ISBN- 8120300270, 2009
4	Purchasing And Materials Management – LeendersFearon Universal Book Stall
5	Purchasing AndInventory Control – K S Menon – WheelerPublishers
6	Materials Management – Varma M M – Sultan Chand And Sons

OPEN ELECTIVE COURSES

CO351 ENTERPRISE & JAVA PROGRAMMING

1. Subject Code: **CO351** Course Title: **Enterprise & Java programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Enterprise Java Programming, concepts of program development using beans.
10. Details of Course :

Unit No.	Contents	Contact Hours
1.	**Collections :** Collection Interfaces, Concrete Collections, Collections Framework. **Multithreading :** Creating and running thread, Multiple thread synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle ofThread.	5

2.	Fundamentals in Networking: Sockets in Java - Internet Addressing - DNS – Ipv4,IPv6- URL class - TCP/IP and Datagram. The interfaces and classes for networking :Interfaces and classes of java.net package; InetAddress class : IP address scope - Host name resolution - Methods of InetAddress class; Program to look up the IP addresses for a hostname - Factory methods - Creating and using Sockets : Socket class - constructors and methods of Socket class. Creating TCP servers &clients : TCP/IP server sockets - Constructors and methods of ServerSocket class - Program to create a TCP/IP server and client. Handling URL: URL class - constructors and methods of URL class -URLConnection class - fields of URLConnection class - methods of URLConnection class. Working with Datagrams: DatagramPacket - Constructors for DatagramPacket class - Methods of DatagramPacket class - creating Datagram server and client.	6
3.	JDBC Package :JDBC – JDBC versus ODBC – Types of JDBC drivers – Connection – Statement – PreparedStatement.ResultSet :Fields of ResultSet – Methods of ResultSet – Executing a query - ResultSetMetaData – DatabaseMetaData. Datatypes in JDBC : Basic datatypes in JDBC – Advanced datatypes in JDBC – fields of Statement – methods of Statement – CallableStatement Interface – BatchUpdates	6
4.	Servlets : Using Servlets - Servlet Package - Servlet lifecycle - init() method - service() method , doGet() method, doPost() method and destroy() method . Classes and interfaces of Servlet: Servlet - GenericServlet - ServletConfig - ServletContext - ServletException - ServletInputStream - ServletOutputStream - ServletRequest – ServletResponse. Classes and interfaces of HttpServlet: HttpServlet - HttpServletRequest - HttpServletResponse - Reading HTML form data from Servlets - Response Headers - Response Redirection. Handling Servlets : Servlet Chaining - HttpUtils - Database access with JDBC inside servlet. State and Session management : Cookies - HttpSession - Server Side includes - Request forwarding – RequestDispatcher.	7

5.	Concepts of Java Beans: Java Beans - Advantage of Java Beans - Reflection and Introspection - Customizers – Persistence. Developing Java Beans : Bean Developer Kit (BDK) - Creating a Java Bean - Creating a Bean Manifest file - Creating a Bean JAR file. Controls and Properties of a Bean : Adding controls to Beans - Giving Bean Properties - BeanInfo interface - SimpleBeanInfo class. Types of Properties: Design pattern for Properties: Simple properties - Indexed Properties; Descriptor Classes - Giving Bean methods - Bound and Constrained Properties - Property Editors.	9
6.	Components of EntrepriseBeans : Distributed Multitiered Applications -J2EE components: J2EE clients, Web components, J2EE containers. Developing an Enterprise Bean : Packaging - Enterprise JavaBeans Technology - Enterprise Bean - Contents of an Enterprise Bean. Session Bean : Stateful session bean – life cycle of stateful session bean - Stateless session bean – life cycle of stateless session – ejbCreate methods – Business methods – Home interface – Remote interface – Running the session bean. Entity Bean :Persistence - Bean managed Persistence - Container Managed Persistance - Shared Access - Primary key – Relationships. Message Driven Bean :life cycle of message driven bean – onMessage method.	9
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
	Text Books
1.	Java 2 Programming Black Book - Steven Holzner dreamTech Press(ISBN-9788177226553), 2005
2.	JavaBeans Programming from the GroundUp - Joseph O'Neil, TMGH, New Delhi(ISBN- 007463786X), 2001
	Reference Books

3	Head first EJB-O'Reilly (ISBN: 8173665265), 2003
4.	"Beginning Java™ EE 6 Platform with GlassFish 3 From Novice to Professional" by Antonio Goncalves– Apress publication(ISBN: 9781430219545), 2009

CO353 E-COMMERCE AND ERP

1. Subject Code: **CO353** Course Title: **E-Commerce and ERP**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce E-Commerce and ERP
10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction: Definition of Electronic Commerce, E-Commerce: technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, advantages and disadvantages, framework, Impact of E-commerce on business, E-Commerce Models.	7
2.	Network Infrastructure for E- Commerce: Internet and Intranet based E-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN, FRAME RELAY). Mobile Commerce: Introduction, Wireless ApplicationProtocol, WAP technology, Mobile Information device.	7

3.	Web Security: Security Issues on web, Importance ofFirewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.	6
4.	Electronic Payments: Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Formsof Agreement, Govt. policies and Agenda.	6
5.	ERP Introduction, Benefits, Origin, Evolution and Structure:Conceptual Model of ERP, The Evolution of ERP, The Structure of ERP. Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing(OLAP), Product Life Cycle Management(PLM),LAP, Supply chain Management.	8
6.	ERP Marketplace and Marketplace Dynamics:Market Overview, Marketplace Dynamics, The Changing ERP Market. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. ERP Implementation Basics, ERP Implementation Life Cycle, Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees, ERP & E-Commerce, Future Directives- in ERP, ERP and Internet.	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Goel, Ritendra “E-commerce”, New Age International,2007
2.	Ravi Kalakota, Andrew Winston, “Frontiers of Electronic Commerce”, Addison-Wesley. 1996
3.	Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning – Concepts and Practice”, PHI 2004
4.	Rahul V. Altekar “Enterprise Resource Planning”, Tata McGraw Hill, 2004
5.	Alexis Leon, “ERP Demystified”, Tata McGraw Hill, 2014

CO355 CRYPTOGRAPHY AND INFORMATION SECURITY

1. Subject Code: **CO355** Course Title: **Cryptography and Information Security**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To study various cryptographic techniques, mathematics related to cryptography and some network security protocols.
10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction:** Need for security, Introduction to security attacks, services and mechanism, introduction to cryptography, Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers, Intruders, Viruses and related threads.	6
2.	**Modern Block Ciphers:** Block ciphers principals, Shannon's theory of confusion and diffusion, Fiestal structure, data encryption standard(DES), strength of DES, crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution.	6

3.	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption	8
4.	**Message Authentication and Hash Function:** Authentication requirements, authentication functions, message authentication code (MAC), hash functions, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA), Public Key Infrastructure(PKI): Digital Certificate, private key management, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	6
5.	**Authentication Applications:** Kerberos and X.509, directory authentication service, password, challenge-response, biometric authentication, electronic mail security-pretty good privacy (PGP), S/MIME.	8
6.	**IP Security:** Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. **Web Security:** Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money, WAP security, firewall design principals, Virtual Private Network (VPN) security.	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy. 2016
2.	Atul Kahate, "Cryptography and Network Security", TMH. 2009
3.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.2007
4.	Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag. 2004
5.	Bruce Schiener, "Applied Cryptography". 2015

CO357 OPERATING SYSTEM

1. Subject Code: **CO357** Course Title: **Operating System**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiar with the fundamental principles of the operating system, its services and functionalities, the concepts of processes, synchronization and scheduling, memory management and need for protection in computer systems

10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction:** Operating system and function, Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection. **Operating System Structure:** System Components, System structure, Operating System Services.	4
2.	**Concurrent Processes:** Process concept, Principle of Concurrency, Producer Consumer Problem, Critical Section problem, Semaphores, Classical problems in Concurrency, Inter Process Communication, Process Generation, Process Scheduling. **CPU Scheduling:** Scheduling Concept, Performance Criteria of Scheduling Algorithm, Evolution, Multiprocessor Scheduling.	9

3.	**Deadlock:** System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock combined approach.	8
4.	**Memory Management:** Base machine, Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Paged replacement algorithms, Allocation of frames, Thrashing, Cache memory organization, Impact on performance.	9
5.	**I/O Management & Disk Scheduling:** I/O devices and organization of I/O function, I/O Buffering, DISK I/O, Operating System Design Issues. **File System:** File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues	9
6.	**Case Studies:** Windows, Linux and Unix	3
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
Text Books	
1.	Silbersachatz and Galvin, “Operating System Concepts”, Pearson, 5th Ed, 2001
2.	Tannenbaum, “Operating Systems”, PHI, 4th Edition, 2000
Reference Books	
3.	Milenekovic, “Operating System Concepts”, McGraw Hill 2001
4.	Dietel, “An introduction to operating system”, Addison Wesley 1983

CO359 INTELLECTUAL PROPERTY RIGHTS

1. Subject Code : **CO359** Course Title: **Intellectual Property Rights**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : To familiarize the students with basic concepts in each type of IPR together with historical developments in the subject & its importance in modern times.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction: Concept of IPR, Historical development , kinds of IPR,brief description of patent, trademark, copyright ,industrial design, importance of IPR, IPR authorities.	5
2.	PATENTS :Introduction, Indian Patent Act 1970 &2002, Protectable subject matter--patentable invention, Procedure for obtaining patent, Provisional and complete specification Rights conferred on a patentee, transfer of patent, Revocation and surrender of patents, Infringement of patents, Action for infringement, Patent agents, Patent in computer programs.	8
3.	Trademark: Introduction, Statutory authorities, principles of registration of trademarks, rights conferred by registration of trademarks, Infringement of trademarks and action against infringement, procedure of registration and duration,licensing in trademark	7
4.	Copyright: Introduction, Author and ownership of copyright, rights conferred by copyright,term of copyright, assignment/licence of copyright, Infringement of copyright ,remedies against infringement of copyright, registration of copyright, copyright enforcement and societies	7

5.	Industrial design: The design act-2000, registerability of a design, procedure of registration of a design, piracy of a registered design, Case law on designs	6
6.	International IPR & case laws: World intellectual property organization, WCT, WPPT, TRIPS, Copyright societies, international IPR dispute resolution mechanism. Case laws.	9
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
Textbooks:	
1.	Law Relating to Intellectual property, fourth edition by B.L.Wadehra .Universal law publishing co. pvt. Ltd , 2007. ISBN 978-81-7534-588-1
Reference books:	
2.	Intellectual property: Patents, copyright ,trademarks and allied rights. Fifth edition by W.R. Cornish. Sweet & Maxwell publisher, 2003. ISSN 9780421781207
3	Law and practice of intellectual property in India by VikasVashishth, 2006 **ISBN:** 81-7737-119-3
4	Patents ,copyrights, trade marks and design by B L Wadhera, 2014
5	Dr. B. L. Wadhera, "Intellectual Property Law Handbook". Universal Law Publishing, 2002.

CO361 DATABASE MANAGEMENT SYSTEM

1. Subject Code: **CO361** Course Title: **Database Management System**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To provide knowledge about the principles, concepts and applications of Database Management System.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction:** Data base system concepts and its architecture, Data models schema and instances, Data independence and data base language and interface, Data definition languages, DML. Overall data base structure. **Data modeling using Entity Relationship Model:** E.R. model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model.	7
2.	**Relational Data Model and Language:** Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL.	7
3.	**Data Base Design:** Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal forms, join dependencies and fifth normal forms. Inclusion dependencies, loss less join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design.	6
4.	**File Organization, Indexing and Hashing** Overview of file organization techniques, Indexing and Hashing-Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management **Transaction processing concepts:** Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling.	8

5.	**Concurrency Control Techniques:** Locking Techniques for concurrency control, time stamping protocols for concurrency control, concurrency control in distributed systems. multiple granularities and multi-version schemes.	8
6	**Case Studies:** Commercial databases, Oracle, Postgress, MySQL	6
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
Text Books	
1	Elmasri, Navathe,"Fundamentals of Database systems", Addision Wesley, 2016
2	Korth, Silberchatz, Sudarshan,"Data base concepts", McGraw-Hill. 2010
Reference Books	
1	Ramakrishna, Gehkre, "Database Management System", McGraw-Hill 2014
2	Date C.J.,"An Introduction to Database systems" 2006

EC351 MECHATRONICS

1. Subject Code: **EC351** Course Title: **Mechatronics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Mechatronics

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction : Basic Definitions and key elements of Mechatronics, Mechatronic Design Approach: Functions of Mechatronic Systems, Ways of Integration, Information Processing Systems (BasicArchitecture and hardware and Software trade-offs, Concurrent Design Procedure for Mechatronic Systems	6
2.	System Interfacing, Instrumentation,and Control Systems: Input and output Signals of a Mechatronic System, Signal Conditioning and microprocessor control, Microprocessor-Based Controllers and Microelectronics, Programmable Logic Controllers	6
3.	Introduction to Micro- and Nanotechnology, Micro-actuators, Micro-sensors, Nanomachines. Modeling Electromechanical Systems: Models for Electromechanical Systems, Rigid Body Models, Basic Equations of Dynamics of Rigid Bodies, Simple Dynamic Models, Elastic System Modeling, Dynamic Principles for Electric and Magnetic Circuits, Earnshaw's Theorem and Electromechanical Stability	10
4.	The Physical Basis of Analogies in Physical System Models: The Force-Current Analogy: Across and Through Variables, Maxwell's Force-Voltage Analogy:Effort and Flow Variables, A Thermodynamic Basis for Analogies	6
5.	Introduction to Sensors and Actuators: Characteristics of Sensor and Actuator Time and Frequency Measurement, The Role of Controls an modelling in Mechatronics: Integrated Modeling, Design, and Control Implementation, Special Requirements of Mechatronics that Differentiate from Classic Systems and Control Design, Modeling as Part of the Design Process, Modeling of Systems and Signals	6
6.	Design Optimizationof Mechatronic Systems: Optimization Methods, Principles of Optimization : ParametricOptimization, General Aspects of the OptimizationProcess, Types of Optimization Methods, Selection of aSuitable Optimization Method, Optimum Design of Induction Motor (IM), IM Design Introduction : Classical IM Design, Use of a Neuron Network for the Identification ofthe Parameters of a Mechanical dynamic system, Mechatronics and Computer Modelingand Simulation, Mechatronics and the Real-Time useof Computers, Communications andComputer Networks,Control withEmbedded Computersand ProgrammableLogic Controllers	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Mechatronics : an introduction by Robert H Bishop, Taylor & Francis, 2005
2	Introduction to Mechatronics by KK AppuKuttan Oxford University Press, 2007

EC353 COMPUTER VISION

1. Subject Code : **EC-353** Course Title: **Computer Vision**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Computer Vision and algorithms for object detection, recognition and tracking.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to computer vision: Role of Artificial intelligence and image processing in Computer Vision, Industrial Machine Vision applications, System architecture. Visual Sensors: Camera sensors: RGB, IR, Kinect sensor, Camera interfaces and video standards, Characteristics of camera sensors commercially available cameras. Camera Calibration: Interior, exterior calibration and rectification using Tsai's Calibration method.	5

2.	Basics of image processing – Pixel representations histograms ,transforms, colour filters, noise removal, Geometry: Math methods -linear algebra, vectors, rotations, Stereo – Epi-polar geometry, correspondence, triangulation ,Disparity maps . Basics of video processing – Background subtraction techniques – frame differencing, Gaussian Mixture Modelling (GMM), Object localization and processing:- Contours, edges, lines, skeletons.	7
3.	Image representation: Local Wavelet basis (multiscale), Global Fourier basis(Frequency), Adaptive basis (PCA and ICA) , Adaptive basis(discriminants) Basics of Object detection – Template matching, Cascade classifiers.	8
4.	Object Recognition : Object Modeling, Bayesian Classification, Feature Selection and Boosting, Scene and Object Discrimination.	6
5.	Motion and Tracking: Motion detection and tracking of point features, optical flow, SURF, SIFT. Tracking- Kalman filter, Particle Filter, Comparison of deterministic and probabilistic methods condensation, tracking humans, multi-frame reconstruction under affine and perspective projection geometry.	8
6.	Introduction to Computer Vision programming libraries: MATLAB/ OpenCV. advantages and disadvantages of each .	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Computer Vision: A Modern Approach (2nd Edition) 2nd Edition by David A. Forsyth (Author), Jean Ponce (Author), 2002
2.	Learning OpenCV: Computer Vision with the OpenCVLibrary Gary Bradski, Adrian Kaehler, 2008

EC355 EMBEDDED SYSTEM

1. Subject Code: **EC- 355** Course Title: **Embedded Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Knowledge of Computer Architecture and Microprocessors
9. Objective : To introduce fundamentals of 16 and 32 bit Microcontrollers, assembly language programming. The course also focuses on interfacing of different interrupt driven peripherals. It also covers in detail Real Time Operating Systems, Bus architecture, Digital Signal Processors and System On-Chip.
10. Details of Course

Unit No.	Contents	Contact Hours
1.	Overview of Embedded Systems: Characteristics of Embedded Systems. Comparison of Embedded Systems with general purpose processors. General architecture and functioning of micro controllers. PIC and 8051 micro controllers : Architecture, memory interfacing , interrupts, instructions, programming and peripherals .	8
2.	ARM : Architecture, memory interfacing , interrupts, instructions and Assembly Language programming. Exception processing and pipeline architecture and applications.	12

3.	Digital Signal Processors: DSP Architecture, DSP applications, algorithms, data path, memory, addressing modes, peripherals. TI and Sharc family of DSP processors.	4
4.	System On Chip : Evolution, features, IP based design, TI OMAP architecture and peripherals. Digital Multimedia processor: Architecture and peripherals.	4
5.	SRAM, DRAM working and organization. Interfacing memory with ARM 7. Elements of Network Embedded Systems	4
6.	RTOS : RT-Linux introduction, RTOS kernel, Real-Time Scheduling Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Computers as components: Principles of Embedded Computing System Design, Wayne Wolf, Morgan Kaufman Publication, 2000
2.	ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, , Morgan Kaufman Publication, 2004
3.	Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002
4.	The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrav, 2003
5.	Embedded System Design, Marwedel, Peter, Kluwer Publishers, 2004

EC357 DIGITAL IMAGE PROCESSING

1. Subject Code: **EC 357** Course Title: **Digital Image Processing**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Signals and Systems

9. Objective : To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to Image processing, fundamental steps in DIP, concept of visual information, image formation model, image sampling and quantization, digital image representation, spatial and gray level resolution, relationship between pixels, application of image processing system.	6
2.	Introduction to Multidimensional signals and systems, 2D-Signals, 2D systems, classification of 2D system, 2D convolution, 2D Z-transform, Image Transform: 2D-DFT, discrete cosine, discrete sine, Haar, Walsh, Hadamard, Slant, KL, SVD, Hough, Radon, Ridgelet.	8
3.	Image enhancement; Spatial domain: linear transformation, image negative, grey level shifting, non-linear transformation, logarithmic transformation, exponential transformation, grey level slicing, bit plane slicing, image averaging, mask processing, histogram manipulations, histogram thresholding, histogram stretching, histogram equalization, noise removing filters, smoothing filters, sharpening filters. Enhancement in Frequency Domain; ideal low pas filter, Butterworth low pass filter, ideal high pass filters, Butterworth high pass filter, band pass filter, Gaussian filters, Homomorphic filtering.	10
4.	Image restoration: degradation model, noise models, restoration in presence of noise, periodic noise removal in frequency domain, notch filters, inverse filtering, Wiener filtering.	6

5.	Introduction to Morphological Image Processing operations, dilation and erosion, opening and closing, hit-or-miss transformation, boundary extraction, region filling, extraction connected components, convex hull, thinning, thickening, skeletons, pruning.	6
6.	Introduction to various colour models: RGB, CMY, CMYK, HSI, HSV, and YCbCr. Concept of image compression, Image Segmentation: detection of discontinuities, edge linking and boundary detection, thresholding, region based segmentation, use of motion in segmentation.	6
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Digital Image Processing/ Gonzalez and Woods/ Pearson Education, 2008/Third Edition
2.	Fundamentals of Digital Image Processing/ A.K. Jain/ PHI, Indian Edition
3.	Digital Image Processing using MATLAB/ Gonzalez, Woods, and Eddins/ McGraw Hill, Second/ 2013
4.	Digital Image Processing/ K.R. Castleman/ Pearson, 2014
5.	Digital Image Processing Algorithms and Applications/I. Pitas/John Wiley, 2002
6.	Image Processing, Analysis, and Machine Vision/Milan Sonka, Vaclav Hlavac, Roger Boyale/ Cengage Learning, 4th Edition

EC359 VLSI DESIGN

1. Subject Code: **EC -359** Course Title: **VLSI Design**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : To give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology. MOS transistor, Energy band diagram of MOS system,MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS	6
2.	MOSFET scaling and small geometry effects, MOScapacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models. The Wire: Interconnect parameters: capacitance, resistanceand inductance. Electrical wire models: The ideal wire, the lumpedmodel, the lumped RC model, the distributed RC model, the transmission line model, SPICE wire models.	6
3.	MOS inverters: Resistive load inverter, inverter with n-type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, IC layout design and tools.	8

4.	Designing Combinational Logic Gates in MOS and CMOS: MOS logic circuits with depletion MOS load. Static CMOS Design: Complementary CMOS, Ratioedlogic, Pass transistor logic, BiCMOS logic, pseudo nMOS logic, Dynamic CMOS logic, clocked CMOS logic CMOS domino logic, NP domino logic, speed and power dissipation of Dynamic logic, cascading dynamic gates.	8
5.	Designing sequential logic circuits: Timing matrices for sequential circuits, classification of memory elements, static latches and registers, the bistability principle, multiplexer based latches , Master slave Edge triggered register , static SR flip flops, dynamic latches and registers, dynamic transmission gate edge triggered register, the C2MOS register	8
6.	Pulse registers, sense amplifier based registers, Pipelining, Latch verses Register based pipelines, NORA-CMOS. Two-phase logic structure; VLSI designing methodology –Introduction, VLSI designs flow, Computer aided design technology: Design capture and verification tools, Design Hierarchy Concept of regularity, Modularity & Locality, VLSI design style, Design quality.	6
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Digital integrated circuits a design perspective byJan M Rabaey, Anantha Chadrakasan Borivoje Nikolic, Pearson education, 2011.
2.	CMOS digital integrated circuits by Sung MO KangYusuf Leblebici, Tata McGraw Hill Publication, 2002
3.	Principle of CMOS VLSI Design by Neil E Weste and Kamran Eshraghian, Pearson education, 2000.

EE351 POWER ELECTRONIC SYSTEMS

1. Subject Code: **EE-351** Course Title: **Power Electronic Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with power electronics and its applications.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Solid State Power Devices: Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, parameters of SCR, dv/dt and di/dt protection, snubber circuit, commutation circuits; Principle of operation ofMOSFET, IGBT, GTO, MCT, SIT, SITH, IGCT, their operating characteristics.	8
2.	Single-phase Converter: Half wave converter, 2-pulse midpoint converter, half controlled and fully controlled bridge converters, input current and output voltage waveforms, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage, effect of free-wheeling diode, triggering circuits. Three-phase Converter: Half wave, full wave, half controlled and fully controlled bridge converters, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage,	8
3.	AC-AC Converters: Principle of operation of cycloconverter, waveforms, control technique; Introduction of matrix converter.	4
4.	DC-DC Converters: Principle of operation of single quadrant chopper, continuous and discontinuous modes of operation; Voltage and current commutation, design of commutating components; Introduction to SMPS.	4

5.	Inverters: Voltage source and current source inverters, Principle of operation of single-phase half bridge and full bridge voltage source inverters, voltage and current waveforms; Three-phase bridge inverter, 120^0 and 180^0 modes of operation, voltage and current waveforms with star and delta connected RL load; Voltage and frequency control of inverters; PWM techniques-single pulse, multiple pulse, selective harmonic elimination, sinusoidal PWM.	8
6.	Applications: FACTS Technology: Reactive power control in power systems, transmission system compensation, static series and shunt compensation, static shunt and series compensators- SVC, STATCOM, TCSC, SSSC and their working principles and characteristics. Combined series-shunt compensators –UPFC and its applications and characteristic. VSC-HVDC Systems: Principles and applications	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Mohan N., Undeland T. M. and Robbins W. P., “Power Electronics-Converters, Applications and Design”, 3rd Ed., Wiley India, 2002.
2.	Rashid M. H., “Power Electronics Circuits Devices and Applications”, 3rd Ed., Pearson Education, 2004.
3.	N.G. Hingorani and L. Gyugyi, “Understanding FACTS”, IEEE Press, 2000
4.	K.R. Padiyar, “Facts Controllers In Power Transmission and Distribution”, New Age publishers, 2013
5.	HVDC power transmission system, K.R.Padiyar, NewAge Publishers,2011

EE353 ELECTRICAL MACHINES AND POWER SYSTEMS

1. Subject Code: **EE-353** Course Title: **Electrical Machines and Power Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with electrical machines and power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Transformers : constructional features, types, Special constructional features – cruciform and multiple stepped cores, cooling methodology, conservators, breather, Buchholz relay, voltage, current and impedance relationships, equivalent circuits andphasor diagrams at no load and full load conditions,voltage regulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.	8
2	Asynchronous machines: General constructional features of poly phase asynchronous motors, concept of rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, torque and power equations, torque-slip characteristics, losses and efficiency.	8
3	Synchronous machines : General constructional features, armature winding, emf equation, effect of distribution and pitch factor,flux and mmf relationship, phasor diagram, non-salient pole machine, equivalent circuit, determination of equivalent circuit parameters by open and short circuit tests, voltage regulation using synchronous impedance method, power angle characteristics	9
4	Single line diagram of power system, brief description of power system elements, synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator. Supply System:different kinds of supply system and their comparison, choice of transmission voltage. Transmission Lines:configurations, types of conductors, resistance of line, skin effect	9

5	Transmission lines: Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit ,transmission lines, representation and performance of short, medium and long transmission lines, Ferranti effect,surge impedance loading.	8
Total		**42**

11. Suggested Books

S. No.	Name of Authors /Books / Publishers
1	Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 2006.
2	M.G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers, New Delhi, 2008
3	Nagrath I. J and Kothari D.P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
4	Power System Analysis, J. Grainger and W.D. Stevenson, TMH, 2006.
5	Electrical Power Systems,C. L.Wadhwa, New age international Ltd. Third Edition, 2010
6	Electric Power Generation, Transmission&Distribution,S.N.Singh, PHI Learning, 2008.

EE-355 INSTRUMENTATION SYSTEMS

1. Subject Code: **EE-355** Course Title: **Instrumentation Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with instrumentation systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Transducers-I:Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, strain gauges, resistance thermometer, thermistors, thermocouples, LVDT, RVDT	8
2	Transducers-II:Capacitive, piezoelectric, Hall effect and opto electronic transducers. measurement of motion, force, pressure, temperature flow and liquid level.	8
3	Telemetry:General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System:A/D and D/A converters, analog data acquisition system, digital data acquisition system, modern digital data acquisition system and signal conditioning.	8
4	Display Devices and RecordersDisplay devices, storage oscilloscope, DSO, spectrum analyzer, digital recorders. RecentDevelopments:Introduction to virtual and intelligent instrumentation, fibre optic transducers, smart sensors, smart transmitters, process instrumentation diagrams.	8
5	Programmable Logic Controllers :Evolution of PLC-sequential and programmable controllers, architecture and programming of PLC, relay logic and ladder logic, functional blocks, communication networks for PLC, field bus, profi-bus, mod-bus	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A.D. Helfrick, Prentice Hall International, 2009.
2	Measurement Systems Application and Design Ernest Doebelin, McGraw- Hill Higher Education, 5th edition , 2003
3	Instrumentation, Measurement and Analysis, B.C. Nakra& K. Chaudhry, Tata McGraw Hill, 2nd Edition, 2001.
4	Advanced Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& Sons, 2010
5	Process Control Instrumentation Technology, Curtis D. Johnson, Pearson, 6th edition, 1999
6	Programmable Logic Controllers, Frank D. Petruzella McGraw-Hill Higher Education, 4th edition, 2010

EE357 UTILIZATION OF ELECTRICAL ENERGY

1. Subject Code: **EE-357** Course Title: **Utilization of Electrical Energy**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of electrical power, energy and its utilization.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Illumination: Definition:- Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Review of laws of illumination, Different types of lighting sources and their use in domestic, street and industrial lighting, Energy considerations. LED's and their driving circuits.	10
2	Electric Heating : Advantages of electrical heating, Heating methods: Resistance heating – direct and indirect resistance heating, properties of resistance heating elements, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace, Dielectric heating, applications in various industrial fields, Infra-red heating and its applications, Microwave heating	08
3.	Electric Welding: Introduction to electric welding, Welding methods, Principles of resistance welding, types – spot, projection seam and butt welding and welding equipment used, Principle of arc production, electric arc welding, characteristics of arc, Design of Power supply and welding control circuit, comparison between AC and DC arc welding, welding control.	08
4.	Electrolytic Processes: Need of electro-deposition laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing equipment and accessories for electroplating factors affecting electro-deposition , principle of galvanizing and its applications, anodising and its applications, electroplating on non-conducting materials, manufacture of chemicals by electrolytic process, electrolysis for water purification	08
5.	Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, description of electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler, variable speed drive for compressors, high speed compressors, insta-chill, Peltier effect, thermoelectric cooling, sterling engines, solar concentrator heating and cooling,	08
Total		**42**

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House,2007.
2.	Taylor E. O., "Utilization of Electric Energy (in SI units)", Orient Longman, Revised in S.I. units by Rao, V.V.L,1999
3.	Hancock N. N., "Electric Power Utilisation", Wheelers,1979.

EE-359 NON-CONVENTIONAL ENERGY SYSTEMS

1. Subject Code: **EE-359** Course Title: **Non-conventional Energy Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the non-conventional sources of energy and their integration to the grid.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction to Non Conventional Energy Systems Various non-conventional energy resources Introduction, availability, classification, relative merits and demerits. Solar Cells: theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations. Solar Thermal Energy: solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	10
2	Geothermal Energy Resources of geothermal energy, thermodynamics of geo-thermal energy conversion, electrical conversion, non-electrical conversion,environmental considerations. Magneto-hydrodynamics (MHD):principle of working of MHD power plant, performance and limitations.	8
3	Fuel Cells: Basic principle of working, various types of fuel cells, performance and limitations.	8
4	Thermo-electrical and thermionic conversions Principle of working of thermo-electrical and thermionic conversions, performance and limitations. Wind energy: wind power and its sources, site selection criteria, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of wind energy conversion systems.	8
5	Energy from Bio-mass, Ocean Thermal, Wave and bio-waste Availability of bio-mass and its conversion principles, ocean thermal energy conversion principles, performance and limitations, wave and tidal energy conversion principles, performance and limitations, bio-waste recycling power plants.	8
Total		**42**

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1	Renewable Energy Resources, John Twidell, Tony Weir, Taylor and Francis, 2nd edition,2005.

2	Solar Engineering of Thermal Processes,John A. Duffie, William A. Beckman, John Wiley & Sons, 4th edition,2013.
3	Biofuels, Solar and Wind as Renewable Energy Systems: Benefits and Risks,D. Pimentel, Springer,1st edition,2010.
4	Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers,Chetan Singh Solanki, PHI Learning,2013.
5	Non Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd.,2006

EE-361 EMBEDDED SYSTEMS

1. Subject Code: **EE-361** Course Title: **Embedded Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of embedded systems.
10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Embedded Processing – Evolution, Issues and Challenges;	1
2	System and Processor Architecture : von Neumann, Harvard and their variants	2

3	Memory Architecture and Devices; Input-Output Devices and Mechanisms	5
4	Instruction Set and Addressing Modes, Interfacing of Memory and Peripheral Devices – Functional and Timing Issues	6
5	Application Specific Logic Design using Field Programmable Devices and ASICs	2
6	Analog to Digital and Digital to Analog Converters	2
7	Bus I/O and Networking Considerations, Bus and Wireless Protocols	4
8	Embedded Systems Software : Constraints and Performance Targets	2
9	Real-time Operating Systems : Introduction, Scheduling in Real-time Operating Systems	4
10	Memory and I/O Management : Device Drivers	2
11	Embedded Software Development : Flow, Environments and Tools	2
12	System Specification and Modelling	2
13	Programming Paradigms	2
14	System Verification	2
15	Performance Analysis and Optimisation : Speed, Power and Area Optimisation, Testing of Embedded Systems	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	S. Heath, “Embedded Systems Design”, Elsevier India,2005
2.	M. Ben-Ari, “Principles of Concurrent and Distributed Programming”, Pearson,2005
3.	Jane Liu, “Real Time Systems”, Pearson,2002

EN-351 ENVIRONMENTAL POLLUTION AND E –WASTE MANAGEMENT

1. Subject Code: **EN-351** Course Title: **Environmental Pollution & E- Waste Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs. Practical: 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : The overall aims of the course are for students to acquire understanding of the new and emerging contaminants from various industrial processes and their transformation products. Studying emerging environmental issues related to newer methods of manufacture of industrial products.

10. Details of Course

Unit No.	Contents	Contact Hours
1	UNIT-I New and emerging pollutants and related transformation products, Effects & risks of emerging contaminants on ecosystems and humans, Persistent pollutants. Analytical methods for identifying emerging pollutants and the products of their transformation	9
2	UNIT-II Micro pollutants- Pesticides, Pharmaceutical - Veterinary and human drugs, personal care products, Surfactants and surfactant metabolites, Flame retardants, Industrial additives and agents.Emerging pollutants' toxicity, and their water-related characteristics (degradability, solubility, sorption…)	9

3	UNIT-III Emerging Issues - E-waste, Hazardous Waste, Nuclear Waste, Nano pollution, Thermal Pollution, pollutant emission and treatment	8
4	UNIT-IV Emerging pollutants' emergence and fate in surface and ground water, as well as mathematical modelling, Sustainable Development, Risk mitigation	8
5	UNIT-V Transformation Products of Emerging Contaminants in the Environment, Removal of emerging contaminants from water, soil and air, methods and preventive measures.	8
Total		**42**

Course Outcome:

1. Introduction to new and emerging contaminants and their transformation products.
2. Study of pollutants from manufacturing of goods.
3. Emerging area in environmental pollution.
4. Study of life cycle of a contaminant, modeling and mitigation.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	G. Buttiglieri, T.P. Knepper, (2008), Removal of emerging contaminants in Wastewater Treatment: Conventional Activated sludge Treatment, Springer-Verlag Berlin Heidelberg, HdbEnvChem, vol. 5, Part S/2:1-35, DOI: 10.1007/698_5_098
2.	Alok Bhandari; Rao Y. Surampalli; Craig D. Adams; Pascale Champagne; Say Kee Ong; R. D. Tyagi; and Tian Zhang, Eds., (2009) Contaminants of Emerging Environmental Concern, American Society of Civil Engineers, ISBN (print): 978-0-7844-1014-1, ISBN (PDF): 978-0-7844-7266-8
3.	Dimitra A. Lambropoulou, Leo M. L. Nollet Eds. () Transformation Products of Emerging Contaminants in the Environment: Analysis, Processes, Occurrence, Effects and Risks, 1st Edition, Wiley, ISBN-13: 978-1118339596, ISBN-10: 1118339592

EN353 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

1. Subject Code: **EN- 353** Course Title: **Occupational Health and Safety Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Prerequisite : Nil
9. Course Objectives :
   1. Introduction about occupational health and related issues.
   2. To give a basic idea about environmental safety management, industrial hygiene.
   3. To introduce about training cycle, chemical hazards and control measures.
   4. To aware and provide knowledge about ergonomics and different disorders.
   5. To provide knowledge about different standards related to safety and health.
10. Detail of Course:

Unit no.	Contents	Contact Hours
1	UNIT –I Definition of Occupational Health as per WHO/ILO. Occupational Health and Environmental Safety Management – Principles practices. Common Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.	8

2	UNIT –II Occupational Health and Environment Safety Management System, ILO and EPA Standards. Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.	8
3	UNIT –III Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Chemical Hazard: Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values.	9
4	UNIT –IV Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit. Ergonomics-Introduction, Definition, Objectives, Advantages. Ergonomics Hazards. Musculoskeletal Disorders and Cumulative Trauma Disorders. Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction system etc. Assessment of Workload based on Human physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria or fixation limits.	9
5	UNIT –V Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department, Safety committee and Function.	8
Total		**42**

Course Outcomes:

1. The student will be able to understand the basics of occupational health and related issues.
2. Understanding of the fundamental aspects of safety, industrial hygiene along with learning theory to safety training methodology.
3. Considerate about hazardous materials, emergency management, ergonomics and human factors

4. Able to understand the adverse effects of hazards and develop control strategies for hazardous conditions and work practices
5. Learn about Indian standards of health and safety and able to apply applicable standards, regulations and codes.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Handbook of Occupational Health and Safety, NIC, Chicago, 1982.
2.	Encyclopedia of Occupational Health and Safety, Vol. I and II. International Labour Organisation, Geneva, 1985.
3.	Accident Preventional Manual, NSC Chicago, 1982.
4.	Henrich, H.W., Industrial Accident Prevention, McGraw Hill, 1980.

EN-355 GIS & REMOTE SENSING

1. Subject Code: **EN-355** Course Title: **GIS & Remote Sensing**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Prerequisite : Nil
9. Course Objectives :

1. Introduce GIS and its significance in engineering and science.
2. To familiarize students with GIS data and its applications.
3. To familiarize students about the basics of remote sensing and its multi concepts.
4. To disseminate knowledge about sensors and different kind of resolution in the area of remote sensing.
5. To familiarize students about the diverse applications of remote sensing.

10. Detail of Course:

Unit no.	Contents	Contact Hours
1	Unit-1: Geographic Information System Introduction, Definition of GIS, Components of GIS, Input data for GIS, Geographical concepts	7
2	Unit-2:GIS Data GIS data types, Data representation, Data sources, Geo-referencing of GIS data, GIS database, Database Management System, Data analysis terminology, GIS software packages, GIS application	9
3	Unit-3:Remote Sensing Introduction to Remote Sensing and Remote Sensing System, Multi concept of remote sensing, Advantages and disadvantages of remote sensing, Electromagnetic radiation, Polarisation, Thermal radiation	8
4	Unit-4:Remote Sensing Platforms Important remote sensing satellites, Classifications of sensors and platforms, Passive and Active sensors, Major remote sensing sensors, Spatial resolution, Spectral resolution, Radiometric resolution, Temporal resolution, Glopal Positioning System	9
5	Unit-5:Application of Remote Sensing Digital Image Processing, Application of Remote Sensing in Land use and Land cover mapping, Ground water mapping, Urban growth studies, Wasteland mapping, Disaster management, Agriculture, Forestry application	9
Total		**42**

Course Outcomes:

1. The Student will learn about basics of GIS and its significance.
2. The Student will be able to understand the utility of GIS data as well as Data Management System.
3. The Student will learn the fundamentals of remote sensing.
4. The unit of Remote Sensing Platform will generate a clear cut understanding among students about the satellites, their functioning and Global Positioning System. Geographical information system, its components, DMS and its various applications in real life.
5. The Student will be able to attain thorough knowledge about the application of remote sensing in different areas.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Fundamentals of Remote Sensing – George Joseph, University Press, Hyderabad, India.
2.	Remote Sensing and Geographical Information System – AM Chandra & SK Ghosh Narosa Publishing House, New Delhi.
3.	Concepts and Techniques of Geographic Information Systems – C. P. Lo & Albert K.W. Yeung, PHI Learning Private Limited, New Delhi.
4.	Geographic Information System – Kang Tsung Chang, Tata Mc Graw hill, Publication Edition, 2002.

EP351 PHYSICS OF ENGINEERING MATERIALS

1. Subject code: **EP351** Course title: **Physics of Engineering Materials**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the fundamentals /basic concepts and advances of the different materials keeping in view of the engineering applications. There is ample opportunity to become involved in cutting edge Materials Science and Engineering Research

10. Detail of Course:

Unit No.	Contents	Contact Hours
1.	**Crystallography:** Introduction to crystal physics,Space lattice, Basis and the Crystal structure, Bravais lattices; Miller indices, simple crystal structures,Interplanar spacing, Intra and Intermolecular bonds (Ionic, Covalent, Metallic, Van der Waals and Hydrogen Bond), Defects in crystals, Basics of X- ray diffraction and its applications	10
2.	**Semiconductors:** Band theory of solids, Intrinsic and Extrinsic semiconductors, Statistics of electrons and holes in intrinsic semiconductor, Hall effect, Effect of temperature on conductivity, Generation and recombination, drift and diffusion current, Einstein relation, Applications of Semiconducting Materials.	10
3.	**Dielectric and Magnetic Materials** *Dielectric Materials:* Dielectric polarization and dielectric constant, Various polarization processes, Applications of Dielectric Materials *Magnetic Materials:* Concept of Magnetism, Classification of dia-para, Ferro, Antiferro and Ferrimagnetism, ferrites, soft and hard magnetic materials, Applications of Magnetic Materials	07
4.	**Superconductivity:** Introduction and historical developments; General properties of super conductors, Meissner effect and its contradiction to the Maxwell's equation; Types of Superconductors, London equations, Penetration depth, High Temperature Superconductors, Applications of superconductors.	07
5.	**Advanced Engineering Materials:** Introduction, Synthesis, characterization and applications of Photonic glasses, Phosphors and Nanophosphors, other selective topics in advanced materials.	08
Total		**42**

11. Suggested Books:

S. No.	Name of Books/ Authors
1.	Introduction to Solid State Physics, by C. Kittel, 1996/ John Wiley & sons
2.	Solid State Physics, by S. O. Pillai, 2010/ New Age International (P) Ltd.
3.	Materials Science and Engineering by V. Raghavan, 2009/PHI Learning Pvt. Ltd.
4.	Solid State Physics, N. W. Ashcroft and N. D. Mermin, 1976/ HBC Publication
5.	Engineering Materials Science by Milton Ohring, 1995/Academic Press
6.	Material Science and engineering: An Introduction By W. D. Callister Junior, 2007/ John Wiley & Sons, Inc
7.	Handbook of Electronic and Photonic Materials by SafaKasap, Peter Capper (Eds.), 2006/Springer

EP353 NUCLEAR SECURITY

1. Subject code: **EP353** Course title: **Nuclear Security**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS:-- MTE: 25 ETE: 50 PRE: --
5. Credits : 3
6. Semester : V
7. Subject area : OEC
8. Pre-requisite : Basic knowledge of Nuclear Physics
9. Objective : This course will provide basic understanding of Nuclear Security which is essential for establishing nuclear culture in the society

10. Detail of Course:5th/6th Semester

S. No.	Contents	Contact Hours
1.	Introduction to nuclear security: Basics of nuclear security, Practice and culture, Background, Objective, Scope, Structure, Nuclear security and safety culture: Characteristics of nuclear security culture	08
2.	Nuclear security regime, Importance of human factor and management leadership in nuclear security, Nuclear security threats: Threat informed security, The design basis threat	07
3.	System characterization, PPS requirements and objectives: Facility characterization, Target identification, Consequence analysis, PPS performance objectives	06
4.	Physical protection system technologies: Intrusion detection, Exterior and Interior Sensors, Access control, Contraband detection, Field detection sensors at borders/major public Events, Alarm assessment, Communication and display, Access delay, Response and neutralization, Response strategies and impact of On and Off site response, Cyber security.	09
5.	Security system design and evaluation: Adversary path analysis and Multi path optimization, Scenario development, Insider analysis, Transportation, Design approaches and vulnerability assessments, System design at major public events, Design of security systems to interrupt illicit trafficking, Analysis of quantitative risk assessment methods.	08
6.	Consequence mitigation and event response: Consequence management following nuclear events, Analysis of deterrence value of security measures, Roles and responsibilities of institutions and individuals	04
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors
1.	Nuclear security briefing book, by Wyn Bowen, Matthew Cottee, Chris Hobbs, Luca Lentini and Matthew Moran, 2014/King's College, London, UK
2.	IAEA Nuclear Security Series No. 13, Nuclear Security recommendations on physical protection of nuclear material and nuclear facilities by IAEA, 2011/ International Atomic Energy Agency (IAEA)
3.	The International Legal Framework of Nuclear Security: IAEA International law series No. 4 by IAEA, 2011/International Atomic Energy Agency (IAEA)
4.	Seeking Nuclear Security Through Greater International Cooperation by Jack Boureston and Tanya Ogilvie-White, 2010/Council on Foreign Relations (CFR's) International Institutions
5.	Book Review: South Asia's Nuclear Security by Bhumitra Chakma , 2015/Oxon, UK, Routledge

HU351

1. Subject Code: **HU351** Course Title: **Econometrics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective:

10. Details of Course

Unit	Contents	Contact Hrs
1.	Introduction Concept of Econometrics, methodology of Econometrics, types of Econometrics, Difference between Econometrics and Mathematical Economics, Type of Data, Sources of data, Estimating Economic Relationship	8
2.	Mathematics and Economic Application Differential Calculus and its application in Economics- Price and Cros Elasticity of demand, Profit maximization under Perfect Competition, Monopoly, Oligopoly and Monopolistic Competition Integral Calculus and its application in Economics - Capital Formation, Compound Interest; Capital value and Flow Value; Consumer surplus under pure competition and monopoly; Producers Surplus Differential Equation and its application in Economics – Market Price Function; Dynamic Multiplier;	12
3.	Regression Statistical verses Deterministic Relationships, Regression verses Causation; Two variable Regression Analysis; Population Regression Function (PRG), Stochastic specification of PRF; The Significance of the Stochastic Term; stochastic disturbance Term; the sample regression Function (SRF); Method of Ordinary Least Squares; Properties of Least Square Estimators: The Gauss-Markov Theorem, Coefficient of determination r^2 : A Measure of "goodness of fit"; Monto Carlo Experiments	8
4.	Classical Normal Linear Regression Mode (CNLRM) The Probability distribution of Disturbances (meu); Normality Assumption, Method of Maximum Likelihood Multiple regression Analysis: The Problem of estimation; The problem of Inference Cobb-Douglas Production function; Polynomial Regression Model; Testing for structural or Parametric stability of regression Models; the Chow test	6
5.	Dummy Variable (DV) Regression Models Nature; ANOVA models; Regression with a mixture of Quantitative and Qualitative regressors: The ANCOVA Models; DV alternative to the Chow Test; Interaction effects using Dummy Variable; Use of DV in seasonal Analysis	6
Total		**40**

11. Suggested books

S.No.	Name of Books, Authors, Publishers
1.	Wooldridge Jeffrey , Introductory Econometrics, Cencage Learning- ISBN-13-978-81-315-1673-7; ISBN-1081-315-1673-3,2014
2.	Damodar N. Gujrati, Basic Econometrics, Mcgraw Hill Education (India) Limited, Fifth Edition,2013 ISBN-978-0-07-133345-0; ISBN; 0-07-133345-2
3.	Ramu Ramanathan, Introductory Econometrics with Applications, Harcourt Brace Jovanovich Publishers, Latest USA ISBN-

MA351 HISTORY CULTURE & EXCITEMENT OF MATHEMATICS

1. 1 Subject code: **MA351** Course title: **History Culture and Excitement of Mathematics**
2. Contact Hours : L-3 T-0 P-0
3. Examination Duration (Hrs) : Theory: 3hrs
4. Relative weightage : CWS: 25 PRS: - MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre requisite : --
9. Objective: To be capable in learning the history and culture on the Mathematics subjects

Unit No.	Contents	Contact Hours
1.	Ancient, Medieval and Modern Indian Mathematics: Aryabhata, Brahmagupta, Bhaskar, Lilavati, Ramanujan	7
2	Introduction to Ancient books of Indian Mathematicians: Sidhantas, Sulvasutras, Vedic Mathematics	7

3	Contribution of Indian Mathematicians in the field of Mathematics: Value of Pi, The symbol zero, Number theory, Trigonometry, and Mensuration, Hindu Multiplication, Long Division, Indeterminate equation	7
4	Mathematicians Around the world: Newton, Leibnitz, Cauchy, Lagrange in the field of Geometry, Calculus, Algebra, Probability	7
5	Algebra in the Renaissance: Solution of cubic equation, Ferrari's Solution in the quartic equation, Irreducible Cubics and complex numbers	7
6	Paradoxes, Fallacies and Pitfalls of Mathematics	7
Total		**42**

11. Suggested books

S.No.	Name of Books, Authors, Publishers
1.	History of Mathematics, by carl B Boyer, Wiley International edition, 1968.
2.	Mathematics of Music, Susan Kelly, UW-L Journal of under graduate research, Vol-XIV, 2011.

ME 351 POWER PLANT ENGINEERING

1. Subject Code: **ME 351** Course Title: **Power Plant Engineering**
2. Contact Hours: 42 : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with thermodynamic cycles and various components of power plants.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Indian energy scenario, Indian coals: formation, properties, analysis, benefication and heating value calculation of coals; coking and non-coking coals, fuel handling systems; coal gasification. Classification of power plants, base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria,.	7
2	**Steam Generators:** High pressure utility boiler, natural and forced circulation, coking and non-coking coal, coal benefication, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment.	7
3	**Combined Cycle Power Plants:** Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD-Steam power plant.	7
4	**Other power plants:** Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, tidal power plants, diesel and gas power plants.	7
5	**Instrumentation and Controls in power plants:** Important instruments used for temperature, flow, pressure, water/steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS).	7
6	**Environment Pollution and Energy conservation:** Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/management of nuclear power plant waste, concept of energy conservation and energy auditing.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Power Plant Engineering** by M.M. Elwakil, Tata McGraw Hill, ISBN- 0070662746.
2	**Power Plant Engineering** by P.K Nag, Tata McGraw Hill, ISBN- 0070435993.
3	**Steam and Gas turbines** by A Kostyuk and V Frolov, MIR Publishers, ISBN-9785030000329.
4.	**Modern Power Plant Engineering** by J Wiesman and R Eckart, Prentice hall India Ltd, ISBN- 97801359725.
5.	**Planning Fundamentals of thermal Power Plants** by F.S Aschner, John Wiley, ISBN- 07065159X.
6.	**Applied Thermodynamics** by T.D Eastop and McConkey, Longman Scientific and Technical, ISBN- 0582305351.
7.	**CEGB volumes on power plant, Cwntral Electricity Generation Board, ISBN-0080155680.**
8.	**NTPC/NPTI publications on Power plants**, ISBN- 9788132227205.

ME353 RENEWABLE SOURCES OF ENERGY

1. Subject Code: **ME 353** Course Title: **Renewable Sources of Energy**
2. Contact Hours: 42 : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives	7
2	Solar radiation: Origin, nature and availability of solar radiation, estimation of solar radiation. Photovoltaic cells. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors. Effects of receiving surface location and orientation.	7
3	Devices for solar thermal collection and storage. Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems. Heat transfer considerations relevant to solar energy. Characteristics of materials and surfaces used in solar energy absorption.	7
4	Application systems for space heating, solar water pumps, solar thermal pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning, other solar energy utilization.	7
5	Solar PV systems. Fuel Cell Technologies. Generation and utilization of biogas, design of biogas plants, Wind energy systems.	7
6	Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations. Role of the nonconventional energy sources in power planning.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	G. D. Rai, “Energy Technolgy”, Khanna Publishers, ISBN- 97881740907438.
2	S.P. Sukhatme, “ Solar Energy”, Tata-Mcgraw hill, New Delhi, ISBN- 0074624531.
3	“Solar Energy thermal process” JADuffie and W.A. Beckman, John Wiley& sons, New York, ISBN- 1118418123.

4	Solar energy, Frank Kaieth& Yogi Goswami, Taylor and Francis, ISBN- 1560327146.
5	Treatise of Solar Energy, H.P. Garg, John Willey & sons, ISBN- 9027719306.

ME355 COMBUSTION GENERATED POLLUTION

1. Subject Code: **ME 355** Course Title: **Combustion Generated Pollution**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To introduce the students to different types of fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Engine fundamentals: Fuels, alternative fuels for IC engines, Type of hydro carbons. Gasoline specifications. Effect of Engine parameters on performance, fuel injection for SI engines, Engine vehicle road performance, road performance and fuel economy.	7
2	Emissions and air pollution: Automotive Emissions and their role in air pollution. Photo-chemical smog. Chemistry of smog formation. Combustion in Homogeneous mixtures, emission formation. Incomplete combustion, formation of hydro-carbons, Carbon monoxide and oxides of nitrogen, Aldehyde emissions.	7

3	Influence of design and operating variables on gasoline engine exhaust emissions. Hydrocarbon Evaporative Emissions: Various sources and methods of their control. Canisters for controlling evaporative emissions. Emission control systems for gasoline engines: Blow by control closed PCV system design.	7
4	Exhaust treatment devices: Air injection into exhaust system.	7
5	Thermal reactors, Catalytic convertor. Stratified charge engines. Honda CVCC engine. Diesel engine combustion Emissions: Sources of emissions during combustion. Effect of air fuel ratio, speed, injection timing on performance and emission formation. D.I and I.D.I engine emissions.	7
6	Methods of reducing emissions, exhaust gas recirculation, smoke emission from diesel engines. Emission Instruments: Non- dispersive Infrared analyzer, Gas chromatograph, flame ionization detector, chemiluminescent analyzer	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Combustion generated air pollution, Earnest S Starkman, Springer, ISBN-9780306305302.
2	Fundamentals of Air pollution engineering, Richard C. Hagan, Prentice Hall, ISBN-0133325371.
3	Air pollution threat & response, David Alym, Addison-Wesley Publication, ISBN-0201043556.

ME357 THERMAL SYSTEM

1. Subject Code: **ME 357** Course Title: **Thermal System**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To familiarise the students with the process of thermodynamic analysis of engineering systems and to enhance critical thinking and provide them with a wider view to handle engineering problems.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Fundamentals**: properties of pure substance in Solid, Liquid and Vapour Phases, PVT Behavior of simple compressible system, T-S and H-S diagram, Steam Tables, determination of quality of steam, Throttling Calorimeter, Combined Separating & Throttling Calorimeter, Maxwell and other thermodynamics relations, mixture of non reactive ideal gases, Real gases, Compressibility chart, Law of corresponding state, Air water vapor mixture, calculation of properties of air water vapour mixture.	7
2	**Rankine Cycle And Analysis**: Rankine cycle and its representation on T-S and H-S diagrams; Effect of low backpressure and high entry pressure and temperature and its limitations; necessity of re-heating, ideal and actual regenerative feed water heating cycle and its limitations. Typical feed water heating arrangements for various capacity power plants.	7
3	**Introduction To Boilers**: Classification of Boilers, Boiler mountings and accessories; draft systems, circulation system; Combustion and its calculations, and Boiler performance.	7
4	**Steam Nozzles**: Types of Nozzles, Flow of steam through nozzles; Condition for maximum discharge through nozzle; Nozzle efficiency. Effect of friction and Supersaturated flow through nozzle.	7

5	**Steam Turbines** : Working principle and types of steam turbines; Velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; Optimum velocity ratio and maximum efficiency. Comparison of impulse and reaction turbines. Condition line and reheat-factor, losses in steam turbines; governing of steam turbines.	7
6	**Condensers and Cooling towers**: Types and working of condensers, types and performance of cooling towers.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Engineering Thermodynamics** by P.K.Nag, Tata McGraw Hill Publishing Company Limited, ISBN – 1259062562, 2013.
2	**Engineering Thermodynamics**byRogers, Pearson Education, ISBN- 631197036.
3	**Thermodynamics** by Kenneth Wark, Mcgraw-hill Book Company, 5th edition, ISBN- 0070682860, 1988.
4.	**Engineering Thermodynamics: work and heat transfer** by Gordon Rogers and Yon Mayhew, Longman, 4th edition, ISBN – 0471861731, 1992.
5.	**Fundamentals of Classical Thermodynamics** by Van Wylen and Sonntag, John Wiley & Sons Inc., 3rd edition, ISBN – 0471861731, 1986.
6.	**Fundamentals of Engineering Thermodynamics** by Moran and Shaprio, **John Wiley & Sons, Inc., 7th edition, ISBN – 0470917687, 2010.**
7.	**Thermodynamics: An Engineering Approach** by Cengel and Boles, The McGraw-Hill Companies, 8th edition, ISBN: 0073398179, 2014.
8.	**Applied Thermodynamics for Engineering Technologists**byT.D. Eastop, Prentice Hall, 5th edition, ISBN- 05820919344, 1993.
9.	**Treatise on Heat Engineering** by V. P.Vasandani and D.S. Kumar, Metropolitan Book Co. (p) Ltd., ISBN- 810003500.

ME359 REFRIGERATION & AIR CONDITIONING

1. Subject Code: **ME 359** Course Title: **Refrigeration and Air Conditioning**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To learn properties of different refrigerants, and thermodynamic cycles of refrigeration.To understand comfort parameters and air conditioning.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction to Refrigeration**: Necessity and applications, unit of refrigeration and C.O.P., types of Ideal cycles of refrigeration, air-refrigeration, bell coleman cycle, open and dense air systems, actual air-refrigeration system problems, refrigeration needs of aircrafts, actual refrigeration system	7
2	**Vapour Compression Refrigeration**: Working principle and essential components of the plant, simple vapour compression refrigeration cycle - COP, Representation of cycle on T-S and p-h charts - effects of sub cooling and super heating - cycle analysis - Actual cycle, Influence of various parameters on system performance – necessity of multistaging, multistage compression system, and their analysis, necessity and working of cascading system	10

3	**Refrigerants and Absorption Refrigeration:** Desirable properties of refrigerants, classification of refrigerants used, nomenclature, ozone depletion, global warming, vapor absorption system, calculation of max COP.	4
4	**Air Conditioning**: Psychometric properties & processes, comfort air-conditioning, summer and winter air-conditioning, cooling & dehumidification systems, load calculation and applied psychrometry.	7
5	**Human Comfort:** Requirements of human comfort and concept of effective temperature, comfort chart, comfort air-conditioning, requirements of industrial air-conditioning, air-conditioning load calculations.	7
6	**Control:** Refrigeration and air-conditioning control, air handling, air distribution and duct design	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Refrigeration and Air Conditioning** by C. P. Arora, Tata McGraw Hill, ISBN-9788120339156.
2	**Refrigeration and Air Conditioning** by A. R .Trott and T. C. Welch, Butterworth-Heinemann, ISBN- 9780080540436.
3	**Refrigeration and Air ConditioningTechnology** by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, ISBN- 1111644470.
4	**Refrigeration and Air Conditioning** by Abdul Ameen, Prentice Hall of India Ltd, ISBN- 9789303206560..
5	**Basic Refrigeration and Air Conditioning** by P. N. Ananthanarayan, Tata McGraw Hill, ISBN- 9789383286560.
6	**Refrigeration and Air Conditioning** by Wilbert F. Stoecker and Jerold W. Jones, Tata McGraw Hill, ISBN- 007061623X.
7.	**Refrigeration and Air Conditioning by** Richard Charles Jordan, Gayle B. Priester, Prentice hall of India Ltd, ISBN-9780406269313.

8	**ASHRAE Handbook – Refrigeration 2010,** ISBN- 9781933742922.

ME361 INDUSTRIAL ENGINEERING

1. Subject Code: **ME361** Course Title: **Industrial Engineering**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make students aware of industrial engineering concepts of work study and measurement, quality control and reliability etc.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction** Introduction, Definition and objectives of Industrial Engineering, Scope of Industrial Engineering, Production systems and their classifications; Productivity-Total and partial productivity, Reasons and remedy for poor productivity	7
2	**Job analysis and Work Measurement Systems** Work System Design: Taylor's scientific management, Gilbreth's contributions; method study, micro-motion study, principles of motion economy; work measurement - stop watch time study, micro motion and memo motion, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering	7

3	**Production Planning and Control** Types and characteristics of production systems Objective and functions of Production, Planning & Control, Routing, Scheduling and Operations scheduling, production scheduling, job shop scheduling problems, sequencing problems, scheduling tools and techniques, Loading, Dispatching and its sheets & Gantt charts	7
4	**Quality Engineering** Quality concept and costs; statistical quality control, Concept of specification limits, statistical control limits, process capability, Process control and control charts for both attributes and variable data. Acceptance Sampling- Single and double sampling	7
5	**Reliability and Maintenance** Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; Maintenance management and its objectives, Various types of Maintenance Planning, House Keeping, 5S concepts	7
6	**Material Handling** Principles, functions, and objectives of Material Handling; Selection and classification of Material Handling Equipments; Relation of material handling with plant layout	7
Total		**42**

11. Suggested Books

S. No.	Name of Authors /Books / Publishers
1	Industrial Engineering and Management; B. Kumar, Khanna Publication, ISBN-8174091963, 2011.
2	Introduction to work Study, International Labour Office, Geneva, 3rd edition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, ISBN- 8120406028, 2008.
3	Industrial Engineering and Management, Pravin Kumar, Pearson Education, 1st edition, ISBN- 9789332543560, 2015.

ME363 PRODUCT DESIGN & SIMULATION

1. Subject Code: **ME363** Course Title: **Product Design & Simulation**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the process of product design and development.
10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Stages in design process:** Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	5
2	**Product life cycle:** New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies	5
3	**Value engineering:** Introduction, nature and measurement of value. Value analysis job plan. Creativity. Value analysis test. Case studies	5
4	**Concurrent/ reverse engineering:** Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering	5

5	**Material selection:** Materials in design. The evolution of engineering materials. Design tools and material data. Material selection strategy, attribute limits, selection process, material selection. Case studies	5
6	**Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, process cost. Computer – aided process selection	5
7	**Design for manufacture and assembly:** Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives	4
8	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages	4
9	**Simulation of Mechanical Systems**: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
TEXT BOOKS:	
1	David G Ullman, “The Mechanical Design Process.” Publisher- McGrawhillIncSingapore, ISBN-13: 9780072975741, 1992.
2	Kevin Otto & Kristin Wood Product Design: “Techniques in Reverse Engineering and new Product Development.” 1 / e 2004 , Publisher- Pearson Education New Delhi , ISBN-13: 9780130212719,
3	L D Miles “Value Engineering.”Publisher- McGraw-Hill, 1972
4	Karl T Ulrich, Steven D Eppinger , “ Product Design &Development.”Publisher- Tata McGrawhill New Delhi, ISBN-13: 9780078029066, 2003

5	Hollins B & Pugh S “Successful Product Design.” Publisher- Butter worths London, ISBN 9780408038614.
6	N J M Roozenberg , J Ekels , N F M Roozenberg “ Product Design Fundamentals and Methods .”Publisher- John Willey & Sons, ISBN-13: 9780471954651, 1995.

ME365 COMPUTATIONAL FLUID DYNAMICS

1. Subject Code: **ME 365** Course Title: **Computational Fluid Dynamics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To provide basic concepts of CFD in terms of comprehensive theoretical study and its computational aspects.
10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction to CFD, Historical background, Impact of CFD	3
2	The Governing Equations of Fluid Dynamics Derivation, Discussion of physical meanings and Presentation of forms particularly suitable to CFD.	7
3	Mathematical Behavior of Partial Differential Equations: Impact on CFD	6

4	Basic Aspects of Discretization: Introduction to Finite Difference, Finite Elements and Finite Volume Methods. Detailed treatment of Finite Difference method, explicit and implicit methods, errors and stability analysis.	12
5	Grids with Appropriate Transformations Adaptive grids and unstructured meshes. Lift reduction, down force generation and drag reduction. An introduction to the aerodynamics of airflows for cooling.	7
6	Commercial codes (e.g. FLUENT etc.). Grid generation, techniques and application. Basic principles and concepts and the characteristics of wings and diffusers	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Computational Fluid Dynamics",John Anderson," McGraw- Hill Ltd.
2	Computational Fluid Dynamics",Tu, Elsevier.
3	Introduction to Computational Fluid Dynamics,Niyogi, Pearson Education, Delhi

ME367 FINITE ELEMENT METHODS

1. Subject Code: **ME 367** Course Title: **Finite Element Methods**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To enable students to apply Galerkin method and virtual work principle to problems in solid mechanics. To teach them numerical solution of differential equations with finite element method.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Fundamental concepts of the Finite Element Method. One Dimensional Problem(Bar of uniform and variable cross sections), The Galerkin Approach, The potential –Energy Approach, shape Functions, Derivation of stiffness matrix and load vector for the element and for the entire domain. Evaluation of displacement, stresses and reaction forces.	12
2	**Trusses**:-. Introduction, Plane Trusses, Local and Global coordinate Systems, Element Stiffness Matrix and Stress calculations	3
3	Two –Dimensional problem using Constant strain triangles(CST), Two-dimensional isoparametric elements and numerical integration ,element stiffness matrix, Force vector.	6
4	Applications of finite element method to heat transfer.	4
5	Application of finite element method to electrical systems.	10
6	**Dynamic analysis**:- Element mass matrices,Evaluation of Eigenvalues and Eigenvectors. Use of Softwares such as MAT LAB/ABAQUS/ANSYS/ NASTRAN/ IDEAS. Basic feature of these softwares.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Finite Element Procedures, K.J. Bathe, Prentice Hall of India.
2	Finite Elements in Engineering by Chandrupatla and Belegundu.
3	Finite element Method by J.N.Reddy.
4.	Finite element Method,O.C. Zienkiewicz& R.A. Taylor
5.	Finite element Analysis,C.S. Krishnamurthy
6.	Finite element Method, Kenneth H. Hubener
7.	Finite Element Method, Desai & Abel

ME369 TOTAL LIFECYCLE MANAGEMENT

1. Subject Code: **ME 369** Course Title: **Total Lifecycle Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of Total Life Cycle, and applying life cycle thinking to define tradeoffs. This course also introduces to sustainability and use of renewable resources.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:** Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, Organizing for CE, CE tool box, Collaborative product development	8
2	**Use of Information Technology:** IT support, Solid modeling, Product data management, Collaborative product Commerce, Artificial Intelligence, expert systems, Software hardware component design.	8
3	**Design Stage:** Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, automated analysis, Idealization control, CE in optimal structural design, Real time constraints	8
4	**Need for PLM:** Importance of PLM, Implementing PLM, Responsibility for PLM, Benefits to different managers ,Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize	9
5	**Components of PLM:** Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Integrated Product Development M.M. Anderson and L Hein IFS Publications
2	Design for Concurrent Engineering J. Cleetus CE Research Centre, Morgantown
3	Concurrent Engineering Fundamentals: Integrated Product Development Prasad Prentice hall India

4	Concurrent Engineering in Product Design and Development I Moustapha New Age International
5	Product Lifecycle Management John Stark Springer-Verlag, UK
6	Product Lifecycle Management Michael Grieves McGraw Hill
7	Concurrent Engineering: Automation tools and Technology Andrew Kusiak Wiley Eastern

ME371 VALUE ENGINEERING

1. Subject Code: **ME 371** Course Title: **Value Engineering**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand the concept and approaches of value analysis and engineering with an emphasis on case studies.
10. Details of Course:

Unit No.	Contents	Contact Hours
1	An Overview Of Value Engineering-Concepts and approaches of value analysis and engineering - importance of value, Function - identity, clarify – analysis	8

2	Evaluation of VE-Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value	8
3	Results accelerators, Basic steps in using the systems	8
4	Understanding the decision environment, Effect of value analysis on other work in the business- Life Cycle Cost (LCC), Case studies	9
5	VE Level Of Effort-VE Team, coordinator, designer, different services, definitions, construction management contracts, value engineering case studies, Effective organization for value work, function analysis system techniques- FAST diagram, Case studies	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Parker, D.E., "Value Engineering Theory", Sundaram publishers, 1990
2	Miles, L.D., "Techniques of Value Engineering and Analysis", McGraw Hill Book Co., 2nd End., 1972
3	Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai and Sons, 1999.

MG351 FUNDAMENTALS OF FINANCIAL ACCOUNTING AND ANALYSIS

1. Subject Code : **MG351** Course Title: **Fundamentals of Financial Accounting and Analysis**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS: 25 PRS MTE: 25 ETE : 50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : Familiarizing the students with the financial environment of business, especially the financial markets and acquaint them with accounting mechanics, process and system.

10. Details of Course:

Unit No.	Detail Contents	Contact Hours
1	**Introduction to Management** :Basic concepts of management, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to Financial Environment and accounting:** Financial Markets - Capital Markets, Basics of capital market mechanism, instruments, financing and rating institutions. Importance, Objectives and Principles of Accounting, Accounting Concepts and conventions, and the Generally Accepted Accounting Principles (GAAP) Overview of the Accounting Process. Accounting standards as Issued by Institute of Chartered Accountants of India (ICAI).	10
3	**Overview of Business Activities and Principal Financial Statements:** Observe the types of information provided by the three principal financial statements and how firms might use this information in managing and evaluating a business. Understand the rationale and the information value of the statements of Balance Sheet, Profit and Loss statement, cash flows.	8
4	**Financial Analysis-I:** Distinction between cash profits and book profits. Understanding the cash flow statement and the funds flow statement.	8
5	**Financial Analysis –II**: Importance, objectives and concept of Ratio Analysis- Liquidity, leverage, solvency and profitability ratios.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN- 978-0273755869
2	Introduction to Accountancy, 10 ed., T.S. Grewal, S. Chand and Company (P) Ltd., New Delhi,2009, ISBN- 9788121905695
3	Advance Accounts by M.C Shukla and T.S Grewal and SC Gupta, S. Chand and Company (P) Ltd., New Delhi,1997, ISBN- 9788121902786
4	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005, ISBN- 8125918523
5	Financial Accounting Reporting & Analysis, Cengage, 7/e, W Albrecht Stice & James Stice, Cengage Learning,2010, ISBN- 0538746955

MG353 FUNDAMENTALS OF MARKETING

1. Subject Code : **MG353** Course Title : **Fundamentals of Marketing**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : The basic objective of this paper is to make students aware of fundamental concepts of marketing necessary for making decisions in complex business situations by managers and start up entrepreneurs.

10. Details of Course:

Unit No.	Detail Contents	Contact hours
1	**Basic concepts of management**: management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to marketing**: nature and scope of marketing, marketing mix, marketing vs. sales, role of marketing in society, interface of marketing with other departments in organization, Customer Life Time Value, ethical issues in marketing Concept of market segmentation: consumer and industrial, targeting and positioning, sales forecasting	9
3	**Product mix decisions:** new product development process, test marketing, concept of Product Life Cycle, product packaging decisions	8
4	**Pricing decisions** : consideration in setting price, major pricing strategies, promotional mix decisions: advertising, sales promotion, personal selling, publicity, opportunities and avenues of online promotion	9
5	**Promotion and distribution decisions** :design and management of distribution channel for physical products and services, reasons of channel conflict, handling strategies, basic challenges in supply chain management of e-commerce firms	9
Total		**42**

11. Suggested Books

Unit No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, New Delhi, 2013,(**ISBN-10:** 9788131767160)

3	Marketing, 14th ed., Etzel, Bruce J Walker, William J Stanton and Ajay Pandit, Mc Graw Hill Education, 2009, ISBN -9780070151567
4.	MKTG, Charles W Lamb, Joe F Hair, Carl NcDaniel and Dheeraj Sharma, Cengage Learning,2012, ISBN- 9788131517086
5.	Marketing Management, RajanSaxena, Tata Mc Graw Hill Education, 2005, ISBN-9780070599536

MG355 HUMAN RESOURCE MANAGEMENT

1. Subject Code : **MG355** Course Title : **Human Resource Management**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To develop necessary understanding in design and execution of human resource strategies for the achievement of organization goals.

10. Details of Course**:**

Unit No.	Content	Contact hours
1.	**Basic concepts of management:** management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8

2.	**Introduction:** Concept, nature, scope, objectives and importance of HRM; Evolution of HRM; Environment of HRM; Personnel Management vs HRM. Acquisition of Human Resources: HR Planning; Job analysis – job description and job specification; recruitment – sources and process; selection process – tests and interviews; placement and induction. Job changes – transfers, promotions/ demotions, separations.	9
3.	**Training and Development:** Concept and importance of training; types of training; methods of training; design of training programme; evaluation of training effectiveness; executive development – process and techniques; career planning and development.	8
4.	**Performance Appraisal:** Performance appraisal – concept and objectives; traditional and modern methods, limitations of performance appraisal methods.	8
5.	**Compensation and Maintenance:** Compensation: job evaluation – concept, process and significance; components of employee remuneration – base and supplementary; maintenance: overview of employee welfare, health and safety, social security.	9
	Total	**42**

11. Suggested Books

S. No	Name of the book /Authors /Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Human Resource Management, G. Dessler, B. Varkkey, Pearson prentice Hall, 2011, (ISBN – 978-81-317-5426-9)
3	International HRM a cross cultural approach, T. Jackson, Sage publications, London, 2002, (ISBN – 0-7619-7404-0)
4	HRM and Performance: Achievements and Challenges, D. E. Guest, J .Paauwe, P. Wright, John Wiley and sons, UK, 2013, (ISBN – 978-1-118-48261-2)
5	A Handbook of Human Resource Management Practice, M. Armstrong, Kogan Page Limited, UK, 2007 ,(ISBN – 978–0–7494–4631-4)

MG357 KNOWLEDGE AND TECHNOLOGY MANAGEMENT

1. Subject Code : **MG 357** Course Title : **Knowledge and Technology Management**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : Preparing the students to understand how the new age organizations are leveraging on the power of knowledge and technology. Acquiring the knowledge to address the issues faced by the corporate world for a deeper understanding.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Basic concepts of management**, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2.	Introduction to Knowledge Management: Data, Information, Knowledge Management (KM), Knowledge Society, Knowledge Economy, Types of Knowledge, Tacit knowledge and explicit knowledge, Essential components of KM model Building Knowledge Assets: Various knowledge assets, Tools of Knowledge, Knowledge Audit, AAR (After Action Review), Analyzing current knowledge state.	9

3.	Creating Strategies for Success: KM strategy, Codification, Personalization, Knowledge Management Implementation, Generating a KM-specific vision, Integrating organizational and business goals with KM, Choosing the right KM techniques, Relevant case studies in this area.	9
4.	Understanding Technology: Definition, Key concepts, Need for technology, History of technological developments, Role and importance of technology in 21st century, Recent developments in the field of technology.	8
5.	Technology-Management integration: Management as a concept, Technology management, Life cycle approach to technology management, Innovation, Creativity, Technology innovation process.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books /Authors/Publishers
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN-978-0273755869
2	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013, ISBN: 9780199691937.
3	The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, IkujiroNonaka and Hirotaka Takeuchi, Oxford University Press,1995, ISBN: 0195092694.
4	Hitotsubashi on Knowledge Management (Hardcover), Hirotaka Takeuchi and IkujiroNonaka, John Wiley and Sons, 2004, ISBN: 0470820748.
5	Management of Technology: The Key to Competitiveness and Wealth Creation, Tarek Khalil and Ravi Shankar, McGraw Hill Education (India) Private Limited, 2nd Edition, 2012, ISBN: 9780070677371.

PE351 ADVANCED MACHINING PROCESS

1. Subject Code: **PE-351** Course Title: **Advanced Machining Process**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand basic principles of various processes and their applications. State various parameters influencing the machining process.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction, need of advanced machining processes, hybrid processes, microelectro mechanical system, (MEMS), nano electromechanical systems(NEMS),Ultrasonic micro machining - mechanics of cutting, parametric analysis, process capabilities, applications.	7
2	Abrasive jet machining: Introduction, set ups, gas propulsion system, abrasivefeeder, machining chamber, AJM nozzle, abrasive parametric analysis, processcapabilities, applications, abrasive micro machining, Water jet machining:Introduction, process characteristics, process performance, applications, Abrasive Water jet machining: Abrasive finishing process: Working principle, parametric analysis, process variables, process performance and applications,	8

3	Abrasive flow machining- Working principle, parametric analysis, process variables, process performance and applications, Magnetorheological abrasive flow finishing- Working principle, parametric analysis,process variables, process performance and applications, Magnetic float polishing,Magnetic abrasive finishing- Working principle, parametric analysis, processvariables, process performance and applications	10
4	Electro discharge machining (EDM): Introduction, Working principle, parametricanalysis, process variables, process characteristics, applications, hybrid processessuch as electro discharge grinding, diamond grinding, wire EDM, Electrodischargemicro grinding,	7
5	Laser beam machining- production of laser, working principle, types of laser, processcharacteristics and applications. Electron beam machining: Working principle,process parameter, process characteristics, and applications. Ion beam machining:Working principle, process parameter, process characteristics, and applications.	8
6	Plasma arc machining: Working principle, Plasma arc cutting system, applications.	2
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1	Advanced machining process, Dr.V.K.Jain, Allied publisher, **ISBN**:978-81-7319-915-8.
2	Non traditional methods of manufacturing, Shan&Pandey, **ISBN**, 0070965536

PE353 SUPPLY CHAIN MANAGEMENT

1. Subject Code: **PE-353** Course Title: **Supply Chain Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that overall organizational performance may improve.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:**Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management.	6
2	**Inventory Management and Risk Pooling:** Inventory management, Classification of inventory, Centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect.	8
3	**Resource planning:** Aggregate Production Planning- Chase and leveling strategies, MRP, MRP-II, Agile manufacturing Systems	6
4	**Procurement and Outsourcing strategies:**Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation.	7
5	**Strategic Alliances:** Introduction, Third party logistics, Demand driven strategies, Distribution strategies- direct shipment, cross docking, transshipment, Supplier relationships management, Customer relationship management.	8
6	**International Issues in Supply Chain Management:** Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics.	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Simchi-Levi, Kaminsky, Philip K. and 'Designing and Managing the Supply Chain: Concepts, Strategic and Case Studies', McGraw-Hill/Irwin, (ISBN, 10: 0072357568, 13: 978-0072357561).
2	Supply Chain Management by Chopra and Mendle, **ISBN**: 9780132743952
3	Supply Chain Management: Text and Cases by JannatSah.,**ISBN**-10: 8131715175.

PE355 WORK STUDY DESIGN

1. Subject Code: **PE-355** Course Title: **Work Study Design**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To provide basic understanding to the students about the concept and significance of work study and ergonomics. To impart thorough knowledge to the students about various techniques of work-study for improving the productivity of an organization.

10. Details of Course:

Unit No.	Contents	Contact Hrs
1	Productivity: Definition, reasons for low productivity, methods to improve productivity, Work-study and productivity	4

2	Human factor in work-study: Relationship of work-study man with management, supervisor & workers, qualities of a work-study man.	5
3	Method-study: Definition, objectives, step-by-step procedure, questioning techniques, charts and diagrams for recording data. Like outline process charts, flow process charts, multiple activity charts, two handed process chart, string diagram, travel chart, cycle graph, Chrono-cycle graph, therbligs, micro motion study and film analysis, Simo chart, principles of motion economy. Development and installation of new method..	9
4	Work-Measurement: Definition, various techniques of work-measurement work-sampling, stopwatch time study & its procedure, Job selection, Equipment and forms used for time study, rating, methods of rating, allowances and their types, standard time, numerical problems, predetermined - time standards and standard data techniques. Incentive: Meaning, objectives of an incentive plan, various types of incentive plans	9
5	Ergonomics: Introduction, history of development, man-machine system and its components. Introduction to structure of the body- features of the human body, stress and strain, metabolism, measure of physiological functions- workload and energy consumption, biomechanics, types of movements of body members, strength and endurance, speed of movements. NIOSH lifting equation, Lifting Index, Maximum acceptable Weights and Forces, Distal upper extremities risk factors, Strain Index, RULA, REBA.	8
6	Applied anthropometry - types, use, principles in application, design of work surfaces and seat design. Visual displays for static information, visual displays of dynamic information, auditory, tactual and olfactory displays and controls. Assessment of occupational exposure to noise, heat stress and dust .Effect of vibration/ noise, temperature, illumination and dust on human health and performance	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Barnes Ralph M., “Motion & Time study: Design and Measurement of Work”, Wiley Text Books, **ISBN-10:** 8126522178, 2009.

2	Marvin E, Mundel& David L, “Motion & Time Study: Improving Productivity”, Pearson Education,**ISBN-10:** 0136030440, 2000.
3	Benjamin E Niebel and FreivaldsAndris, “Methods Standards & Work Design”, McGraw Hill,**ISBN-10**1259064840, 1997.
4	International Labour organization, “Work-study”, Oxford and IBH publishing company Pvt. Ltd., N.Delhi, **ISBN-10** 8120406028, 2001

PE357 PRODUCT DESIGN & SIMULATION

1. Subject Code: **PE-357** Course Title: **Product Design & Simulation**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight **:** CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To allow students to develop the technical, analytical, and managerial skills necessary to perform the tasks successfully.
10. Details of Course:

Unit No.	Content	Contact Hours
1	**Stages in design process:** Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	6

2	**Product life cycle:** New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies.	6
3	**Value engineering:**Introduction, nature and measurement of value. Value analysis, job plan. Creativity and techniques of creativity. Value analysis test. Case studies. **Material selection:**Materials in design. The evolution of engineering materials. Design tools and material data. Functional material, shape and process. Material selection strategy, attribute limits, selection process, common methods of material selection. Case studies.	6
4	**Concurrent/ reverse engineering:** Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering. **Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, Ranking, process cost. Computer – aided process selection.	6
5	**Design for manufacture and assembly:**Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, product Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives.	8
6	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature ofsimulation, Numerical computation techniques, Continuous system models, Analog andHybrid simulation, Feedback systems, Computers in simulation studies, Simulation softwarepackages. **Simulation of Mechanical Systems**: Building of Simulation models, Simulation oftranslational and rotational mechanical systems, Simulation of hydraulic systems.	10
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1	**Product Design and Development**, "Karl T. Ulrich, Steven D. Eppinger"Mc GrawHill.**ISBN:**9780072296471
2	**Integrated Product and Process Development**, "John M. Usher, Utpal Roy and H. R. Parasaei.ISBN: 978-0-471-15597-3
3	**Product Design for Manufacture and Assembly**, "G. Boothroyd, P. Dewhurst and W. Knight" MarceDaker.ISBN:978-1420089271
4.	**Engineering Design and Design for Manufacturing**: A structured approach, "John R. Dixon and CPoli" Field Stone Publishers, USA. ISBN: 9780964527201
5.	**Material Selection in Mechanical Design**, "M. F. Ashby"Elsevier. ISBN: 9780080419077

PE359 TOTAL LIFE CYCLE MANAGEMENT

1. Subject Code: **PE359 Course** Title: **Total Life Cycle Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE:25 ETE:50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of Total Life Cycle, management of old vehicles, applying life cycle thinking to define tradeoffs. This course also introduces to sustainability, use of renewable resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction :** Definition of Total Life Cycle (TLC) – Conceptof TLC - Life Cycle Impacts - Integrating Life Cycle Technologies- Products and Processes Within TLC - TLC Methodology- TLC AccessementData to Complex Products – ResultantImprovement for Product	8
2	**Vehicles End of Life** : Design for End of Old VehicleManagement - Problems of Old Vehicles in EmergingMarkets - Recovery and Economic Feasibility of MaterialsSuch As Plastic, Rubber, Aluminium, Steel, etc.	8
3	**Trade-offs :** Applying Life Cycle Thinking to Define TradeoffsAlong the Supply, Manufacture - Use and End of Life Chain- Effects on the Customer - Expectation of the Customer -Evaluate Product Cost on Fuel Consumption, Emission,Durability, Environment and Health	10
4	**Sustainability:**What Is Sustainability - Use of RenewableResources - View to Design Horizon.	8
5	**Harmonization of Environmental Goals:** TLC for Emerging Vs Developed Markets - Rules and Regulations to Guide Designers - International Common Practices for End of LifeVehicles.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Life Cycle Management Case Study of an Instrument Panel /SAE, 1997/
2	Accident Reconstruction: Automobiles, Tractor-semitrailers, Motorcycles, and Pedestrians /Society of Automotive Engineers, 1987 /0898834546, 9780898834543.

PE361 TOTAL QUALITY MANAGEMENT

1. Subject Code: **PE-361** Course Title: **Total Quality Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To understand the philosophy and core values of Total Quality Management (TQM); determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;

10. Details of Course:

Unit No.	Content	Contact Hours
1	**Introduction to Quality-** Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control;Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	9
2	**Statistical Process Control-**Introduction to Quality characteristics-variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	8
3	**Acceptance Sampling-**Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	7
4	**Six Sigma and ISO 9000:2000-** Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations, structure of ISO standards, Factors leading to ISO, Implementation and registration, Benefits of ISO.	6

5	**Life Testing-Reliability-**Life testing: objective, failure data analysis, MTTF, MTBF, hazard rate, exponential and Weibull models, system reliability-series, parallel and mixed configurations, Markov model.	6
6	**Reliability Design and Allocation-** Design for reliability, reliability improvement techniques, active redundancy and standby redundancy, K-out-of-N redundancy and maintenance policies.	6
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Evans JR,Lindsay WM, "The Management and Control of Quality", Cengage learning, India, **ISBN-10:** 8131501361, 2011
2	BediKanishka,"Quality Management",Oxford University Press India, **ISBN-10:** 0195677951, 2006
3	Besterfield,"Total Quality Management", Pearson Education, **ISBN-10:** 9332534454, 2015
4	Gryna FM, Chua RCH, Defeo JA, "Juran‟s Quality Planning and Analysis for Enterprise Quality", McGraw Hill Education (India) Private Limited, **ISBN-10:** 0070618488, 2006

PT361 HIGH PERFORMANCE POLYMERS

1. Subject Code: **PT361** Course Title: **High Performance Polymers**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL

9. Objective : To impart knowledge about heat resistant polymers, liquid crystalline polymers, conducting and other special polymers.

10. Details of Course

S. No.	Contents	Contact Hours
1	Heat resistant polymers: Requirements for heat resistance, Determination of heat resistance, Synthesis, Structure-property relationships, Applications of heat resistant polymers like polyamides, polyimides and its derivatives, polyquinolines, polyquinoxalines, PBT, PBO, PBI, PPS, PPO, PEEK, engineering plastic blends.	9
2	Liquid crystalline polymers, Concept of liquid crystalline phase, Theories of liquid crystallinity, Characteristics of LC state and LCPs, Rheology of liquid crystalline polymers, Blends of LCPs, Self reinforced composites, Applications.	9
3	Conducting polymers, Conduction mechanism, semi-conductors and conducting polymers, Band theory, Doping of polymeric systems, Processing and testing of conducting polymers, Applications and recent advances in conducting polymers.	9
4	Synthesis and applications of photosensitive polymers, Curing reactions.	6
5	Polymers in specialty applications: Polymers in agricultural applications, Green houses, Mulches, Control release of agricultural chemicals, Seed coatings, Polymers in construction and building applications.	9
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Encyclopedia of Polymer science and Engineering Vol.1-17/ J.I. Kroschwitz, 2007
2	Additive for coatings/ John Bieleman/ Wiley-VCH, 2000.
3	Fire Properties of Polymeric Composites Materials/ A.P. Mouritz, A G. Gibson/ Springer, 2006.

4	Modern Biopolymers science: Bridging the divide between fundamentals treatise and industrial application/S. Kasapis, I.T. Nortan, J.B. Ubbink/ Elsevier 2009

PT363 SEPARATION TECHNOLOGY

1. Subject Code: **PT363** Course Title: **Separation Technology**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize students with various separation techniques.
10. Details of Course

Unit No.	Contents	Contact Hours
1	Separation factors and its dependence on process variables, classification and characterization, thermodynamic analysis and energy utilization, kinetics and mass transport, Theory of cascades and its applications.	7
2	Membrane Separations, Merits and demerits, Commercial, pilot plant polarization of membrane processes and laboratory membrane permeators, Dialysis, Reverse osmosis, Ultrafiltration, Membrane operations, Design controlling factors.	7
3	Separation by Sorption Techniques, Types and choice of adsorbents, chromatographic techniques, Retention theory mechanism, Design controlling factors, ion exchange chromatography equipment and commercial processes, recent advances in sorption technology.	7

4	Ionic Separations: Theory, mechanism and equipments for electrophoresis, dielectrophoresis and electro dialysis, Controlling factors, Applications, Design considerations.	7
5	Thermal Separation: Thermal diffusion, Rate law, Theories of thermal diffusion for gas and liquid mixtures, Equipments design and applications, Zone melting, Equilibrium diagrams, Controlling factors, Apparatus and applications.	7
6	Other Techniques: Adductive crystallization, Molecular addition compounds, Clathrate compounds and adducts, Equipments, Applications, Economics and commercial processes. Foam Separation: Surface adsorption, Nature of foams, Apparatus, Applications and Controlling factors.	7
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	New Chemical Engineering Separation Techniques/ Schoen/ Wiley Interscience, New York, 1972.
2	Separation Processes/ C.J. King/ Tata McGraw Hill, New Delhi,1982.
3	Bioseparations – Principles and Techniques/ B. Sivasankar/ Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Separation process Principles/ Seader, Henley and Roper/ John Wiley & Sons 2010
5	Membrane Separation processes/ Kaushik Nath/ PHI , 2008.

PT365 NON-CONVENTIONAL ENERGY

1. Subject Code: **PT365** Course Title: **Non-Conventional Energy**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits : 03

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To make student aware about the fundamentals and applications of non-conventional energy.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Renewable and non-renewable energy sources, trends in energy consumption, Global and National scenarios, Prospects of renewable energy sources, Energy Management.	6
2	Solar Energy: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, measurement of solar radiation, flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, Storage of solar energy-thermal storage, Photo voltaics - solar cells & its applications.	6
3	Wind Energy: Basic system principles, Assessment of wind available, Design principles, Manufactured designs, Sizing and storage of energy, System efficiency, Overview of wind industry.	4
4	Energy from Biomass: Calorific value of Biomass samples, Pyrolysis, Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	6
5	Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages, and application of geothermal energy.	4

6	Ocean Energy: Ocean Thermal Electric Conversion systems like open cycle, closed cycle, Hybrid cycle. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.	4
7	Magnetohydrdynamic Power Generation: Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.	4
8	Fuel Cells: Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, applications of fuel cells.	4
9	Hydrogen Energy: Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.	4
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Principles of Sustainable Energy Systems, Second Edition/ Frank Kreith, Susan Krumdieck/ CRC Press, 2013.
2	Non-conventional energy sources/ G.D. Rai/ Khanna Publishers, 2004.
3	Solar Energy: Fundamentals and Applications/ H.P. Garg & Jai Prakash/ Tata McGraw Hill, 2000
4	Solar Engineering of Thermal Processes/ Duffic and Beckman/ John Wiley, 2013
5	Non Conventional Energy Resources/ Saeed and Sharma/ S.K. Kataria& Sons ,2013

PT367 POLYMER WASTE MANAGEMENT

1. Subject Code: **PT367** Course Title: **Polymer Waste Management**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00

4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits : 03

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To impart knowledge about polymer waste and their management.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Polymer and Plastics Waste: Definition of plastics waste and the associated problems, Identification, collection methods and separation. Integrated waste management – source reduction, recycling, energy recovering process through thermal and biological destruction, Land filling and composting.	8
2	Plastics waste management: Source reduction, reuse, repair, recycling, and incineration with examples. Plastics recycling: Classification, Code of practice, Primary, secondary, territory and quaternary recycling with examples, Waste plastics as fillers.	8
3	Recycling and degradation of plastics: Recycling and sustainability correlation, Basic principles and recovery, recycling and resource conservation.	9
4	Recycling of plastics by surface refurbishing, Application of a coating, polishing, Plastics, Environmental and Thermal ageing, Chemical degradation, Wear and erosion, Biodegradable plastics – an overview.	9
5	Environmental issues, policies and legislation in India.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Plastics Recycling – Products and Processes/ Ehrig (Ed.)/ Hanser Publication, 1993
2	Recycling and recovery of plastics/ Brandrup/ Hanser Publishers, New York, 1996
3	Handbook of Plastics Recycling/ By Francesco La Mantia/ Rapra Tech Ltd , 2002
4	Introduction to Plastics Recycling/ By VannessaGoodship/ Rapra Tech Ltd ,2007

PT369 NANOTECHNOLOGY IN POLYMERS

1. Subject Code: **PT369** Course Title: **Nanotechnology in Polymers**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make student aware about the applications of nanopolymers in various fields.
10. Details of Course

S. No.	Contents	Contact Hours
1	Concepts of nanotechnology, Time and length scale in structures, Nanosystems, Dimensionality and size dependent phenomena, Surface to volume ratio-Fraction of surface atoms, Surface energy and surface stress, surface defects, Properties at nanoscale (optical, mechanical, electronic, and magnetic).	8
2	Nano-materials, Classification based on dimensionality, Quantum Dots, Wells and Wires, Carbon-based nano-materials, Metal based nano-materials, Nanocomposites, Nanopolymers, Nanoglasses, Nanoceramics, Biological nanomaterials.	8
3	Synthesis of nanopolymers, Chemical Methods, Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Sonochemical Routes, Chemical Vapor Deposition, Metal Oxide - Chemical Vapor Deposition, Physical Methods such as ball Milling, electrodeposition, spray pyrolysis, flame pyrolysis, DC/RF magnetron sputtering, Molecular beam epitaxy.	9
4	Nanofabrication, Photolithography and its limitations, Electron beam lithography, Nanoimprint, Soft lithography patterning, Characterization with Field Emission Scanning Electron Microscopy, Environmental Scanning Electron Microscopy, High Resolution Transmission Electron Microscope, Scanning Tunneling Microscope, Surface enhanced Raman spectroscopy, X-ray Photoelectron Spectroscopy, Auger electron spectroscopy, Rutherford back scattering spectroscopy.	9
5	Applications of nanomaterials, Solar energy conversion and catalysis, Molecular electronics and printed electronics, Nanoelectronics, Polymers with aspecial architecture, Applications in displays and other devices, Nanomaterials for data storage, Photonics, Plasmonics, Nanomedicine, Nanobiotechnology and Nanotoxicology.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Organic and Inorganic Nanostructures/ Nabok/ Artech House, 2005.
2	Nanoscience: Nanotechnologies and Nanophysics/ Dupas, Houdy, Lahmani/ Springer-Verlag Berlin Heidelberg ,2007

3	Nanostructured Materials and Nanotechnology/ H.S. Nalwa/ Academic Press , 2002
4	A Textbook of Nanoscience and Nanotechnology/ Pradeep/ Tata McGraw Hill Education Pvt. Ltd. , 2012

PT371 APPLICATIONS OF POLYMER BLENDS AND COMPOSITE

1. Subject Code: **PT371** Course Title: **Applications of Polymer Blends and Composite**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make student aware about the applications of polymers, blends and composites.
10. Details of Course

Unit No.	Contents	Contact Hours
1	Concepts of polymer blends, Advantages of blends over conventional polymers, Significance of polymer blend technology, Different steps involved in designing of a blend, Different methods of blending, Characterization of polymer blends.	8
2	Compatibilization and Phase Morphology, Role of compatibilizers in blend technology, techniques of compatibilization, Phase structure development in polymer blends, Factors affecting morphology of polymer blends, Properties of polymer blends.	8

3	Reinforcements, Properties and applications of Glass, Carbon, Kevlar, polyethylene, boron, ceramic and natural fibers. Concepts of matrix material, Thermoset matrix materials like - epoxy, polyester, vinyl esters, phenolic resin, polyimides, Thermoplastic matrix materials like - polyolefins, polyether ether ketones, polyphenylene sulfide, thermoplastic polyimides.	9
4	Concept of composites, particulate and fibrous composites, Properties of composites, Fabrication of continuous and short fiber composites and particulate composites, mechanical and physical properties	9
5	Applications of blends and composites for civil, aerospace, automobiles etc	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Fibre Reinforced composites/ P. K. Malik/ Marcel Deckar, 1988.
2	Composites Manufacturing: Materials, Product, and Process Engineering/ S.K. Mujumdar/ CRC press ,2002
3	Fibre-glass Reinforced Plastics/ N. P. Cheremisinoff (Ed)/ Noyce Pub, 1988.
4	Design Data for Reinforced Plastics/ N. L. Hancex, R. M. Mayer/ Chapman Hall, 1994.
5	Reinforced Plastics: Properties and Applications/ Raymond Seymour/ The Materials Information Society, 1991.

IT351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT351** Course Title: **Artificial Intelligence and Machine Learning**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0

4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Knowledge of discrete mathematics

9. Objective : The student should be able to understand the different supervised, unsupervised and reinforcement learning algorithms and choose the appropriate machine learning tool for different real world examples.

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction** to Artificial Intelligence and Machine learning, State Space representation of problems, Concept of Search, overview of different tasks: classification, regression, clustering, control, Concept learning.	6
2.	**Heuristic Search Techniques:** Generate and Test, Hill Climbing, Best-first search, Branch and bound, A* algorithm, Game playing.	6
3.	**Knowledge Representation:**Propositional logic, Predicate Logic, semantic nets, frames	8
4.	**Supervised Learning:** Decision trees, nearest neighbors, linear classifiers and kernels, neural networks, linear regression; Support Vector Machines.	8
5.	**Unsupervised Learning:** Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning.	8
6.	**Applications &Research Topics**: Applications in the fields of web and data mining, text recognition, speech recognition	6
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Book	
1.	Artificial Intelligence by Elaine Rich, K. Knight, McGrawHill	2009
1.	Introduction to Machine Learning, Alpaydin, E., MIT Press, 2004	
2.	Machine Learning, Tom Mitchell, McGraw Hill, 1997.	1997
3.	Elements of Machine Learning, Pat Langley Morgan Kaufmann Publishers, Inc. 1995. ISBN 1-55860-301-8	1995
	Reference Book	
4.	The elements of statistical learning, Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. Vol. 1. Springer, Berlin: Springer series in statistics, 2001.	2001
5.	Machine Learning: A probabilistic approach, by David Barber.	2006
6	Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006	2006

IT353 DATA STRUCTURES AND ALGORITHMS

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT353** Course Title: **Data Structures and Algorithms**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : ODD
7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction:** Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to C programming through Arrays, Stacks, Queues and Linked lists.	8
2.	**Trees:** Basic Terminology, Traversals, Binary search trees, optimal and average BST's. 2-4 trees, Applications of Binary search Trees, Complete Binary trees, Extended binary trees.	7
3.	**Introduction to algorithms:** Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem, **Searching and Searching:** Linear Search, Binary search, Insertion Sort, Quick sort, Merge sort, Heap sort, Radix Sort.	9
4.	**Graphs:** Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs, Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.	8
5.	**Spanning trees:** Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path. **Dynamic programming**: Principles of dynamic programming. Applications: Matrix multiplication, Travelling salesman Problem.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books:	
1.	Horowitz and Sahni, “Fundamentals of Data structures”, Galgotia publications	1983
2.	Tannenbaum, “Data Structures”, PHI	2007(Fifth Impression)
3.	T .H . Cormen, C . E . Leiserson, R .L . Rivest “Introduction to Algorithms”, 3rd Ed., PHI.	2011 (reprint)
4.	E. Horowitz, S. Sahni, and S. Rajsekaran, “Fundamentals of Computer Algorithms,” Galgotia Publication	
	Reference Books	
1.	R.L. Kruse, B.P. Leary, C.L. Tondo, “Data structure and program design in C”, PHI	2009(Fourth Impression)
2.	Aho ,Ullman “Principles of Algorithms ”	

IT355 COMMUNICATION AND COMPUTING TECHNOLOGY

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT355** Course Title: **Communication and Computing Technology**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : Operating systems, Algorithm Design and Analysis and data structures

9. Objective : To introduce the concept of Communications in Computer networks

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction** to Goals and Applications of Networks, Network structure and architecture, The TCP/IP reference model, services, Network Topology.	6
2.	**Data Link Layer and Medium Access sub layer** - Channel Allocations, LAN protocols -ALOHA protocols - Overview of IEEE standards - FDDI. - Elementary Data Link Protocols, Sliding Window protocols.	6
3.	**Network Layer**: Routing, Congestion control, Internetworking -TCP / IP, IP packet, IP address, IPv6 and Mobile IP.	8
4.	**Transport Layer:** Design issues, TCP and UDP, connection management, Congestion control, Leaky bucket, Token bucket algorithm. QoS.	8
5.	**Application Layer:** File Transfer, Access and Management, Electronic mail, Virtual Terminals, Internet and Public Networks, Firewalls	6
6.	**Information and Web security**: IP Security, Architecture, Authentication header, Encapsulating security payloads, combining security associations, Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money.	8
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Book		
1.	S. Tananbaum, “Computer Networks”, 3rd Ed, PHI	1999

2.	U. Black, “Computer Networks-Protocols, Standards and Interfaces”, PHI	1996
3.	W. Stallings, “Computer Communication Networks”, PHI	1999
3.	Data Communications and Networking, Behrouz A. Forouzan 5/e	2013
Reference Book		
4.	William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersy.	2001
5.	Behrouz A. Forouzan, “Cryptography and Network Security”, TMH.	2006

IT357 INTERNET AND WEB PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code : **IT357** Course Title: **Internet and Web Programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce the concept of internet and web programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Internet and WWW:** Internet basic, Introduction to internet and its applications, E- mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers - internet explorer, netscape navigator, opera, firefox, chrome, mozilla. Search engine, web saver - apache, IIS, proxy server, HTTP protocol.	6
2.	**WEBSITES BASIC ANDWEB 2.0**: Web 2.0: Basics-RIA Rich Internet Applications - Collaborations tools - Understanding websites and web servers: Understanding Internet – Difference between websites and web server- Internet technologies Overview – Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0 , XHTML, CSS 3.	6
3.	**E-MAIL SECURITY & FIREWALLS** : PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls - Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions, intellectual property: copyright, patents, trademarks, cyber laws	8
4.	**SERVELETS AND JSP**: JSP Technology Introduction-JSP and Servelets- Running JSP Applications Basic JSP- JavaBeans Classes and JSP-Tag Libraries and Files- Support for the Model- View- Controller Paradigm- Case Study- Related Technologies.	8
5.	**XML**: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT	6
6.	**PHP:** Starting to script on server side, Arrays, function and forms, advance PHP, Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP my admin and database bugs.	8
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books	
1.	Internet and Web Technologies by Raj Kamal, Tata McGraw Hill edition. (ISBN: 9780070472969)	2002
2.	An Introduction to Search Engines and Web Navigation, Mark Levene, Pearson Education. (ISBN: 978047052684)	2010
3.	Modeling the Internet and the Web,PierreBaldi,PaoloFrasconi, Padhraic Smyth, John Wiley and Sons Ltd. (ISBN: 978-0-470-84906-4)	2003
	Reference Books	
4.	HTML: A Beginner's Guide by Wendy Willard, Tata McGraw-Hill (ISBN: 9780070677234)	2009
5.	PHP and MySQL for Dynamic Web Sites, Ullman, Larry, Peachpit Press.1 (ISBN: 978-0-321-78407-0)	2012

IT359 JAVA PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code: **IT359** Course Title: **Java Programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil

9. Objective : To introduce the concept of java programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction to Java**: Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? , Why Java?, Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java , Java's Magic Byte code.	6
2.	**The Java Environment:** Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.	6
3.	**Object Oriented Programming**: Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method.	8
4.	**Extending Classes and Inheritance**: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.	8
5.	**Package**: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	6
6.	**GUI Programming**: Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of Array List & Vector.	8
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books	
1.	The Complete Reference Java,, Herbert Schildt, ISBN: 978-0-07163177-8, Publisher: McGraw Hill	7th Edition
2.	Thinking in Java, Bruce Eckel, ISBN: 0-13-187248-6, Publisher: Prentice Hall	4th Edition
3.	The Java Programming Languages,, Ken Arnold, ISBN-13: 978-032134980, Publisher: Sun	4th Edition,
4.	Java in Nutshell,, Benjamin,ISBN: 9781449371296, Publisher: O'Reilly Media, Inc.	6th Edition

1. Subject Code: **CE351** Course Title: **Geoinformatics and its Applications**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To familiarize the students with the concepts of the subject and its related applications in Civil Engineering and allied fields.

10. Details of Course

S. No.	Contents	Contact Hours
1	**Introduction to Geoinformatics, Remote Sensing, GIS and GPS:** Definitions of Geoinformatics, Remote Sensing, GIS and GPS, sources of energy, electromagnetic spectrum, electromagnetic radiation, reflection, transmission and absorption, Platforms and sensors, active and passive sensors, PAN, Multi and hyperspectral remote sensing data acquisition systems	8
2	**Maps, Datums, Projections Systems and spatial data analysis** - Plane and Geodetic surveying, Classification of surveys, Basic Principles of Surveying, Type of maps, scales and uses, plotting accuracy, map sheet numbering. Datums, coordinates and map projection systems. Data retrieval and querying, measurements in GIS, classification, accuracy.	8
3	**Optical, Thermal and Microwave Remote Sensing**. Brief review of Optical, thermal and microwave remote sensing, their utility, merit and demerits, Interaction of EMR with atmosphere, scattering, refraction, absorption, transmission, atmospheric windows, interaction of EMR with earth surface, spectral characteristics of remote sensing data,	8
4	**Basic Photogrammetry and Digital Image Processing:** Photogrammetry, aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement. Digital image, digital image processing introduction to, preprocessing, enhancement, classification, visual image interpretation, Introduction to software - MATLAB, ENVI, ERDAS, AutoCAD etc	10
5	**Applications of Geoinformatics, Remote Sensing, GIS and GPS:** Land cover classification survey and Mapping, Digital elevation model (DEM), Introduction to SAR data, Applications in Disaster management, geology, forest security and military projects.	8
Total		**42**

11. Suggested Books:

S.N.	Name of Books/ Authors	
1	Agarwal, C.S. and Garg, P.K., “Remote Sensing in Natural Resources Monitoring and Management”, Wheeler Publishing House(ISBN 6-74-268173-4)	2000
2	Bossler, J.D., “Manual of Geospatial Science and Technology”, Taylor and Francis. (ISBN 0-74-68914355-7)	2002
3	Burrough, P.A. and McDonnell, R.A., “Principles of Geographic Information System”, Oxford University Press. (ISBN 0-07-985256-4)	2000
4	Chandra, A.M. and Ghosh, S.K., “Remote Sensing and Geographical Information Systems”, Alpha Science. (ISBN 0-07-8452567-1)	2005
5	Gopi, S., “Global Positioning System: Principles and Applications”, Tata McGraw Hill. (ISBN 0-07-7691528-1)	2005

DELHI TECHNOLOGICAL UNIVERSITY

(Estd. by Govt. of NCT of Delhi vide Act 6 of 2009)
Shahbad Daulatpur, Bawana Road, Delhi-110042
www.dtu.ac.in